Curtin School of Allied Health

The impact of a workplace-based hand therapy intervention on the management of Lateral Elbow Tendinopathy

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Doctor of Philosophy
of
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Author's Declaration

To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007), updated 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Numbers OTSW-10-2014 (dated 24.10.20), HR46/2016 (dated 16.3.16), and Amendment Approval number HR46/2016-22 (dated 10.2.2020).

Signature: _____

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Date: 8 August 2022

Statement of Contributors

As co-authors of the following article:

Tran, T., Falkmer, T., & Ciccarelli, M. (2020). Do hand therapists have a role in workplace-based education to manage tennis elbow? Beliefs about effective treatments among Australian hand therapists and medical practitioners. *Work*, *66*(3), 1–11. https://doi.org/10.3233/WOR-203196

We confirm that Thuy Tran has made the following contributions:

Conceptualisation and design of research
Collection of data
Analysis and interpretation of results; and
Writing paper and critical appraisal of content

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Abstract

Lateral elbow tendinopathy (LET), commonly known as tennis elbow, is a prevalent work-related upper extremity musculoskeletal disorder. Medical practitioners and hand therapists manage LET with commonly available clinic-based treatments, but rarely consider patients' work environments and have limited focus on education regarding occupational risk factors. Workplace-based rehabilitation has shown benefits in the return-to-work (RTW) for injured workers with other health conditions, but no studies have investigated this rehabilitation approach in the management of LET.

This study aimed to identify the impact of an additional workplace-based hand therapy intervention on the management of LET. A mixed-methods approach consisting of five stages (studies) of research was used to answer the overall research question.

In the first study, a systematic review was conducted to determine the available evidence for workplace-based interventions, specifically for the management of work-related LET. The findings from this systematic review suggested that further research was required to understand the nature and implications of this type of management strategy for LET. These findings helped inform the development of the next study.

The second study used a cross-sectional design to determine Australian hand therapists' and medical practitioners' perceptions about the effectiveness of common treatments for LET and obtain their views about a hand-therapist delivered workplace-based educational intervention. This study identified that Australian health professionals believed that education was the most effective management approach for LET. They believed that hand therapists have a pertinent role in workplace-based education.

The findings from Study 2 informed the development of Study 3. Study 3 describes and discusses the development, training, and implementation phases for the standard hand therapy program (comparison intervention) and the novel workplace-based education intervention (also known as *Working Hands-ED*). This study also describes the processes, procedures, and study protocol used for the randomised controlled trial conducted in Study 4.

Study 4 was a randomised controlled trial that aimed to investigate the impact of adding a hand therapist-delivered workplace-based educational intervention on (i) the

clinical outcomes of pain, grip strength, and function, and (ii) the work status, duration, and costs of hand therapy services of 49 injured workers with LET. The findings from this study suggested that while the addition of *Working Hands-ED* did not impact positively or negatively on the clinical outcomes at 12-weeks. A greater proportion of participants in the intervention group returned to pre-injury duties and hours at 6-months.

The final study (Study 5) explored the hand therapists' experiences and perceived benefits and challenges in delivering the novel workplace-based educational intervention. An exploratory, descriptive qualitative study using a semi-structured interview data collection method was used to gain an in-depth understanding of their experiences. The findings from Study 5 identified that hand therapists experienced mutual benefits (for them and their patients) and had positive experiences when delivering *Working Hands- ED* at their patients' respective workplaces. They also reported several logistical challenges to consider when providing services out of the clinic setting.

This research provided new evidence regarding using an educational approach that considers the work environment when managing LET. The findings from this research help inform all key stakeholders of the Western Australian (WA) Workers' compensation system and provide preliminary evidence on an alternative management strategy that is not common practice for hand therapists in the management of work-related LET.

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To all the patients, hand therapists, medical practitioners, employers, vocational rehabilitation providers and insurance case managers that contributed to this research, thank you for being part of my research journey. Without you, this study would not have been possible. I hope that you gained as much from it as I did from your contribution.

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Thank you to my Mum and Dad, for always encouraging me to reach for the stars, and for all the support you have provided along the way. You have both instilled values in me that got me through this challenging, yet fulfilling, journey.

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Dedication

To my parents, Tran Thanh Binh and Dang Thi Thanh Mai – who have inspired me to never give up, thank you for all the sacrifices you have made and for believing in me.

List of Publications

This doctoral thesis consists of the following publications:

1. Tran, T., Falkmer, T., & Ciccarelli, M. (2020). Do hand therapists have a role in workplace-based education to manage tennis elbow? Beliefs about effective treatments among Australian hand therapists and medical practitioners. *Work, 66*(3), 1-11: https://doi.org/10.3233/WOR-203196

2. Tran, T., Harris, C., & Ciccarelli, M. (2021). The impact of a hand therapy workplace-based educational approach on the management of lateral elbow tendinopathy: A randomised controlled study. *Journal of Hand Therapy,* in press. https://doi.org/10.1016/j.jht.2021.09.004

3. Tran, T., Harris, C., Keesing, S., & Ciccarelli, M. *(Under Review).* Managing work-related lateral elbow tendinopathy: Australian hand therapist's experiences with workplace-based interventions.

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Thuy Tran Date: 8 August 2022

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List of Abbreviations

Abbreviation	Full text
CETO	Common extensor origin
CSI	Corticosteroid injection
DEB	Dorsal extensor bulk
ECRB	Extensor carpi radialis brevis
EDC	Extensor digitorum communis
HT	Hand therapist
ICF	International Classification of Functioning, Disability and Health
LET	Lateral elbow tendinopathy
MP	Medical practitioners
MRI	Magnetic resonance imaging
PRTEE	Patient-Rated Tennis Elbow Evaluation
PRPI	Platelet rich plasma injection
PSFS	Patient-Specific Functional Scale
RCT	Randomised controlled trial
RTW	Return-to-work
WA	Western Australia
WHO	World Health Organization

Preface

I remember meeting my patient Mary*, earlier in my career as a new graduate hand therapist. Mary had a one-year history of on/off LET symptoms and was referred to our hand therapy clinic under the workers' compensation system. Mary was in her early forties and worked at a local café as a kitchenhand. She had trialled many treatments, including cortisone injections, blood injections, and physiotherapy. She was also seen by a surgeon who told her she wasn't a candidate for surgery. Nothing seemed to work for her. At our initial appointment, I asked her if she knew what LET was; surprisingly, she didn't. Although she had seen numerous health professionals before me, no one had taken the time to explain to her what the pathology of her condition and what movements may aggravate her symptoms. Mary got emotional and teary during our first appointment because she felt fed up with her condition. However, she felt that having a better understanding of LET was a breakthrough moment for her. The LET symptoms were debilitating for her, and she was worried about losing her job because she had not been able to work to full capacity for so long. Mary's doctor had recommended she be placed on modified duties with a 1kg lifting restriction. Unfortunately, she said that even with these restrictions, she struggled to fulfil her modified work duties. She also had a workplace rehabilitation provider involved with her injury management.

Mary asked me if I could go to her workplace and provide some suggestions on what she should do. Although I had not done this before, I contacted the workplace rehabilitation provider who advised me that he had not recently visited Mary’s workplace. I proposed conducting a worksite visit together, which he agreed to. Mary demonstrated some of her work duties at her workplace, which included making sandwiches, heating up and preparing other common café foods, cleaning dishes, and clearing the tables. I provided suggestions for activity modification based on an understanding of the pathology of LET to reduce loading of her wrist extensors and symptoms. Her supervisor was open to the suggestions and her vocational rehabilitation provider agreed to write a revised graduated return-to-work (RTW) program that included my specific recommendations. At her follow-up

appointment in the hand therapy clinic, Mary told me how grateful she was for my help. She said the suggestions had already made her feel more aware of her condition, and her supervisors had been supportive of the proposed changes. Mary was discharged from our hand therapy services four months after I initially saw her and returned to her pre-injury duties and work hours. She had a self-management program and adapted the way she worked.

I started my PhD journey on this chosen topic because I believe that all patients like Mary should receive a more holistic approach to managing their condition. Mary has inspired me to step outside my comfort zone and conduct research in an area that is not common practice for hand therapists. Hand therapy is a unique profession as occupational therapists and physiotherapists share this role. I believe that the findings from my research can benefit health professionals working in hand therapy.

*Name has been changed to maintain for confidentiality

"I often think that in the clinic we get so caught up on treating the symptoms that we don't always consider the entire person"

(Sarah*, 2020)

*Name has been changed to maintain confidentiality

Chapter 1

Introduction and overview

1.1 Background

1.1.1 Lateral elbow tendinopathy

Lateral elbow tendinopathy (LET), also known as tennis elbow, epicondylalgia, epicondylitis, or tendinosis, has an estimated prevalence of 1-3% in the general population and is more common among the working population (De Smedt et al., 2007; Shiri, Viikari-Juntura, Varonen, & Heliövaara, 2006). Population studies have identified an association between physical workplace factors and LET, with ranges of 2.4% to 23.1% of the working population with LET symptoms depending on occupations (Herquelot et al., 2013; Hong et al, 2013). Other studies have suggested that 35% and 64% of all LET cases are work-related (Dimberg, 1986; Hong et al, 2013). The average duration of a typical episode of LET is between six months and two years and is equally common in both men and women aged 35-55 years (Gerberich & Priest, 1985; Hudak et al., 1996). This upper extremity disorder is characterised by pain and tenderness over the lateral side of the elbow that often radiates down the forearm, impacting grip strength and hand function (Cutts et al., 2020). Consequently, these symptoms may affect a person's participation in self-care, leisure, and work activities.

The risk of developing LET is highest among heavy manual labourers and workers who require repetitive and forceful wrist and arm motions (Shiri, Viikari-Juntura, Varonen, & Heliovaara, 2006; Walker-Bone et al., 2012). Some of the reported occupational risk factors for the development of LET include repetitive use of the upper limb for >2 hours/day; handling tools weighing >1kg; handling loads weighing >20kg more than 10 times per day; participating in activities demanding high handgrip forces; and the use of vibrating tools (Shiri et al., 2006; Rahman Shiri & Viikari-Juntura, 2011). Workers who engage in occupations requiring these repetitive motions, such as painters, plumbers, carpenters, auto workers, cooks, and butchers, are at greater risk of developing LET (Shiri & Viikari-Juntura, 2011). Psychosocial risk factors for the development of LET must also be considered. For example, low social support in the workplace has been associated with an increased occurrence of LET and poorer overall prognosis after one year (Haahr & Anderson, 2003). Patients with LET who also had depressive feelings were more likely to receive more medical interventions and experience greater LET symptoms than those without depressive feelings (Aben et al., 2018).

1.1.2. The cost of workplace injury and illness

There is a substantial financial burden on employers, employees, insurers and society to cover direct medical costs to treat LET; and indirect costs including administrative expenses, lost productivity, and training replacement employees (Saunders et al, 2016). A large population study in the USA identified that the annual incidence of LET and the rate of surgical intervention have remained constant from 2007 to 2014 (Degen et.al, 2018). This study indicated that the proportion of LET patients over >65 years receiving surgical treatment has significantly increased in recent years and that the total reimbursement and average per- patient reimbursement have steadily risen, demonstrating the increasing burden of cost on the health-care system (Degen et al, 2018).

The Australian Institute of Health and Welfare analysed the costs of injury and disease in Australia and found that musculoskeletal injuries were the second highest in health expenditure, with an average of AUD$3 billion spent on direct and indirect health care costs (Australian Institute of Health and Welfare, 2020). Workplace injuries cost the Australian Government directly incapacity payments for lost earnings and medical and workplace rehabilitation costs. The 2018/19 annual report of workers' compensation claims in Western Australia (WA) identified that most claims were associated with musculoskeletal disorders, with one-third involving the upper limb (WorkCover WA, 2020b). These musculoskeletal injury claims were characterised by an average of 110 days lost time from work and an average cost of AUD $56 235 per claim (WorkCover WA, 2020b). Indirect costs of workplace injury to the employer include loss of productivity; loss of skills, experience, and knowledge; injured worker absenteeism; injured worker turnover; workplace conflict, and the cost of recruitment and training for replacement workers (Barnett et al., 2010). Direct and indirect costs incurred to the injured workers may include loss of income, loss of work skills, social isolation and secondary psychological problems, and reduced participation in self-care, work, and leisure activities (Barnett et al., 2010).

1.1.3 Management of LET

Despite the prevalence of LET in the general population, there remains no gold standard treatment for this common condition. To date, over 40 different management

strategies are described in the literature aimed at managing pain, improving grip strength and endurance, and increasing function (Hong, 2003; Lenoir et al., 2019). Commonly reported treatments include rest (Smidt et al., 2003), physical therapy, (Bisset & Vicenzino, 2015; Chen & Baker, 2020; Huisstede et al., 2018; Lenoir et al., 2019), use of wrist and elbow orthoses (Derebery et al., 2005; Garg et al., 2010; Heales et al., 2020), corticosteroid injections (Coombes et al., 2010; Nynke Smidt et al., 2002), autologous and platelet-rich plasma injections (Rabago et al., 2009; Tinsley et al., 2012; Wolf et al., 2011), and surgery (Huisstede et al., 2018).

Reviews of the literature on the effectiveness of these standard treatments for LET have demonstrated weak clinical evidence to support long-term benefits in pain reduction and maintaining grip strength and function, with associated time off work and increased economic costs (Hong, 2003; Lenoir et al., 2019). Studies involving surveys of clinicians have yielded various responses among hand therapists (i.e., occupational therapists and physical therapists) and medical practitioners (i.e., surgeons and general practitioners). There was widespread consensus among hand therapists that patient education, stretching, activity modification recommendations, and physical therapy approaches such as strengthening exercises and prescription of orthoses were perceived as the most effective management strategies for LET (Cioce et al., 2020; Greenfield & Webster, 2002; MacDermid et al., 2010). However, the content of patient education and activity modification recommendations are unclear.

In contrast to hand therapists, medical practitioners favoured non-steroidal anti-inflammatory drugs and corticosteroid injections (Amar et al., 2014; Peterson et al., 2014). This belief is contrary to the substantial evidence available that corticosteroid injections do not offer long term pain relief and the reoccurrence of LET symptoms is high with this type of treatment (Bisset et al., 2006; Huisstede et al., 2018; Sims et al., 2014). These findings suggest that some health professionals use primarily focus treatments on reducing pain rather than optimising functional participation in activities of daily living.

The diverse approaches for LET management by different health professionals may be due to the varied understanding of LET pathology. It was previously considered a form of tendinitis arising from inflammation at the common extensor origin of the elbow that was initiated by macroscopic or microscopic tears in the common tendon of the wrist extensor muscles due to chronic overuse (Ahmad et al., 2013). Consequently, the terms

'epicondylitis' and 'tendinitis' are commonly used in the research literature to describe LET. However, recent histopathological studies have consistently demonstrated that the affected tendon (usually the extensor carpi radialis brevis [ECRB] tendon) is characterised by a dense population of fibroblasts, disorganised and immature collagen, and an absence of inflammatory cells (Bhabra et al., 2016; Waugh, 2005). These findings are considered characteristics of a degenerative process collectively termed 'angiofibroblastic dysplasia' (Bhabra et al., 2016; Waugh, 2005). Some researchers have reinforced the importance of referring to LET as a tendinopathy to reflect the absence of inflammatory cells and the complexity of the pathology (Stasinopoulos & Johnson, 2006).

1.2 Moving towards a more holistic approach

Given that various health professionals manage LET, using a universal framework such as the International Classification of Function, Disability and Health (ICF) endorsed by the World Health Organization (WHO), may provide a common language to improve optimal treatment options across professional disciplines. The ICF is a universal classification system that considers health and disability at the individual and population levels, including the personal factors (e.g., physiological, psychological, and cognitive), and the environmental factors (e.g., social, physical, organisational, legislative environments) that enable or impede a person's participation in their desired activities (Hoefsmit et al., 2014; World Health Organization, 2001).

A recent literature review emphasised the importance of including the environmental context to manage and prevent LET symptoms (Stegink-Jansen et al., 2021). The authors of this review suggested changing the physical environment to minimise occupational risk factors for LET. In support of these findings, hand therapy literature concurs that most hand therapy assessments and treatments for upper limb conditions predominantly focuses on the body function and structure components of the ICF and rarely focus on the other domains (Naughton & Algar, 2019; Winthrop Rose et al., 2011). One way of considering the physical and social work environments is to have hand therapists attend the injured worker's workplace as part of the return-to-work (RTW) process as seen in Figure 1.1. This figure demonstrates the application of all the ICF domains when managing injured workers with LET.

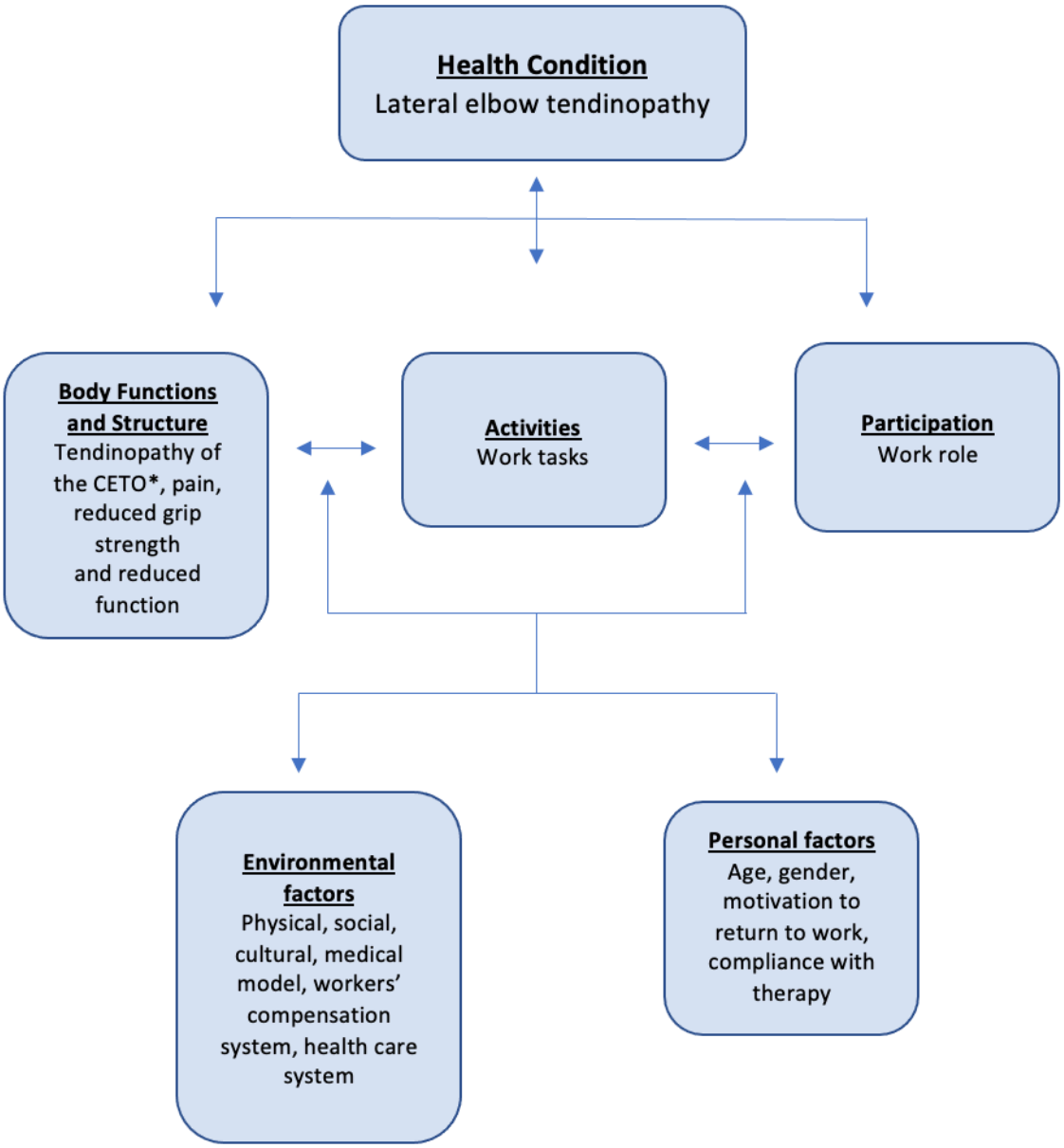

Figure 1.1: Application of the International Classification of Disability, Functioning and Health: Interaction of concepts for patients with LET.
*CETO= common extensor tendon origin

1.2.1 The Person-Environment- Occupation Performance (PEOP) model

Given that most hand therapists in Australia are occupational therapists (Australian Hand Therapy Association (AHTA), 2022), the use of the Person-Environment-Occupation Performance (PEOP) model (Baum et al., 2015), which is a top-down, client-centred and holistic approach is appropriate to consider when managing injured workers with LET. The PEOP model has been used in a variety of workforce and healthcare contexts and has been applied to successfully develop a prevention program to assist workers in a variety of workplaces to improve movement patterns and prevent musculoskeletal conditions (Jarus & Ratzon, 2005). The PEOP model focuses on how the environment impacts on a person's occupational performance and emphasises that a dynamic interaction occurs between the person (i.e., intrinsic factors) and the environment (i.e., extrinsic factors), which present as barriers and/or enabling factors to influence the person's performance in their chosen occupations (Baum et al., 2015).

A hand therapist can apply the PEOP model to identify the enablers and barriers within the person (intrinsic) and environmental (extrinsic) factors to optimise the patient's occupational performance in their work duties and roles following a diagnosis of LET. The PEOP model was chosen for this PhD research project because to date, interventions to manage LET have primarily focused on addressing the physiological barriers of pain, reduced grip strength, and function, and have rarely focused on the extrinsic factors that may be hindering their occupational performance (i.e., occupational risk factors in the physical, organisational, and social environments). Figure 1.2 shows the application of the PEOP model for patients with LET within the WA workers' compensation context.

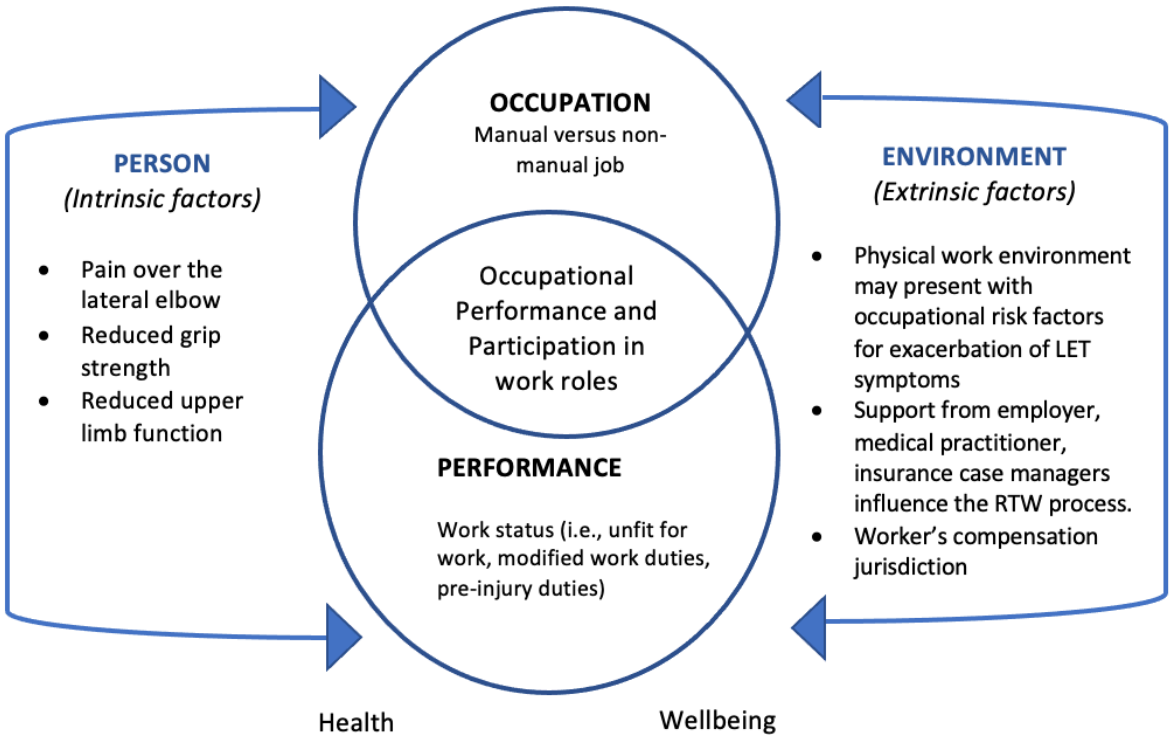

Figure 1.2: Application of the Person-Environment-Occupation-Performance model for patients with LET

1.3 Benefits of workplace rehabilitation

Workplace-based rehabilitation has been recognised as providing many benefits in the RTW process for injured workers (Oakman et al., 2018), and where possible, RTW programs should be undertaken at the injured worker's workplace (Franche et al., 2005; Hoosain et al., 2019). The benefits of workplace-based rehabilitation include maintaining the injured worker's engagement in their worker role at the work environment and maintaining close contact with workplace peers who can provide ongoing support (Suzuki & Smith, 2003). A comprehensive review of the benefits of workplace-based interventions for reducing cardiovascular risk and back pain found that the environmental factors and social support networks in workplaces may make disease prevention programs in these settings more efficacious than similar programs offered in. clinical settings (Pelletier, 1997).

Some factors identified in the literature as being barriers to optimal RTW include less supportive workplace, less supportive co-workers, job dissatisfaction, high job strain and

exposure to physical repetitive upper limb risk factors and workers RTW expectations (Cancelliere et al., 2016; Peters et al., 2020). A systematic review identified that RTW programs that promote contact between health care providers and the workplace, work accommodation, early contact with the worker by the workplace, ergonomic site visits and the presence of a RTW coordinator reduce work disability and the time off work (Franche et al., 2005).

1.4 Identified gaps

The research literature indicates that work-related LET has a high recurrence rate (Herquelot et al., 2013; Shiri, Viikari-Juntura, Varonen, & Heliovaara, 2006) and occupational risk factors (Shiri & Viikari-Juntura, 2011; Stegink-Jansen et al., 2021; Walker-Bone et al., 2012) contribute to the development of LET. However, clinical treatments continue to manage symptoms in the short term only (Peterson et al., 2005). Given that LET can progress into a degenerative state and can last up to two years. (Hudak et al., 1996), interventions should be tailored around changing behaviours and empowering patients to understand the principles of activity modification and what postures to avoid so that they can still participate in their meaningful work roles, despite experiencing symptoms.

Current treatments to manage LET identified in the literature commonly focus on the physiological management of pain, strength, and function and seldom account for the patient's environmental factors. Furthermore, there is an emphasis on body functions and body structures in hand therapy practice (Winthrop Rose et al., 2011). It is proposed that a movement towards incorporating the activities, participation, and environmental factors may improve patient outcomes (Winthrop Rose et al., 2011). The biopsychosocial approaches of the ICF and the PEOP model support a more holistic management approach when treating injured workers with LET. The ICF and the PEOP model can be used to support education of patients with LET about functional biomechanics and activity modification that may assist in their treatment and facilitate their return to pre-injury work and leisure roles.

1.5 Workers' compensation in Australia

In Australia, workers' compensation is a compulsory statutory form of insurance required by all employers, protecting all employees who sustain a work-related injury (Safe Work Australia, 2022). Workers' compensation insurance is legislated by the governments in

each state and territory of Australia and regulated by their respective workers' compensation authority (Safe Work Australia, 2022). One provision of all workers' compensation legislation in Australia, regardless of jurisdiction, is that during the recovery period, injured workers are entitled to a percentage of income replacement (known as the 'Prescribed Amount'), access to medical and workplace rehabilitation services, and where relevant, access to a lump sum financial compensation for significant impairment (Safe Work Australia, 2022).

1.5.1 WorkCover WA

WorkCover (WA) is the government agency responsible for overseeing and regulating workers' compensation and injury management schemes in Western Australia (The Government of Western Australia, 2017). The WA scheme is based on a 'no-fault' system, which means that an injured worker can make a claim for compensation without the need to. determine if the employer was at fault or negligent of 1 July 2022, the prescribed amount available per insurance claim was AUD $243,991 (WorkCover WA, 2022a). Additional funding equating to a maximum of 30% of the prescribed amount (i.e., AUD $73, 197) is available to pay for any medical and allied health treatments including medical consultations and services, diagnostic imaging, and hand therapy services (WorkCover WA, 2022a). An additional seven per cent of the prescribed amount (i.e., AUD $17, 079) is available to pay for workplace rehabilitation services the injured worker receives as part of the work-related injury claim (WorkCover WA, 2022a).

1.5.1.1 Clinical Framework for the Delivery of Health Services

Workcover WA endorses using the national Clinical Framework for the Delivery of Health Services (The Government of Western Australia, 2012); an evidence-based guide designed to support medical and allied health professionals when delivering services to workers with compensable injuries. Five principles underpin the Clinical Framework for optimal recovery and RTW outcomes for injured workers in the RTW process:

1. Measure and demonstrate the effectiveness of treatment
2. Adopt a biopsychosocial approach
3. Empower the injured person to manage their injury
4. Implement goals focused on optimising function, participation, and RTW

5. Base treatment on best available research evidence

(*Clinical Framework for the Delivery of Health Services*, 2012)

These principles are included throughout this research as they are relevant to the research context (i.e., Workplace injuries in WA). They support the biopsychosocial approach that underpins this research project.

1.5.1.2 Treatment management plan

Hand therapists providing a range of hand and upper limb services to an injured worker within the WA workers' compensation system may be requested by the insurer to provide a written Treatment Management Plan (TMP) (WorkCover WA, 2019b). The TMP aims to clarify future treatment options for workers who are likely to require more than 10 consultations or four weeks of treatment for an upper limb injury (WorkCover WA, 2019b) and provides insurers with a mechanism to determine whether the treatments and associated costs are reasonable.

Using the principles outlined in the Clinical Framework, hand therapists are expected to provide treatments that empower the worker to manage their injury by setting expectations, developing self-management strategies, providing education, and promoting independence from the treatment provided (WorkCover WA, 2019b). A copy of the TMP template is attached in Appendix A. There is a section on the form titled "Return to work progression" with the following questions in this section: (i) Has the worker's hours progressed in the last six weeks? (ii) Is the worker likely to return to the functional capacity required to perform pre-injury duties? and (iii) Do you have any comments to assist the medical practitioner certify capacity for the worker such as modifications to the workplace. Currently, the hand therapist is required to provide an estimate timeframe for when the worker can RTW based on their clinical assessment.

1.5.2 Stakeholders in the RTW process

Stakeholders are those involved in the injury management and RTW process. For work-related upper limb injuries, stakeholders typically include health care providers such as medical practitioners and hand therapists, workplace rehabilitation providers (injury management), insurers, and employers. Figure 1.3 illustrates the interaction between the

key stakeholders within the WA workers 'compensation system who are involved in the RTW process, with the injured worker central.

Figure 1.3: Key stakeholders in the injury management and return-to-work process within the WA workers' compensation system.

Descriptions of the stakeholders' respective roles are described in Table 1.1.

Table 1.1 Description of stakeholders' roles in the RTW process

Stakeholder	Description
Injured worker	An injured worker within the WA workers' compensation system is someone that is entitled to compensation (for lost wages, medical expenses, and associated costs when they are unable to work) if they sustained an injury or develop a disease at work (WorkCover WA, 2022b).
Hand therapist	Hand therapy is the merging of occupational and physical therapy theory and practice, which combines comprehensive knowledge of the upper limb, anatomy, biomechanics, and function. Using

	specialised skills in assessment, planning, and treatment, hand therapists provide therapeutic interventions to prevent dysfunction, restore function and/or reverse the progression of pathology of the upper limb to enhance an individual's ability to participate fully in meaningful activities (Australian Hand Therapy Association (AHTA), 2022; World Federation of Occupational Therapists, 2016).
Medical practitioner	The treating medical practitioner has a vital role in the injury management process, including diagnosing and coordinating the medical treatment for the injured worker (WorkCover WA, 2019a). They are responsible for liaising with the employer to facilitate an injured worker's maintenance at or RTW and may refer the worker for workplace rehabilitation and/or other allied health services as required. Medical practitioners are also responsible for providing timely medical certificates, including their medical opinion on the worker's ability to perform their pre-injury work duties (WorkCover WA, 2019a).
Workplace rehabilitation providers	In complex claims or when an injury becomes chronic, the injured worker may be referred to a WorkCover WA approved workplace rehabilitation provider (also known as vocational rehabilitation provider) to assist in the RTW process. Workplace rehabilitation providers (including occupational therapists, physiotherapists, chiropractors, exercise physiologists, or psychologists) have expertise in addressing the physical, psychological, and other workplace barriers that may prevent injured workers from returning to work (Workcover WA, 2020). Common workplace rehabilitation services include job task analysis, environmental modifications, provision of ergonomic equipment, and providing a graduated RTW program that involves progressively challenging work duties and more time on work

	shifts (Sharan, 2012). The workplace rehabilitation provider may or may not have specific knowledge or skills in managing upper extremity musculoskeletal injuries, including LET.
Insurance case managers	Insurance case managers assess the injured worker's claims for compensation and reimburse the employer with compensation for which liability has been accepted. They coordinate and collaborate with the other key stakeholders to ensure the injured worker receives suitable and timely medical treatments based on evidence-based guidelines to encourage the injured worker to RTW safely (WorkCover WA, 2020a).
Employers	Employers in WA have the statutory obligation to ensure injured employees receive appropriate injury management support and accommodation within the workplace following a work-related injury (Workers' Compensation and Injury Management Act 1981, n.d.). Many employers may have little knowledge about their responsibilities once a claim has been submitted for one of their employees; often, they are guided by the insurer about their responsibilities regarding the injury management obligations (Roelofs, 2006).

1.6 Proposed novel intervention

Hand therapists aim to assist injured workers to re-engage with their self-care, leisure, and work roles. This thesis proposes an educational approach that focuses on functional biomechanical changes and that considers an injured worker's personal, occupational, and environmental factors as per the ICF and PEOP model. The workplace-based hand therapy education intervention described in this thesis is guided by the ICF, the PEOP model, and the five principles of the WorkCover WA Clinical Framework. This novel intervention may provide hand therapists with a comprehensive and evidence-based approach to managing injured workers with LET.

The proposed workplace-based hand therapy education intervention is designed to complement the other initiatives undertaken by the key stakeholders in the RTW process. It is not intended to duplicate other services but rather to provide targeted education and advice on occupational risk factors and safe work practices at the workplace to reduce the presence of symptoms related to LET. The proposed management of LET uses a hand therapist's specialised knowledge in the anatomy and pathology of the condition and postures and movements that are risk factors for LET.

1.7 Research aims and objectives

The overall research question investigates the impact of adding a workplace-based hand therapy intervention to the standard hand therapy approach to manage work-related LET. Five stages of research were undertaken to answer this research question. Table 1.2 summarises the research aims and objectives for the five studies included in this thesis.

The underlying hypothesis for this research is that using the ICF as a framework and the PEOP model for a biopsychosocial and client-centred approach to hand therapy interventions and consideration of the work environment, may improve the clinical and work outcomes for workers with a compensable work-related LET injury.

Table 1.2 Study aims and objectives for each research stage

Research stage	Study aims and objectives	Study Design
Study 1	1. Investigate existing evidence for workplace-based interventions for the management of LET. 2. Provide an overview of: i. studies that used workplace-based interventions for workers diagnosed with LET, ii. the content of these interventions, and iii. the method of delivery of these interventions.	Systematic review

Study 2	1. Identify, compare, and contrast the perceptions of Australian hand therapists and medical practitioners about the effectiveness of common treatments for LET. 2. Obtain hand therapists and medical practitioners' views on hand therapist-delivered workplace-based interventions.	Cross-sectional study
Study 3	1. Develop the RCT protocol to be used to investigate the impact of adding a workplace-based hand therapy intervention to standard hand therapy. The objectives are to: i. develop a standard hand therapy program. ii. develop a novel workplace-based hand therapy intervention.	RCT protocol development
Study 4	1. Identify the impact of adding *Working Hands-ED* to standard hand therapy care on the clinical outcomes of pain, grip strength and function. 2. Identify the effectiveness of standard hand therapy on the clinical outcomes of pain, grip strength and function. 3. Identify the impact of adding *Working Hands-ED* to standard hand therapy care on the return-to-work status and hand therapy costs, duration, and sessions.	Randomised controlled trial

Study 5	1. Explore the experiences of the hand therapists who provided *Working Hands- ED* as part of a clinical management program for injured workers with LET. The objectives are to: i. explore the attitudes towards providing this type of intervention. ii. identify the nature of education provided at the workplace; and iii. determine the perceived benefits and challenges of conducting this type of intervention.	Qualitative study

1.8 Significance of study

There are numerous costs that workplace injuries incur for injured workers, employers, insurers, and society. The study findings may. benefit all stakeholders of the worker's compensation system (i.e., employers, medical practitioners, insurers, workplace rehabilitation providers and the injured worker) and has the potential to reduce the claims costs and claims duration related to RTW outcomes for injured workers with LET. Furthermore, a more holistic approach to the management of LET may improve communication between the treating hand therapists and other stakeholders, potentially impacting positively on the RTW process for injured workers.

1.9 Thesis structure and publications

This thesis is presented as a 'thesis by compilation' as per the Curtin University thesis guidelines. Two of the five studies are already published, and one is currently under peer review. It consists of the following stages and corresponding peer-reviewed publications, as seen in Figure 1.4. Each chapter begins with a short introduction to explain the purpose and content of that chapter.

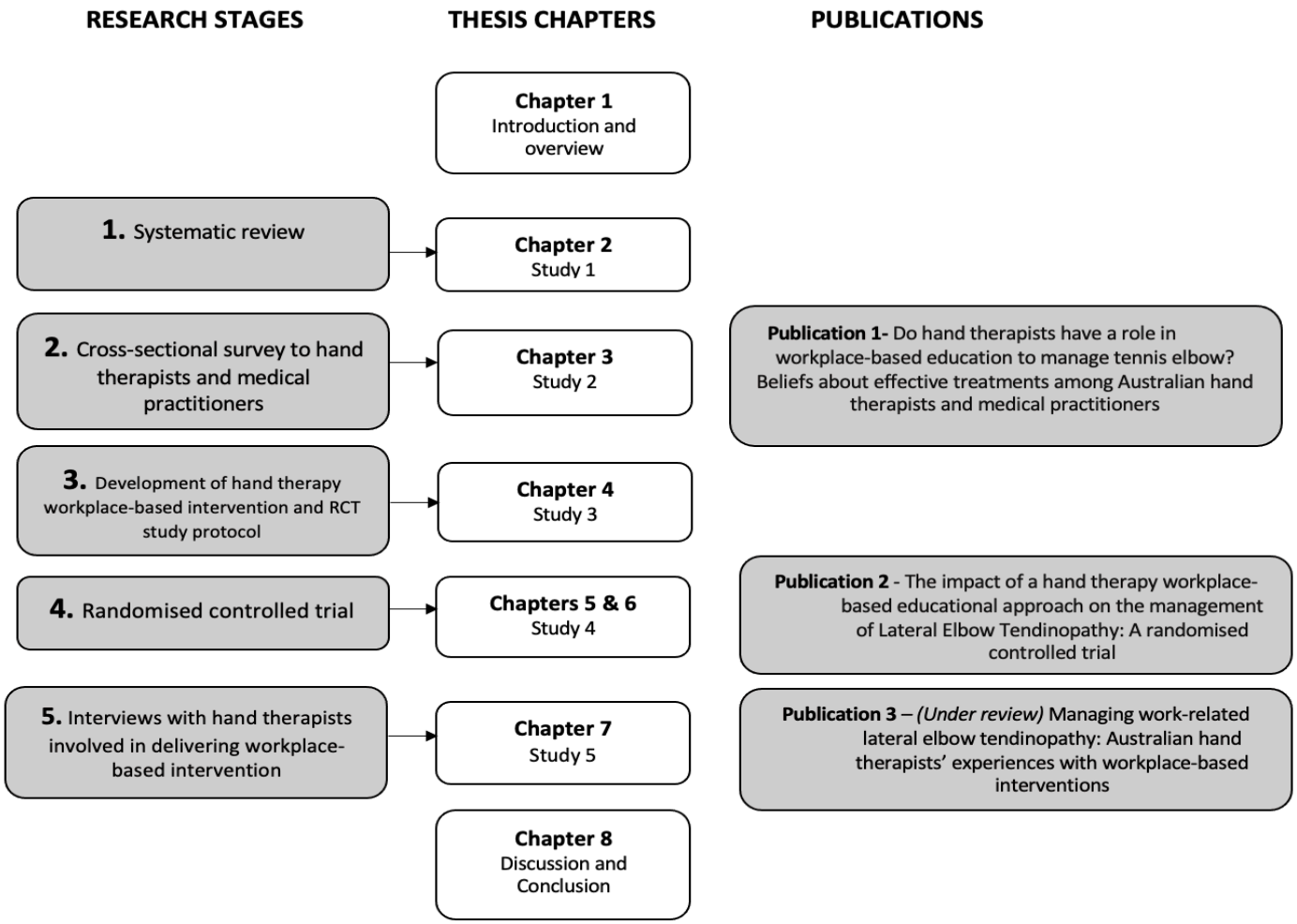

Figure 1.4 Structure of the thesis

1.9.1 Introduction and overview (Chapter 1)

This chapter discusses the clinical presentation of LET, its prevalence among injured workers, and the Western Australian workers' compensation legislation and process to support injured workers to RTW. Chapter 1 provides an overview of the significance of the research, project aims and objectives, the thesis structure, and a summary of the subsequent chapters.

1.9.2 Study 1: Systematic Review (Chapter 2)

A comprehensive systematic review was conducted to determine the evidence available for workplace-based interventions, specifically for the management of work-related LET. The findings from this systematic review suggested that further research was required to understand the nature and implications of this management strategy for LET. The review findings helped inform the development of the following study.

1.9.3 Study 2: Cross-sectional survey (Chapter 3)

This study sought to determine the perceptions about the effectiveness of common treatments for LET among Australian hand therapists and medical practitioners and obtain their views on a workplace-based educational intervention delivered by hand therapists. The cross-sectional study used online surveys to collect responses from Australian hand therapists and medical practitioners. The data were analysed with descriptive statistics to describe their reported beliefs.

This study identified that Australian health professionals believed that education was the most effective management approach for LET, and that hand therapists have a pertinent role in workplace-based education. The findings from Study 2 were published in a peer-reviewed research journal and are included in Chapter 3:

Tran, T., Falkmer, T., & Ciccarelli, M. (2020). Do hand therapists have a role in workplace-based education to manage tennis elbow? Beliefs about effective treatments among Australian hand therapists and medical practitioners. *Work, 66*(3), 1-11 https://doi.org/10.3233/WOR-203196

1.9.4 Study 3: Development of interventions and study protocol (Chapter 4)

The findings from Study 2 informed the development of Study 3. Chapter 4 describes and discusses the development, training, and implementation phases for the standard hand therapy program (comparison intervention) and the novel workplace-based education intervention (also known as *Working Hands-ED*). This chapter also describes the study protocol used for the randomised controlled trial conducted in Study 4.

1.9.5 Study 4: Randomised controlled trial (Chapters 5 and 6)

Study 4 investigated the impact of adding a hand therapist-delivered workplace-based educational intervention to (i) the clinical outcomes of pain, grip strength, and function, and (ii) on the work status, duration, and costs of hand therapy services of 49 injured workers with a workers' compensation claim for work-related LET. The hand therapists who received training to implement the *Working Hands-ED* and comparison interventions in Study 3 were responsible for collecting the clinical outcomes data. These hand therapists were subsequently recruited as participants in the qualitative study (Study 5). The findings from Study 4 are written in two separate chapters (Chapters 5 and 6).

Chapter 5 describes the findings of the RCT on the clinical outcomes that were undertaken at a multi-centred hand therapy private practice in Perth, Western Australia. A peer-reviewed publication is included in Chapter 5:

Tran, T., Harris, C., & Ciccarelli, M. (2021). The impact of a hand therapy workplace-based educational approach on the management of lateral elbow tendinopathy: A randomised controlled study. *Journal of Hand Therapy,* in press. http://doi.org/10.1016/j.jht.2021.09.004

The secondary work outcomes including work status, and the cost and duration of hand therapy services are presented in Chapter 6.

1.9.6 Study 5: Qualitative study (Chapter 7)

The final study (Study 5) explored the hand therapists' experiences and perceived benefits and challenges in delivering the novel workplace-based educational intervention. An exploratory, descriptive qualitative study design using a semi-structured interview data

collection method was used to gain an in-depth understanding of the hand therapists' experiences.

The findings from Study 5 identified that hand therapists experienced mutual benefits (for them and their patients) and had positive experiences with the delivery of *Working Hands- ED* at their patients' respective workplaces. The hand therapists reported some logistical challenges to consider when providing services out of the clinic setting.

1.9.7 Discussion and Conclusion (Chapter 8)

This chapter provides a synthesis of the findings from each study. It presents the relevance of incorporating this novel intervention approach to manage work-related LET in the context of the WA workers' compensation system. The implications on clinical practice and future research are considered, including the recommendations for how hand therapists may use *Working Hands-ED* as part of the rehabilitation process for injured workers with LET. This is followed by a discussion of the strengths and methodological limitations of the research project and a concluding reflection.

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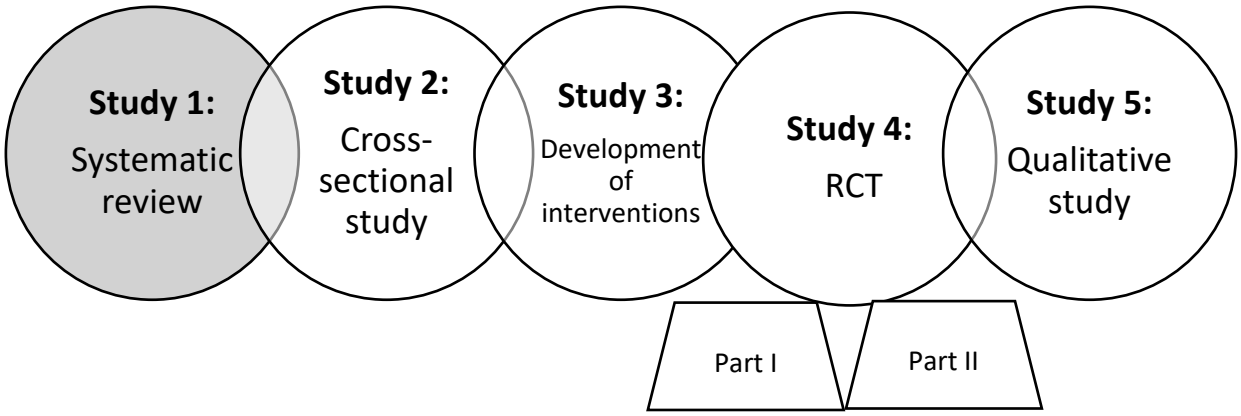
Chapter 2

Study 1: Systematic Review



Chapter 2 presents the findings from Study 1 titled: "A systematic review of workplace-based interventions for managing lateral elbow tendinopathy". This study aimed to investigate existing evidence for workplace-based interventions specifically for lateral elbow tendinopathy.

This systematic review was conducted in 2014; however, database searches were performed again in 2020 to expand the search dates towards the end of this doctoral study as very limited evidence was found in the 2014 review. No new relevant articles were found to include in the final review.

2.1 Introduction

Work-related upper extremity disorders are common among working populations in Western countries (Da Costa et al., 2015). Lateral elbow tendinopathy (LET), also known as tennis elbow, is one of the most prevalent upper extremity disorders, with an estimated prevalence of 1-3% in the general population and is even more common among the working populations (Shiri & Viikari-Juntura, 2011). Work-related risk factors for developing LET are widely reported in the literature. The included repetitive and forceful motions of the wrist and arm for more than two hours/day, handling tools heavier than 1kg, handling loads heavier than 20kg for more than 10 times per day, activities demanding high handgrip forces, and the use of vibrating tools (Shiri et al., 2006). Work risk factors are an area of focus in the management of this common condition as part of a multi-modal approach (Coombes et al., 2015); however, hand therapists often address these risk factors with their LET patients in the clinic setting and are seldom involved in any assessments or interventions at the injured worker's workplace (Coombes et al., 2015; MacDermid et al., 2010).

Since the 1990's, workplace-based rehabilitation has been recognised for its benefits in the return-to-work (RTW) process for injured workers (Edries et al., 2013; Hoosain et al., 2019; Ree et al., 2016). Benefits of workplace-based vocational rehabilitation include maintaining the engagement of the injured worker in their work role in the work environment and maintaining close contact with supervisors and co-workers who can provide ongoing support (Franche et al., 2005; Hoosain et al., 2019; Suzuki & Smith, 2003). Workplace-based interventions have been offered by various disciplines, including occupational therapists, physiotherapists, and ergonomists (Hoosain et al., 2019). Examples of interventions include (i) workplace-based exercise programs, (ii) worker education (Franche et al., 2005), (iii) workstation modification, (iv) changes to work processes and rest breaks, and (v) training of supervisors and case managers (Edries et al., 2013; Williams et al., 2004). The cost versus benefits of workplace interventions for RTW programs were documented in a systematic review (Cullen et al., 2018), which found moderate to strong evidence that lost time from work was reduced when interventions comprised a multi-domain approach and included interventions such as graded activities, service coordination, and work modification components (Cullen et al., 2018).

Several systematic reviews have investigated the effectiveness of workplace-based interventions to prevent and manage upper limb musculoskeletal conditions (Hoosain et al., 2019; Van Eerd et al., 2016; Williams et al., 2004). A recently published review, which included studies of individuals with a range of work-related upper limb conditions (but not LET specifically), identified high-quality evidence for workplace exercise programs in various employment settings and mixed evidence for ergonomic controls (Hoosain et al., 2019). This study concluded that workplace adjustments, ergonomics training, and behavioural counselling also showed positive benefits on work performance (as measured by productivity, absenteeism, pain or comfort and motivation at work) outcomes (Hoosain et al., 2019). An earlier systematic review aimed to present the evidence available on workplace interventions for four common upper limb conditions including LET (Dick et al., 2011). Three studies related to LET were included in this review; however, one study was published almost three decades ago, another study investigated the effects of splinting (Derebery et al., 2005) and the third study explored workplace factors, but not any workplace interventions.

There are benefits of considering the environmental factors to support early RTW (Hoefsmit et al., 2014) but hand therapy research literature (Naughton & Algar, 2019; Winthrop Rose et al., 2011) indicated that hand therapy practice predominantly focused on the body function and body structure components of the International Classification of Functioning, Disability and Health (ICF) (WHO, 2001) and rarely focused on the environmental, activity, and participation components of the ICF. These authors concur that all elements of the ICF should be incorporated to provide a more holistic approach to improve the quality of care for patients with hand and upper limb conditions.

To the best of our knowledge, no previous systematic reviews have investigated the effectiveness of using a holistic hand therapy approach for the management of LET, incorporating all components of the ICF, including the workplace environment.

2.1.1 Study aims and objectives

The purpose of this systematic review was to investigate existing evidence for workplace-based interventions specifically for the management of LET. The objectives were to provide an overview of (i) the studies involving the use of workplace-based interventions

for workers diagnosed with LET, (ii) the content of the reported interventions, and (iii) the method of delivery of these interventions used with this population.

2.2 Method

This systematic review was conducted in accordance with the Joanna Briggs Institute (JBI) Model of Evidence-Based Healthcare methodology for systematic reviews of effectiveness (Aromataris & Munn, 2020). The JBI model requires all systematic reviews to incorporate a process of critique or appraisal of the research evidence using one of their critical appraisal checklists (Aromataris & Munn, 2020).

2.2.1 Eligibility criteria

All types of studies were eligible for inclusion in this systematic review. Searches were filtered to include peer-reviewed journal articles only (2000-2020) and written in English. Studies with participants aged 18+ years with a clinical diagnosis of LET who received interventions to manage LET at the workplace were included in this review.

Studies were included if combinations of therapies with workplace-based interventions were used to manage LET. Studies were excluded if they only reported on the prevention of LET. Conference presentations, abstracts only, and studies reporting interventions conducted outside the workplace were also excluded.

2.2.2 Information sources

A comprehensive systematic search across 11 electronic databases was conducted to identify eligible studies. Databases searched included (1) Medline, (2) Embase, (3) CINAHL, (4) ProQuest, (5) Scopus, (6) Wiley Online Library, (7) Pedro, (8) PubMed, (9) Cochrane Library, (10) OTseeker and (11) ScienceDirect. Hand searches of the reference lists of relevant publications were performed.

2.2.3 Search strategy

The key search terms for the three concepts of (i) lateral elbow tendinopathy, (ii) workplace-based, and (iii) type of intervention used are summarised in Table 2.1. Specific key search terms for each database searched are in Appendix B.

Table 2.1 Key search terms used in the systematic review

	CONCEPT 1	CONCEPT 2	CONCEPT 3
Key Terms	lateral elbow tendinopathy; elbow tendinopathy; tennis elbow; epicondyl*; workers elbow.	workplace; work-place; workplace-based; work-place based; worksite; work-site; onsite; on-site.	education* interven*; work rehab*; vocational rehab*; occupational rehab*; return-to-work; RTW; health education; ergonom*; rehabilitation; vocational; return to work; occupational therapy; therapy

*Truncation of the root search term

2.2.4 Study selection

The first reviewer (TT) screened titles and abstracts of the entire pool of articles that met the inclusion criteria and removed duplicates. After this, all abstracts were screened independently by three reviewers (TT, SK, MC) using the inclusion and exclusion criteria. Full-text articles were sourced for abstracts that met inclusion criteria, and articles that did not meet inclusion criteria were excluded. Consensus on which studies to include in the study was reached by discussion among the reviewers.

2.2.5 Methodological quality

The methodological quality of all included studies underwent a rigorous and independent appraisal by two reviewers (TT and SK) using the relevant JBI Clinical Appraisal tool according to each study design. There were no discrepancies between the two reviewers about their respective quality ratings of the included studies. The results of this appraisal were used to inform data synthesis and interpretation in the systematic review.

2.3 Results

2.3.1 Included studies

This systematic review was conducted in 2014 prior to the publication of the recent Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Page et al., 2021), therefore the 2009 PRISMA (Moher et al., 2009) flowchart was used for this review and is presented in Figure 2.1. The search of the databases and additional records identified through other sources yielded 410 articles; 395 articles were screened after duplicates were removed. Of these, 391 articles did not meet the inclusion criteria after the abstracts were reviewed. Of the remaining four articles, three were excluded after the full text was reviewed because they did not have interventions conducted at the workplace. Therefore, the literature search resulted in only one article meeting the inclusion criteria for this systematic review.

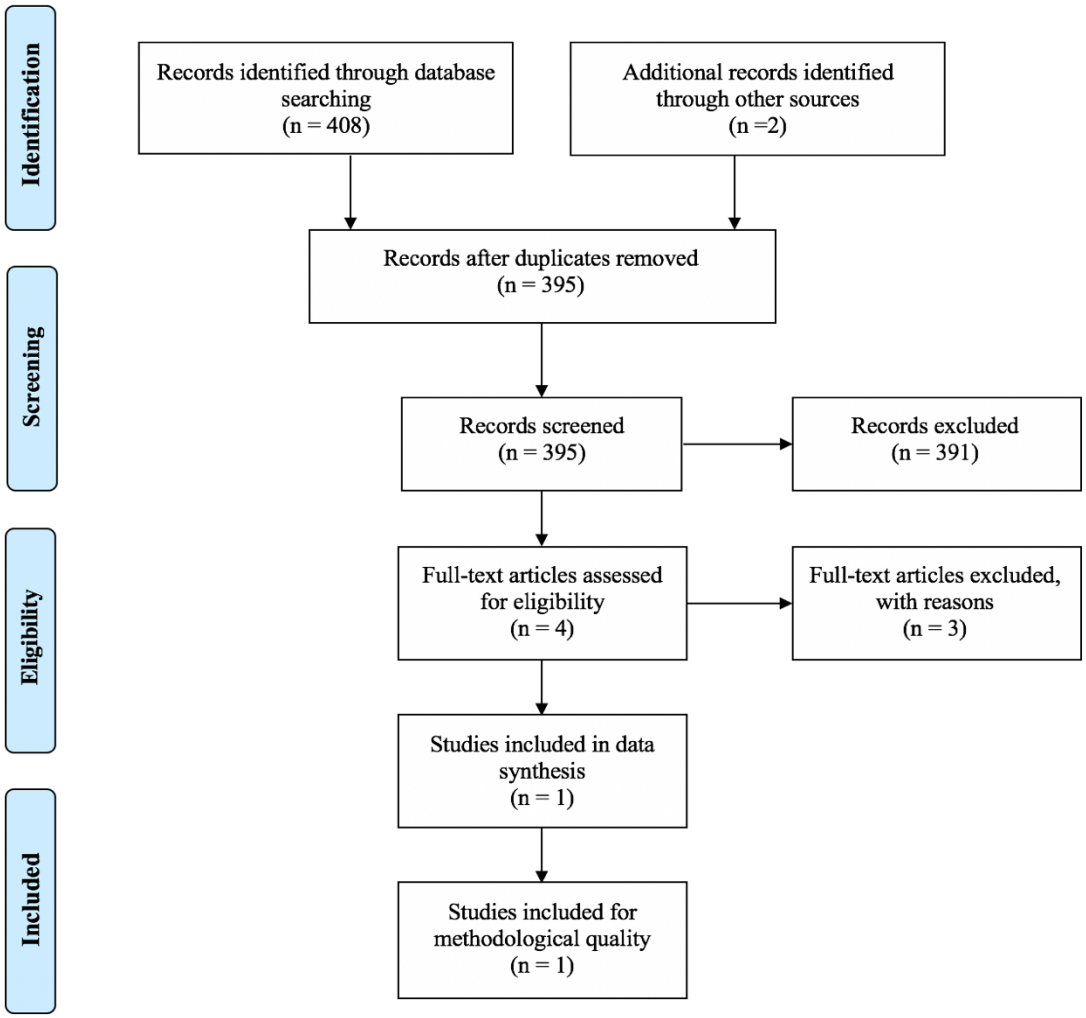


Figure 2.1 PRISMA flow chart

2.3.2 Study characteristics

The only study that met the inclusion criteria for this systematic review was a case report (McCormack, 2010). The purpose of the case report was to address the potential benefits of ergonomic and behavioural changes for a worker performing office-based tasks who was diagnosed with a work-related LET associated with an inadequate workstation (McCormack, 2010).

2.3.3 Outcomes

The clinical and physical outcomes addressed in the article are presented in Table 2.2. Outcomes were measured at the initial appointment and then re-assessed two weeks after the workplace-based interventions were provided.

Table 2.2 Characteristics of included studies

Author and year	McCormack (2010)
Study Design	Case report
Participants	N=1; 45-year-old Caucasian female. Employed 40 hours/week as an administrative assistant at a small, private medical college. Presented with a three-year history of intermittent right elbow pain over the lateral epicondyle region. Previous treatment included three corticosteroid injections and physical therapy over two years. Mild relief of symptoms was reported from these combined treatments.
Outcomes	Clinical outcomes: pain (best, worst, at time of assessment and with palpation over the lateral epicondyle) using an 11-point verbal analogue scale (0=no pain, 10= worst pain), manual muscle test (0-5 scale, with 0= no muscle contraction, 5=normal muscle contraction), and grip strength measured with a JAMAR dynamometer (at the 3rd position). Measures were taken at the

	initial appointment at the participant's workplace and then re-assessed two weeks after the interventions were implemented. Physical outcomes: Self-reported comfort level and frequency of headaches. The participant's posture was observed by the therapist at the initial appointment and then re-assessed two weeks after the interventions were implemented.
Interventions provided	Ergonomic and behavioural interventions were provided to the participant at the workstation.
Main finding	Overall reported pain levels increased, and hand grip decreased during the re-assessment taken two weeks after the interventions. Strength in resistance against wrist extension improved at the re-evaluation. McCormack (2010) reported that the participant felt "more comfortable at her desk and demonstrated improved posture while working. She didn't experience any increase in pain with extended (60 to 90 minutes) keying and mousing activities" (pp. 84). The participant reported a decline in the frequency of headaches.
Level of evidence	5
Validity score	The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Reports was used (https://jbi.global/critical-appraisal-tools). The checklist consisted of 8 items. There was no scoring available for this type of study.
Conclusion	Ergonomic and behavioural changes improved the client's tolerance for keyboard and mouse use over extended periods throughout the workday. The ergonomic and behavioural interventions did not improve her clinical outcomes.

2.3.4 Interventions

The therapist conducted an ergonomic and behavioural assessment to identify any problems in the participant's workplace that might have presented as risk factors for the development of her right sided LET. The ergonomic and behavioural problems identified included "(i) inappropriate postural alignment when keying and mousing; (ii) inadequate lighting; (iii) uneven floor structure; (iv) inappropriate upper quadrant posture with work tasks such as reaching and (v) insufficient rest breaks throughout the workday" (pp. 84). The assessment was immediately followed by ergonomic and behavioural interventions at the workplace to address these identified issues. The participant attended two physical therapy appointments in the week prior to the workplace assessment and interventions in which she received phonophoresis, cross friction massage, myofascial release, passive stretching, and iontophoresis to manage clinical symptoms. The participant continued to experience pain after her physical therapy sessions. A summary of the interventions provided to the participant at her workplace is reported in Table 2.3.

Table 2.3 Summary of interventions

Type of intervention	Intervention provided
Ergonomic	Installation of an adjustable keyboard tray that housed the keyboard and mouse. The tilt of the tray was re-adjusted to allow the wrist position to be neutral.
Ergonomic	Installation of two desk lamps to improve poor lighting.
Ergonomic	Obtained and installed a mat that covered the entire floor space as the floor surface was uneven. This enabled the participant to sit at her desk without holding onto the desk as the mat provided traction to the chair.
Behavioural	Education on working in a 'comfort zone' to improve seated working posture- i.e., shoulders relaxed, elbows flexed to 90 degrees, wrists in a neutral position.
Behavioural	Education on taking stretch breaks and/or 'mini-breaks' every hour. During these breaks, the participant performed passive wrist extensor and flexor stretches; each stretch was held for 30 seconds.

2.4 Discussion

2.4.1 Summary of findings

This systematic review aimed to investigate the existing evidence for workplace-based interventions for the management of LET and found only one study presenting low-level evidence on the use of workplace-based interventions for injured workers with LET. The nature of the interventions provided in this study included a behavioural component that required the participant to adjust her work postures, decrease the pace of work, and add more task variation; and an ergonomic component that made changes to the physical layout of the participant's computer workstation and the furniture/equipment she used to perform her work tasks. The interventions were delivered by an ergonomist immediately after the therapist had assessed the clinical (pain score at rest and with provocative tests, manual muscle strength test and grip strength test) and physicall risk factors at the participant's workplace. The study's author (it is unclear whether the study author provided the intervention) concluded that the interventions provided improved the participant's self-reported tolerance to the computer keyboard and mouse use for extended periods throughout the workday, reduced headaches, improved posture, and better ergonomic set-up. The interventions, however, did not improve clinical outcomes of pain and grip strength, but the participant had an improved manual muscle test score (from 4+ to 5) for the wrist extensor muscles on the affected arm. The participant reported she had commenced physiotherapy in the same week of the re-assessment, which occurred two weeks after the behavioural and ergonomic interventions were made. This may have affected the clinical outcomes of pain and grip strength observed at the two-week reassessment timeframe.

2.4.2 Ergonomic interventions

The ergonomic interventions included in the case study focused on modifying the participant's computer workstation. The two-week re-assessment found that the participant reported increased tolerance to work activities and decreased frequency of headaches. The participant could perform tasks involving keyboard and mouse use for extended periods (from 45-60 minutes to 60-90 minutes) without increased elbow pain. However, her overall elbow pain increased as measured on the VAS, and grip strength decreased. Manual muscle

testing of the right wrist extensors showed improved muscle strength at the two-week re-assessment. The article's author postulated that exposure to the ongoing physical therapy treatments during the intervention implementation period may have contributed to these results (McCormack, 2010). The mixed results of this case study are supported by the findings reported in a recent systematic review that investigated the effectiveness of workplace-based rehabilitation interventions for people with upper limb conditions (Hoosain et al., 2019). The review reported mixed results for different ergonomic controls such as an adapted mouse and keyboard. The review authors concluded that workstation adjustment and ergonomic training appeared to be beneficial in reducing ergonomic risk, and improving musculoskeletal symptoms and productivity; however, these modifications should be made on individuals' specific needs and upper limb conditions (Hoosain et al., 2019). These needs may vary from person to person; thus, it is essential to consider individualised recommendations for ergonomic interventions instead of a 'one size fits all' approach.

Hand therapists have the knowledge and understanding of the biomechanics of the upper limb and commonly treat LET. Current literature suggests that most Australian hand therapists and medical practitioners believe that injured workers with LET would benefit from a workplace-based intervention; however, it is not common practice (Tran et al., 2020). More recently, literature on LET management has focused on the link between LET pathology, tendon function to tissue-level treatment, and ergonomic interventions (Stegink-Jansen et al., 2021). High-risk activities for LET included "handling of tools and loads in overhead positions working with vibrational tools, and awkward upper limb postures" (Stegink-Jansen et al., 2021, pp. 271). These authors recommend consideration of the physical environmental context and conduction of an ergonomic intervention as part of the management program for LET (Stegink-Jansen et al., 2021).

2.4.3 Behavioural interventions

The case study included education about posture awareness such as relaxing shoulder muscles, having elbow bent to 90 degrees, and wrists in a neutral position. The participant was advised to take rest breaks at least every hour to stretch the forearm muscles. The effectiveness of these exercise break recommendations is supported by other studies that found that rest breaks are advantageous in declining musculoskeletal

discomfort in any part of the body for computer-based workers (De Vera Barredo & Mahon, 2007; Osama et al., 2016). A recent randomised controlled trial (RCT) compared the effects of rest breaks (no activity) and exercise breaks in reducing musculoskeletal discomfort experienced by office workers at a static workstation office (Osama et al., 2016). The contents of the 'exercise break' group consisted of shoulder shrugs, neck tilts, wrist and forearm stretches, back and hip stretches, upper body stretches, hamstring stretches, upper back strengthening, hand/finger stretches, side stretches, and neck stretches (Osama et al., 2016). These stretches were completed twice daily during 10-minute exercise breaks. A finding of this RCT was that the exercise breaks provided better protection and reduced pain and discomfort than additional rest breaks alone (Osama et al., 2016), and although the study was not specific to LET injuries, the findings are relevant to the management of LET symptoms. The upper limb stretches described in this RCT were similar to the 2-hourly stretches of the wrist and forearm extensor and flexor muscles that were prescribed in the single-subject case study (McCormack, 2010). Furthermore, all participants in the RCT also received ergonomic training, workstation modification, and postural education (Osama et al., 2016), like that provided to the case study participant (McCormack, 2010). These findings highlight the benefits of stretches to the upper limb on musculoskeletal pain.

Patient education regarding activity modification (modifying the way an activity is performed) plays a crucial role in managing LET symptoms and other researchers support this hypothesis (Bisset et al., 2011; MacDermid et al., 2010; Vaquero-Picado et al., 2016; Viswas et al., 2012). There is some evidence available that suggests specific elbow, forearm, and wrist positions may contribute to the aggravation and exacerbation of LET (Shiri & Viikari-Juntura, 2011). These include activities requiring handling tools weighing more than 1kg repetitively, handling loads heavier than 20kg more than 10 times a day, requiring hand grip forces, and use of vibrational tools (Shiri & Viikari-Juntura, 2011). It is evident that while previous studies have reported on the concept of delivering ergonomic and behavioural interventions to reduce musculoskeletal discomfort, only one published study (McCormack, 2010) has focused specifically on the management of LET in the workplace.

2.4.4 Recommendations for future research

More research to determine the feasibility and efficacy of workplace-based interventions is needed to provide hand therapists with evidence-based treatment options

for patients with LET who are exposed to occupational risk factors. Given the preliminary evidence that recommends consideration of environmental factors and focusing on the activity and participation components of the ICF when managing LET (Leyshon & Shaw, 2008; Winthrop Rose et al., 2011), future studies are needed to investigate the ergonomic and behavioural educational components required to address occupational risk factors at the workplace.

Empirical studies to determine the effectiveness of this type of novel intervention should (i) include a larger sample, (ii) control for bias, (iii) use standardised outcome measures, and (iv) measure outcomes over longer timeframes (i.e., >12 weeks).

2.4.5 Study limitations

This systematic review found limited available evidence on the effectiveness of workplace-based interventions specifically for the management of LET management symptoms; however, there were methodological limitations to this systematic review. The rigorous process to search for and review the quality of eligible studies was limited to studies published in English language, which may have excluded relevant studies published in other languages. Restricting the target population to patients diagnosed with LET and excluding studies that included other upper limb musculoskeletal conditions and their forms of work-based rehabilitation resulted in an almost empty review. Consequently, this systematic review yielded one study that presented low-level evidence, limiting its use in guiding clinical practice for hand therapists treating patients with work-related LET, but highlighted the need to explore the feasibility and preliminary effectiveness of a workplace-based approach in the management of this condition.

2.5 Acknowledgements

Thanks to Diana Blackwood and Vanessa Varis (Curtin University Librarians) for confirming the search strategies for this systematic review in 2014 and 2020, respectively.

2.6 Conclusion

There is a paucity of published research on workplace-based management strategies specifically for the management of LET. The findings of this systematic review suggest that more research investigating workplace-based interventions for patients with work-related

LET is warranted and should consider the long-term effectiveness of ergonomic and behavioural interventions.

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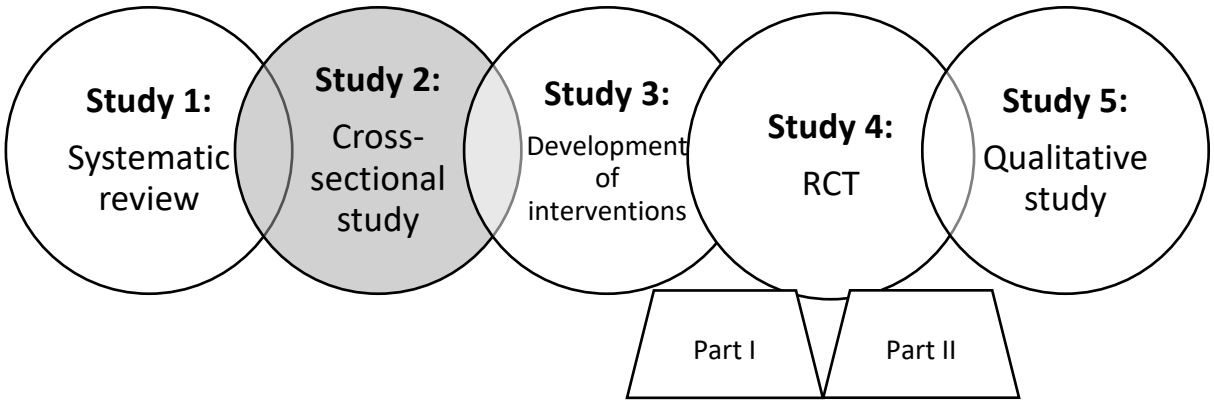
Chapter 3

Study 2: Beliefs about effective treatments among hand therapists and medical practitioners



Chapter 3 reports a cross-sectional study of the beliefs of Australian hand therapists and medical practitioners about effective treatments for LET. The cross-sectional study aimed to i) identify, compare, and contrast Australian hand therapists' and medical practitioners' perceptions about the effectiveness of common treatments for LET, and (ii) obtain their views about workplace-based education on reducing occupational risks for LET delivered by hand therapists.

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Journal Manuscript 1

Title:

Do hand therapists have a role in workplace-based education to manage tennis elbow? Beliefs about effective treatments among Australian hand therapists and medical practitioners

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3.1 Abstract

Background: Lateral elbow tendinopathy (LET), commonly known as tennis elbow, is a prevalent work-related upper extremity musculoskeletal disorder. Medical practitioners and hand therapists manage LET with commonly available clinic-based treatments, despite no sound evidence to suggest long-term relief and functional restoration for workers with LET. Workplace-based rehabilitation is effective for injured workers with other health conditions, but no studies have investigated this rehabilitation approach in the management of LET.

Objectives: (i) Identify, compare, and contrast Australian hand therapists' and medical practitioners' perceptions about the effectiveness of common treatments for LET, and (ii) obtain their views towards a hand therapist delivered workplace-based education approach.

Methods: In this cross-sectional study, 38 medical practitioners from Western Australia and 104 hand therapists around Australia completed online surveys. Independent *t*-tests were used to identify between-group differences in responses.

Results: Despite some between-group differences regarding the perceived effectiveness of common LET treatments, both groups believed education about LET pathology, activity modification, postures, and workplace recommendations were most effective. Most medical practitioners (81%) and hand therapists (71%) believed workplace-based education delivered by a hand therapist would be beneficial for patients with acute and chronic LET.

Conclusion: Australian hand therapists and medical practitioners believed educational approaches were the most important component in the management of LET, and supported workplace-based educational interventions provided by hand therapists in the management of LET.

Keywords

Workplace, therapy, elbow tendinopathy, tendinitis, rehabilitation

3.2 Introduction

Lateral elbow tendinopathy (LET), also known as tennis elbow, is one of the most common work-related musculoskeletal disorders that has a direct correlation of increased risk with exposure to occupations requiring repetitive elbow flexion/extension for >1 hour per day (Shiri et al., 2006; Walker-Bone et al., 2012). The prevalence of LET is estimated to be 1-3% in the working population (R Shiri et al., 2006). LET is characterized by pain and tenderness over the outer surface of the elbow, and reduced grip strength and upper limb function, which affects a person's ability to engage in work, self-care, and daily activities (Ahmad et al., 2013). Previously thought to be an inflammatory condition, histological studies have confirmed that this condition progresses into a degenerative state characterized by an absence of inflammatory cells and therefore should be classified as a tendinopathy (Ahmad et al., 2013; Coombes et al., 2009). LET is equally common in men and women, mostly affects those aged 35-55 years, with the average duration of a typical episode of symptoms ranging from six months to two years (Ahmad et al., 2013).

In Australia, medical practitioners and hand therapists are two groups of health professionals commonly involved in the assessment and management of patients with LET (The Government of Western Australia, 2012). Patients with symptoms of LET typically seek advice first from their medical practitioner. If the injury is not work-related, the patient's private health insurance may reimburse the costs related to assessment and treatment, or else the patient is liable for out-of-pocket expenses. If the injury is work-related, the medical practitioner will provide a First Medical Certificate that allows the injured worker to submit a workers' compensation claim (Workers' Compensation and Injury Management Act 1981, n.d.). The medical practitioner, the employer, and the injured worker communicate with one another to identify suitable alternative work duties and develop a graduated return-to-work program (Workers' Compensation and Injury Management Act 1981, n.d.). In some instances, the injured worker may require a workplace rehabilitation provider to assist with their return-to-work program.

Workplace rehabilitation providers (also referred to as vocational rehabilitation providers) facilitate a return to work after injury (Workers' Compensation and Injury Management Act 1981, n.d.). They are commonly health professionals, such as occupational therapists, physiotherapists, exercise physiologists, or psychologists, who have expertise in

addressing the physical, psychological, and/or workplace barriers that may prevent an injured worker returning to work. The costs of vocational rehabilitation services in the Western Australian workers' compensation system are paid to a maximum of seven per cent of the total amount payable in lost wages (i.e., the 'prescribed amount') for each claim (7, 8). Hand therapy and medical practitioner services are considered medical expenses and are paid to a maximum of 30 per cent of the prescribed amount (The Government of Western Australia, 2017).

The medical practitioner may treat the patient with LET or refer them to a hand therapist. Hand therapists, who usually have a degree in occupational therapy or physiotherapy, merge occupational therapy and physical therapy theories and practice, and combine comprehensive knowledge of upper limb anatomy, biomechanics, and musculoskeletal function. Hand therapists use specialized skills in assessment, planning, and treatment to prevent dysfunction, restore function, and/or reverse the progression of pathology in the upper limb, so as to improve an injured worker's ability to participate fully in meaningful activities (Dimick et al., 2009).

Many treatments used to manage LET reported in the research literature primarily focus on the physiological management of pain, strength, and function. Treatment methods typically include provision of orthoses, exercise programs, use of electrical stimulation technologies, corticosteroid injections, blood injections, pain medications, and surgical options (Bisset & Vicenzino, 2015; Lenoir et al., 2019). Reviews of the effectiveness of common treatments for LET have reported there is weak clinical evidence to support long-term benefits in sustaining pain reduction and maintaining grip strength and function, and to date there is no gold standard method of treatment (Sims et al., 2014; Vaquero-Picado et al., 2016).

Previous cross-sectional studies that explored the perceived effectiveness of LET treatments by hand therapists and medical practitioners focused on clinic-based treatments only, and rarely discussed the work environment nor had consideration of risk factors that may contribute to the exacerbation of LET symptoms (Amar et al., 2014; Greenfield & Webster, 2002; MacDermid et al., 2010). MacDermid et al (2010) surveyed almost 700 American hand therapists and concluded that patient education, stretching, and activity modification were effective in the management of LET, and that most therapists agreed that

the duration of symptoms and the patient's type of work occupation were important factors for symptom resolution.

Health professionals involved in the treatment of injured workers with LET in Australia are guided by the clinical framework guidelines governed by the Australian federal government (The Government of Western Australia, 2012). The framework's underlying principles incorporate the International Classification of Functioning, Disability and Health (ICF) (World Health Organization, 2001), which considers health and disability at the individual and population levels, the environmental factors (e.g., social and physical work environments), and personal factors (e.g., physiological, psychological, and cognitive factors) that impact a person's functioning and participation in activities. The application of the biopsychosocial approach of the ICF supports a holistic approach in the management of injured workers with LET because it considers other factors in addition to changes to the function and structure of the body (Figure 3.1).

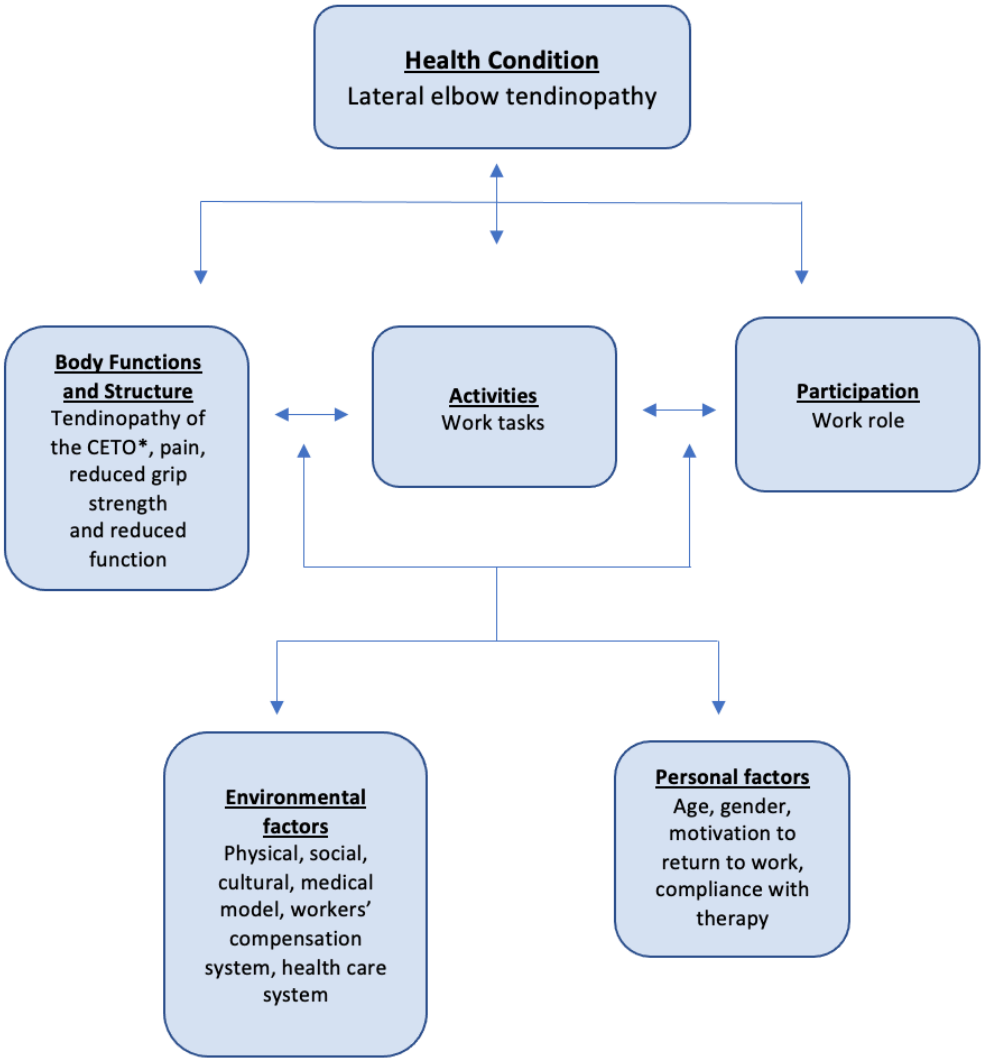

Figure 3.1 Application of the International Classification of Disability, Functioning and Health: Interaction of concepts for patients with LET.
*CETO= common extensor tendon origin

The findings of a qualitative analysis of the ICF and factors impacting on early return to work suggested that health professionals should consider the environmental factors when planning return to work interventions (Hoefsmit et al., 2014). To date, no cross-sectional studies have accounted for other contextual factors during the treatment of LET, such as the injured worker's physical and social environments at home and in the workplace. A recent systematic review of workplace interventions in return-to-work programs for musculoskeletal disorders, pain-related conditions, and mental illness found

moderate to strong evidence that lost-time from work was reduced when interventions comprised a multi-domain approach and included interventions such as graded activities, service coordination, and work modification components (Cullen et al., 2017). Workplace-based rehabilitation has many benefits in the return-to-work process for injured workers for other health conditions (Cullen et al., 2017; Oakman et al., 2018; Ree et al., 2016), but no studies have investigated the effectiveness of this intervention approach specifically for the management of LET.

Combining a hand therapist's specialized knowledge and skills in upper limb rehabilitation with an approach that considers the injured worker's social and physical environments provides a more holistic approach to the management of work-related LET. To date, there is no empirical evidence about the preferred practice trends of hand therapists and medical practitioners in the Australian context, and no studies have investigated medical practitioners and hand therapists' beliefs about a workplace-based rehabilitation approach for injured workers with LET that is delivered by hand therapists. This cross-sectional study aimed to (i) identify, compare, and contrast Australian hand therapists' and medical practitioners' perceptions about the effectiveness of common treatments for LET, and (ii) obtain their views towards a hand therapist delivered workplace-based education approach.

3.3 Methods

3.3.1 Study design

This was a cross-sectional study with a convenience sample using online surveys.

3.3.2 Participants

Australian hand therapists who were qualified occupational therapists or physiotherapists, registered as full or associate members of the Australian Hand Therapy Association (AHTA), and had clinical experience practicing hand therapy within the past five years, were invited to participate in this study. Full members of the AHTA have a minimum of three years' equivalent full-time experience in hand therapy post-graduation with a minimum of 3,600 hours of experience as a practising hand therapy clinician within the last five years and at least 300 hours of professional development or education within the last five years, or those with current certified hand therapist credentials. Associate members of

the AHTA are hand therapists with a letter of recommendation from a full member. Medical practitioners recruited to this study included general practitioners and sports physicians. They were required to have treated upper limb conditions in the past five years, to be eligible for inclusion in the study.

The hand therapists were recruited via an email containing the study information and the online survey link (https://www.dropbox.com/s/h8q2yigdx2j312p/hand%20therapist%20survey%20questions.pdf?dl=0). The email was sent by the first author to the Secretariat of the AHTA, who forwarded the email to all associate and full members in Australia (N=599). Of those, 336 (56%) opened and read the email information about the study, and 104 completed the survey (i.e., 30% response rate based on the 336 hand therapists who opened the email). The researchers were unable to recruit medical practitioners across Australia in a similar manner through the Australian Medical Association. Instead, the first author emailed the study information and survey link (https://www.dropbox.com/s/22zj8uy82fmg10k/Medical%20practitioner%20surveys.pdf?dl=0) to the Practice Managers of 231 medical clinics across metropolitan Perth, Western Australia and asked them to forward the email to the medical practitioners at their respective clinics. At the time of the survey, these medical practices referred patients to the private hand therapy practice (comprised of seven practice locations) where the first author worked. Due to this method of survey distribution, an accurate response rate for the medical practitioners could not be calculated.

3.3.3 Outcome measures and procedure

A pilot survey of 13 hand therapists at a multi-centred private hand therapy practice in Perth identified common treatments currently used to manage patients with LET. The collated list of treatments from this survey, in combination with a search of the available published scientific literature (Bisset & Vicenzino, 2015; Coombes et al., 2013; Sims et al., 2014), were used to develop the items in the online surveys administered to participants in this study. Two surveys were developed for this study: one for the hand therapists and the other for the medical practitioners. The hand therapists' survey consisted of 16 questions and the medical practitioners' survey comprised 20 questions.

Demographic questions were common to both surveys. Questions included the respondent's professional discipline; years of experience treating upper extremity disorders; and information about their LET patients including gender, estimated number of LET cases treated each month, number of work-related cases of LET treated under the Western Australian workers' compensation insurance scheme, and if their LET patients were treated in a private or public health service.

Questions about common treatments for LET were presented separately for the acute and chronic stages of the condition, respectively in both surveys. Acute LET was classified as the presence of symptoms for <3 months, and symptoms lasting for 3+ months were classified as chronic LET (Waugh, 2005). Participating hand therapists and medical practitioners were asked to rate their perceived level of effectiveness of common forms of LET treatments on a scale of 0-10; where 0 indicated 'not effective' and '10' indicated 'most effective'. Hand therapists were asked to rate their level of agreement (where 0 indicated 'strongly disagree' and 10 indicated 'strongly agree') with the statement: "I routinely educate LET patients on their condition, postures to avoid, and provide recommendations for activity modification specific to their work and leisure activities".

Hand therapists and medical practitioners were asked about their attitudes towards having hand therapists conduct workplace-based interventions for injured workers in the acute and chronic stages of LET. Hand therapists were asked to list any pros and cons of having a hand therapist complete a workplace-based intervention as part of the management of LET among injured workers. Additional questions in the medical practitioners' survey asked how frequently they referred LET patients to a vocational rehabilitation provider and the main reasons for referral.

The surveys were pilot tested for face and content validity by a panel of experts. The expert panel for the hand therapist survey included two occupational therapists specialising in hand therapy (one working in a private clinic and the other in a public clinic) and three occupational therapy academicians who were experienced in teaching and researching in this field. The medical practitioner survey was reviewed by a general medical practitioner and the same three occupational therapy academicians. Amendments were made to the content and wording of the final version of the surveys using the feedback from the expert panels. The online surveys were administered using Qualtrics software (www.qualtrics.com) and were available online for a period of six months for data collection.

3.3.4 Research ethics

The Human Research Ethics Committee at Curtin University provided approval for the study. On the first screen of the online survey, participants were provided with information about the study purpose; perceived benefits and risks; the estimated time required to complete the survey; the voluntary nature of their participation; and the contact details of the researchers if they had any questions. Immediately following presentation of the study information, participants were asked to respond to a question asking for their consent to participate.

3.3.5 Data analyses

All survey data were imported into the Statistical Package for the Social Sciences (SPSS, version 22). Descriptive statistics were used to analyse respondents' demographic information. Frequencies of responses were calculated to summarise categorical data and multiple-choice response options. Multiple responses were allowed for some questions and so totals of these frequencies may exceed 100 per cent. Between-group differences for questions common to both surveys were determined using independent *t*-tests. The non-parametric Mann-Whitney U test was also used on the data and produced similar results. A critical alpha of .05 was used to determine statistical significance. Free text responses reporting any pros and cons of having a hand therapist complete a workplace-based intervention were grouped using content analysis.

3.4 Results

3.4.1 Participant demographics

Online surveys were completed by 104 hand therapists from around Australia and 38 medical practitioners from Western Australia. A summary of the respondents' demographic information is shown in Table 3.1.

Table 3.1 Demographic characteristics of survey respondents (*N*=142)

	Hand therapists (n=104)	Medical practitioners (n=38)
Profession	Occupational therapists: 70% Physiotherapists: 30%	General practitioners: 90% Sports Physician: 10%
Experience	<4 years: 25% 4-9 years: 30% 10+ years: 45%	<10 LET patients: 5% 10 > 49 LET patients: 45% 50+ LET patients: 50%
LET caseload	<5 new cases/ month: 65% 5-9 new cases/ month: 32% 10-15 new cases/month: 3% 15+ new cases/month: 0%	<5 new cases/ month: 79% 5-9 new cases/ month: 16% 10-15 new cases/month: 5% 15+ new cases/month: 0%
Gender of LET patients treated	Males: 32% Females: 18% Equal numbers of males and females: 50%	Males: 58% Females: 10% Equal numbers of males and females: 32%
Payment source	Workers' compensation: 64% Private: 27% Other (e.g., public hospital): 9%	Workers' compensation: 20% Private: 76% Other (e.g., public hospital): 4%
Practice context	Private clinic: 84% Hospital: 15% Patient's workplace: 1 %	Private clinic: 100%

3.4.2 Treatments for LET

The 19 different LET treatments reported by respondents are shown in Table 3.2. There were significant differences between the two disciplines in their mean ratings of the effectiveness of common treatments in the acute and chronic stages of LET.

Table 3.2 Mean levels of perceived effectiveness of common treatments used in the acute and chronic phases of LET reported by hand therapists (HT) and medical practitioners (MP).

Treatments for LET	Acute Mean	Acute Mean		Chronic Mean	Chronic Mean	
	HT	MP	*p*	HT	MP	*p*
Wrist orthoses	6.9	4.3	<.001*	5.0	4.4	.375
Counterforce braces	5.6	4.5	.045*	5.5	4.6	.115
Corticosteroid injections	4.2	5.3	.049*	3.6	4.3	.210
Autologous blood injections	3.0	4.1	.030*	4.2	4.2	.997
Platelet rich plasma injections	3.2	4.0	.116	4.3	4.0	.668
Stretching	5.9	5.8	.922	6.1	5.6	.313
Concentric exercises	3.8	5.1	.031*	5.1	5.0	.781
Eccentric exercises	6.4	5.5	.112	7.3	5.6	.003*
Soft tissue therapy	7.0	4.3	<.001*	6.7	4.2	<.001*
Trigger point therapy	6.7	3.7	<.001*	6.3	3.8	<.001*
Heat pack	5.3	4.6	.211	6.1	3.7	<.001*
Cold pack	4.5	3.9	.246	2.8	2.7	.941
Taping	5.8	4.3	.004*	5.7	3.6	.000*
Education - LE pathology	8.7	6.8	<.001*	8.7	6.1	.000*
Education - positions to avoid	8.9	6.7	<.001*	8.6	6.8	.000*

Education – work recommendations	8.8	7.2	<.001*	8.7	6.8	.001*
Education - activity modification	9	7.5	<.001*	8.7	6.7	<.001*
Pain medication	4.1	4.9	.161	3.6	4.2	.208
InterX^{TM} neurostimulation	3.9	1.7	<.001*	3.7	2.0	.002*

Maximum level of perceived effectiveness =10; *denotes statistical significance p =.05. Not all participants rated every intervention method. Mean values are based on completed responses.

3.4.3 Acute stage

Respondents from both disciplines believed education on activity modification, work recommendations, positions to avoid, and pathology of LET were among the most effective interventions. Conversely, both disciplines rated the use of InterX^{TM} neurostimulation as one of the least effective treatment methods for management of LET. Hand therapists generally rated therapy techniques including soft tissue therapy, trigger point therapy, taping, and prescription of wrist and counterforce orthoses as more effective than the medical practitioners, with the exception of concentric strengthening exercises. More invasive treatment options, such as corticosteroid injections, platelet rich plasma injections, and autologous blood injections were rated higher by medical practitioners than the hand therapists, although still at the lower end of effectiveness.

3.4.4 Chronic stage

Hand therapists and medical practitioners believed that education on LET pathology, positions to avoid, activity medication, and work recommendations were the most effective treatment methods in the chronic stages if LET (Table 3.2). Both disciplines rated the use of InterX^{TM} neurostimulation as one of the least effective LET treatments. Hand therapists believed the following therapies were effective for chronic LET: eccentric exercises, soft tissue therapy, trigger point therapy, taping, and the application of heat packs; more so than the medical practitioners.

3.4.5 Education

Hand therapists strongly agreed (mean agreement rating of 9.5 out of 10) that they routinely educated patients with LET on pathology, postures to avoid, and provided recommendations for activity modification specific to work and leisure activities.

3.4.6 Workplace-based Intervention

A majority of hand therapist respondents (71%) reported that they felt it would be valuable for a hand therapist to complete a workplace-based intervention in the acute and chronic stages of LET; however, 74% of hand therapists surveyed reported that they had never conducted a workplace-based intervention. Hand therapists believed there were benefits to providing injured workers with LET specialized, personalized, and contextualized education and recommendations that were specific to their occupations and focused on preventing postures that may aggravate their symptoms. Hand therapists also believed that there is potential for better communication between the key stakeholders in the RTW process (worker/patient, employer, vocational rehabilitation professionals, and insurers) regarding modifications to job tasks/roles and agreement on the return-to-work plan. Hand therapists have specialized knowledge of LET pathology, and because they already treat the injured worker in the clinic, any recommendations they provide at the workplace can be specific to the injured worker's physical work environment job demands to provide a more holistic approach to their hand therapy interventions.

Hand therapists in this study identified the potential barriers to having a hand therapist conduct a worksite visit, including the extra time and costs associated with travel to the worksite; less time available to see other patients in the clinic; and the time required for documenting the findings and recommendations of the worksite visit. Some hand therapists reported they had limited confidence and experience in providing worksite recommendations, and some believed that providing worksite recommendations should be the sole responsibility of vocational rehabilitation providers.

Sixty-one per cent of medical practitioners reported that they had previously referred their LET patients to a vocational rehabilitation provider. Main reasons for referral were to identify suitable work duties; the injured worker's rehabilitation required application of specialist knowledge; or the injured worker was not progressing as well as anticipated. Eighty-one per cent of medical practitioners believed that having a hand

therapist conduct a workplace-based intervention would be valuable in the acute and chronic stages of LET. The majority (71%) of medical practitioners reported that they had never previously requested a hand therapist to conduct a workplace-based intervention.

3.5 Discussion

3.5.1 Study participants

The medical practitioners and hand therapists in this study had varying levels of experience treating patients with LET; therefore, the responses reflect a range of expertise. A majority of respondents in both disciplines had worked in a private clinic and treated more compensable work-related cases of LET than non-work related LET cases. The respondents reported that they treated almost equal numbers of males and females with an LET diagnosis; findings that are similar to those of a Finnish population-based study regarding prevalence of LET between genders (Shiri et al., 2006).

The physical practice in which hand therapists and medical practitioners typically work supports a medical model of care that assumes clinical outcomes of pain reduction, and improved grip strength and range of motion will result in improved overall functional performance in important activities of daily living with limited consideration of the impact of environmental factors.

The hand therapists in the study were either occupational therapists or physiotherapists. An opportunity exists for these allied health professionals to extend beyond their usual clinic-based practice and adopt a more holistic approach to manage work related LET. This concept is supported by a previous study that investigated empowerment of occupational therapists to become evidence-based work rehabilitation practitioners (Vachon et al., 2010). The authors of that study believed that occupational therapists have become key professionals in the management of work durability because of their interaction between workers' capacities and the environmental demands influencing work disability (Vachon et al., 2010). Having a hand therapist playing an active role at the injured worker's workplace supports a more holistic treatment approach that is consistent with the ICF framework (World Health Organization, 2001).

3.5.2 Clinical Treatments

Commonly used treatments identified in this study are those described in the literature including corticosteroid injections (Coombes et al., 2010), blood injections (Krogh et al., 2013; Rabago et al., 2009), InterX^{TM} neurostimulation (Coff et al., 2009), orthoses (Borkholder et al., 2004; Garg et al., 2010), and exercise programs (Smidt et al., 2002; Smidt et al., 2003). Reviews of the effectiveness of common clinical treatments of LET have yielded inconclusive evidence to support their long-term efficacy with some authors stating that LET can resolve over a 12–18-month period without treatment using a 'wait and see' approach (Bisset et al., 2006; Sims et al., 2014).

In this study, medical practitioners generally rated the more invasive treatments, such as corticosteroid injections (CSI), as more effective than did the hand therapists to manage acute stage LET. The prescription of CSI to treat LET is still very common in medical practice, despite strong research evidence that the use of CSI provides effectiveness only in the short term, has poorer outcomes compared to a wait and see approach, and results in high recurrence rates (Coombes et al., 2010, 2013; Smidt et al., 2002). Despite these findings, a recent survey of 291 orthopaedic surgeons from around the world identified the most popular modalities of LET treatment were non-steroidal anti-inflammatory medications (43%) and corticosteroid injections (30%) (Amar et al., 2014). Medical practitioners may continue to prescribe CSI to treat acute and chronic LET because they may believe the condition is inflammatory in nature and may not have current knowledge of histopathological studies that have consistently demonstrated that the affected tendon was characterized by a dense population of fibroblasts, disorganized and immature collagen, and an absence of inflammatory cells; all of which are consistent with a degenerative process (Waugh, 2005).

Hand therapists in our survey rated the prescription of eccentric exercises and application of heat to treat chronic LET significantly higher than the medical practitioners. These findings are consistent with the extensive research evidence that supports the use of exercise in the chronic stages of LET; and specifically, that eccentric exercise is the most effective in improving symptoms when compared to concentric exercises and stretching. A systematic review of 12 studies concluded that the inclusion of eccentric exercise as part of a multimodal therapy program improved outcomes for LET patients (Cullinane et al., 2014). Furthermore, our survey findings are similar to those from the survey of American hand

therapists who rated a home exercise program as the most effective treatment for chronic LET and the second most effective for acute LET (MacDermid et al., 2010).

A recent review identified four main grades of LET pathology, with grade 1 being the mildest form of tendinopathy and grade four being the worst requiring surgical repair. All the treatments suggested by the authors for all stages of pathology were clinic-focused such as physical therapy, blood injections and surgery (Bhabra et al., 2016). Given that occupational risk factors have been identified as contributing to LET pathology (Shiri & Viikari-Juntura, 2011), we believe that treatments to manage LET across all stages of pathology should address the activity and environmental factors of the ICF.

3.5.3 Education

Our survey results indicated that medical practitioners and hand therapists rated educational approaches as the *most* effective treatment method for injured workers with acute and chronic stage LET.

Hand therapists routinely educated injured workers about LET pathology and postures to avoid and provided recommendations for activity modification specific to their work and leisure activities. Findings reported from a large survey of American hand therapists were that most treatments for LET included education as an element of standard therapy, but the content and context of education provided was not clear (MacDermid et al., 2010).

The respondents in our study indicated that education revolved around the principles of activity modification, postures to avoid, work recommendations, and education about LET pathology. The importance of educating patients about LET was also discussed in the findings of another study involving 120 physiotherapists in Scotland (Greenfield & Webster, 2002). Almost two-thirds of those therapists reported that their patients with LET had a poor understanding of their health condition, and the authors postulated that these patients may have poorer outcomes if they are not provided with education about their condition (Greenfield & Webster, 2002). MacDermid and colleagues proposed that future research needs to identify and incorporate the educational "active ingredients" to develop a well-defined educational intervention (MacDermid et al., 2010). Hand therapists frequently practice using a prescriptive approach; however, it is important to empower injured workers with LET through education to enable them to take an active role to self-manage their symptoms. The findings of our study of Australian hand therapists and medical practitioners

suggest that interventions for injured workers with LET should include educational components for self-management that also consider the physical, cognitive and social environmental factors of the ICF.

3.5.4 Workplace-based intervention by hand therapists

The majority of hand therapists (71%) and medical practitioners (81%) in our study agreed that having a hand therapist complete a workplace-based education intervention would be valuable in the acute and chronic stages of LET. The workplace-based education may include LET pathology, postures to avoid, and recommendations for activity modification specific to work and leisure activities; educational content that were reported by hand therapists and medical practitioners in our study as the most effective treatments for injured workers with LET. Education to reduce occupational risk factors including forceful activities, high force combined with high repetition, awkward postures, and hand-arm vibration are associated with symptoms of LET (Shiri & Viikari-Juntura, 2011), and workload modification should be considered, especially for workers in manual and strenuous occupations (Shiri et al., 2006).

Traditionally, vocational rehabilitation providers in Australia perform worksite assessments and develop return to work programs; whereas hand therapists provide clinic-based treatment and are seldom involved at the workplace. However, given the hand therapists in our study most often treat work-related LET cases, there exists potential for them to adopt a holistic treatment approach consistent with the ICF, and use their specialized knowledge of the hand and upper limb to support injured workers at the workplace. Combining the skill sets of medical practitioners, vocational rehabilitation providers, and hand therapists uses a biopsychosocial approach in the management and return to work of injured workers with LET.

3.5.5 Benefits of workplace-based rehabilitation

Inclusion of our survey question about hand therapists providing specialized workplace-based education for injured workers with LET was based on existing empirical evidence to support workplace-based interventions for other health conditions. For example, comprehensive reviews of the benefits of workplace-based interventions for back pain identified that the environmental factors and social support networks in workplaces

may make disease prevention programs in these settings more efficacious than similar programs offered in clinical settings (Franche et al., 2005; Tveito et al., 2004). A recent systematic review about the effectiveness of workplace interventions in return-to-work programs for musculoskeletal and pain-related conditions, and mental illness found moderate to strong evidence that lost time from work was reduced when interventions comprised a multi-domain approach and included health-focused interventions such as graded activities, service coordination, and work modification components (Cullen et al., 2017). Although that study was not specific to injured workers with LET, the findings support workplace-based return to work interventions.

Good communication between stakeholders is important for early return to work outcomes following a work-related injury (Hoefsmit et al., 2014). Hand therapists in the current study reported that having hand therapists deliver workplace-based education interventions facilitated open communication among key stakeholders in the workers' compensation process.

The novel concept of hand therapists delivering a workplace-based educational intervention for injured workers with LET has potential benefits, but also challenges. Hand therapists in our study were concerned about the extra time and costs involved with implementation of a workplace-based approach. These challenges are similar to those reported by others, including limited time, space, and issues with reimbursement for services in occupation-focused interventions (Colaianni & Provident, 2010). However, if the use of hand therapists to deliver workplace specific education is found to be cost-effective, there is potential for reimbursement of associated time and costs within the Australian Workers' Compensation Legislation (WorkCover WA, 2015). Further research using randomized controlled trials is warranted to determine the efficacy and cost-effectiveness of a hand therapist deliver education interventions in the workplace to manage LET.

3.5.6 Study limitations

The limitations of this study include small sample size and low and undefined response rates across the two samples. Not all treatments included in the survey were selected by respondents; therefore, the survey items may not include all the different types of treatments used to manage LET. The medical practitioners surveyed were recruited from Western Australia only and so their responses may not be representative of medical

practitioners from all Australian States and Territories. Furthermore, the medical practitioner group did not include participants from all medical specialist fields involved in the diagnosis and management of LET, and vocational rehabilitation consultants were not included in this survey. This sampling issue may have limited the survey data obtained. These methodological issues should be considered when interpreting the findings of this study.

3.6 Conclusion

Our study found that (i) the majority of hand therapists and medical practitioners believed education to be the most effective treatment for injured workers with acute and chronic LET; and hand therapists and medical practitioners believed that having a hand therapist conduct a workplace-based educational approach would be beneficial in the acute and chronic stages of LET. Based on these findings, we propose future research to determine the effectiveness of workplace-based education interventions delivered by hand therapists as part of a holistic approach to the management of work-related LET.

3.7 Acknowledgements

We would like to thank Richard Parsons for assistance with data analysis; the hand therapists involved in piloting the survey, Courtenay Harris, and Mathilda Bjork for providing feedback in the development of the surveys. Thanks to the Australian Hand Therapy Association for distributing the survey to their members and the Western Australian Occupational Therapy Association for advertising the study in their newsletter.

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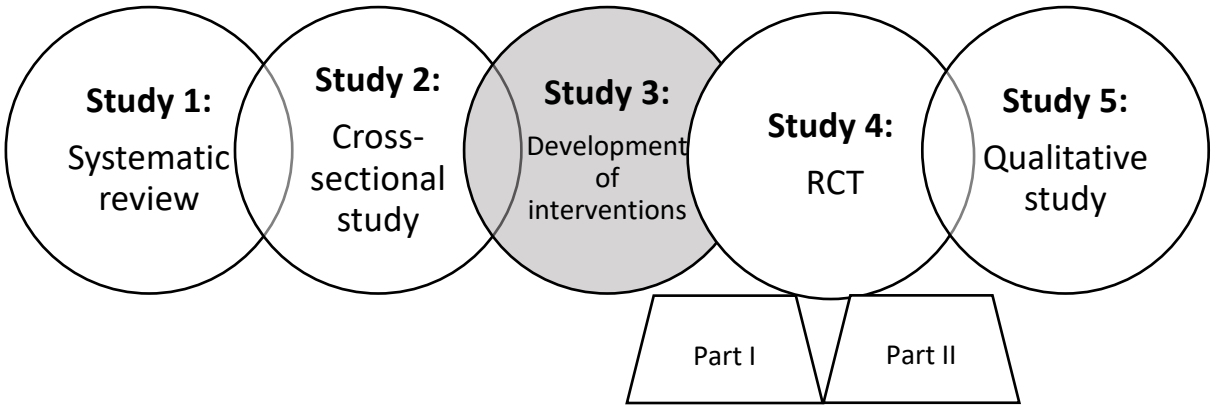
Chapter 4

Study 3: Development and evaluation of interventions



Study 1 (reported in Chapter 2) found limited evidence regarding the management of work-related LET by hand therapists delivered within the context of the workplace. Study 2 (reported in Chapter 3) identified that most Australian hand therapists and medical practitioners supported having hand therapists deliver a workplace-based intervention to manage LET. Study 2 identified that patient education about LET which included pathology, positions to avoid, activity modification, and work recommendations, was perceived by hand therapists and medical practitioners as the most effective treatment strategy for the management of LET. The findings from Studies 1 and 2 informed the development, trial, and evaluation of a novel workplace-based hand therapy education intervention for the management of LET. Chapter 4 describes and discusses the content development, therapist training, and implementation phases of the standard hand therapy program (comparison intervention), the novel intervention (*Working Hands-ED*), and the RCT study protocol.

The term 'lateral epicondylalgia' was in common clinical use at the time of developing the comparison and *Working Hands-ED* interventions, hence this nomenclature

was used instead of ‘lateral elbow tendinopathy’ in some of the education materials created for the RCT study protocol.

4.1 Introduction

Lateral elbow tendinopathy (LET) is one of the most prevalent upper extremity disorders, with an estimated prevalence of 1-3% in the general population, and even more common among the working population (Shiri et al., 2006). The condition is commonly characterised by pain and tenderness over the lateral elbow, affecting grip strength and hand function (Fedorczyk, 2006). The average duration of a typical episode of LET is between six months and two years and is equally common in men and women aged 35-55 years (Lenoir et al., 2019). In addition to age, reported risk factors for developing LET include repetitive and forceful motions of the wrist and arm for more than two hours/day, handling tools >1kg, handling loads >20kg for more than 10 times a day, activities demanding high hand grip forces, and the use of vibrating tools (Shiri & Viikari-Juntura, 2011; Walker-Bone et al., 2012). Workers who engage in occupations that require these repetitive motions such as painters, plumbers, carpenters, auto workers, cooks and butchers are particularly prone to developing LET (Haahr & Andersen, 2003; Shiri & Viikari-Juntura, 2011; Walker-Bone et al., 2012).

Hand therapists aim to assist injured workers to re-engage with their self-care, leisure, and productive work roles. Current practice trends of hand therapists reported in the literature indicate that treatments used to manage LET are targeted at the level of body structure and function only; however, to the best of our knowledge, only one study has investigated interventions implemented at the patient's actual workplace (Heales et al., 2020; Herd & Meserve, 2008; Lenoir et al., 2019; McCormack, 2010).

This chapter describes the development and evaluation of a novel hand therapy workplace-based intervention called *Working Hands-ED*. The *Working Hands-ED* intervention was designed for hand therapists to provide individualised education and work recommendations regarding occupational risk factors at the injured worker's workplace. *Working Hands-ED* uses a biopsychosocial approach that considers the impact of environmental factors on injured workers with LET to optimise their participation in work activities as part of their RTW.

The workplace-based hand therapy intervention was designed to complement other RTW initiatives undertaken by the key stakeholders in the RTW process. It was not intended to duplicate vocational rehabilitation services, but rather to provide targeted education and advice on safe work practices in the workplace to reduce the presence of symptoms related

to LET. Instead, a novel approach to the clinical management of LET was developed that uses hand therapists' specialised knowledge in the anatomy and pathology of LET, and the postures and movements that present as risk factors. It is hypothesised that the addition of a workplace-based hand therapy educational intervention will have better clinical and work outcomes than standard hand therapy care in the management of workers with LET. The efficacy of adding *Working Hands-ED* to standard hand therapy was investigated in a RCT (Study 4) that is presented in Chapters 5 and 6 of this thesis. The study protocol (Study 3) for the RCT is presented here in this chapter.

4.1.1 Study aims

Study 3 aimed to develop the following components for use in an RCT to answer the overall research question "What is the impact of adding in a workplace-based hand therapy intervention on the management of LET?" (Study 4):

1. Develop the *Working Hands-ED* workplace-based hand therapy intervention
2. Develop a standard clinic-based hand therapy program for use as a comparison intervention
3. Develop the study protocol for an RCT to determine the effectiveness of *Working Hands-ED* in improving clinical and RTW outcomes for injured workers with LET compared to a standard clinic-based intervention.

4.2 Randomised Controlled Trial protocol

4.2.1 Study design

The study was a randomised controlled trial (RCT). Hand therapists employed at a multi-centred hand and upper limb clinic in Perth, Western Australia delivered the interventions and collected the clinical and work outcomes data from participants. This study was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12616000339459). The Curtin University Human Research Ethics Committee in Perth, Western Australia approved the study. Participants were required to sign a consent form after being informed about the study aims, procedures, and potential risks and benefits to participate in the study.

4.2.2 Participants, recruitment, and randomisation process

Participants for the RCT were recruited through referrals from their treating medical practitioners to a multi-centred hand therapy practice in Perth, Western Australia. Participants were screened for eligibility for the study by the clinic's administrative staff (who were not part of the data collection process) when scheduling their initial hand therapy appointment. A procedural flowchart to guide the administrative team throughout the data collection phase was provided by the primary researcher (see Figure 4.1).

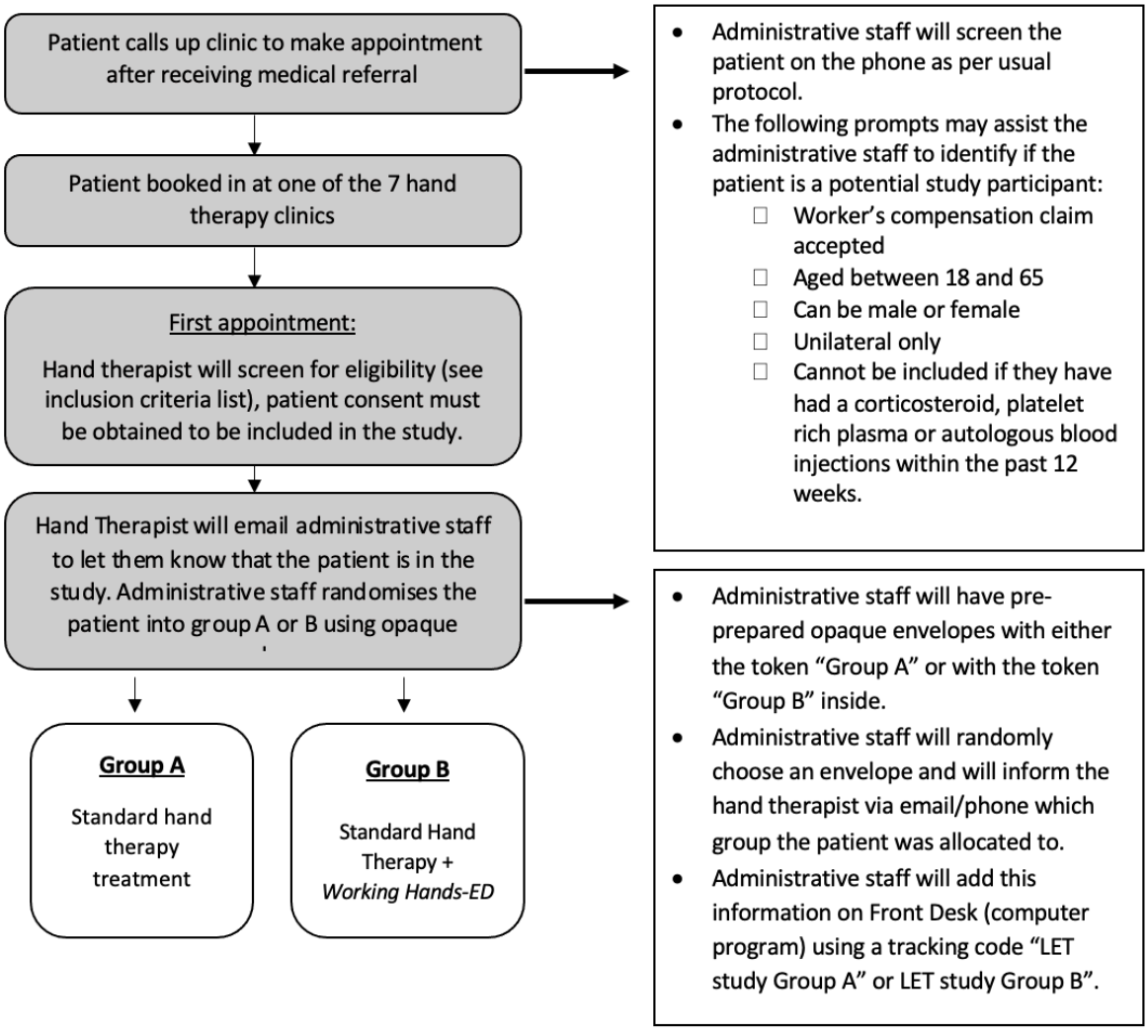


Figure 4.1 The study process used by administrative staff involved with randomisation of participants to treatment groups.

Hand therapists employed at the hand therapy practice assessed for potential participants during their initial hand therapy appointment to confirm eligibility for the study. To be eligible for inclusion in the study, the participant was aged 18-65 years, had a LET diagnosis confirmed via imaging reported pain on at least two out of five provocative assessments (these assessments are discussed in detail in section 4.4) and had an approved workers' compensation claim or a pending claim that was likely to be approved by the insurer. The inclusion and exclusion criteria are listed in Table 4.1. Participants who were interested in participating in the study were informed about the study aims, procedures, and potential risks and benefits and were provided with a consent form to sign. After obtaining informed consent, the hand therapist contacted the administrative staff member via email or telephone and asked them to randomly allocate the participant into either the control or intervention group using sealed opaque envelopes. The allocation ratio was 1:1.

Table 4.1 Patient inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Individuals aged 18 to 65 years. 2. Individuals with a LET diagnosis confirmed via ultrasound or magnetic resonance imaging. 3. Individuals with an acute (<12 weeks) or chronic (>12 weeks) episode of LET. 4. . 5. Individuals must report pain on 2 out of the following 5 provocative tests: - LET palpation - Common extensor tendon origin palpation - Resisted wrist extension - Resisted middle finger test - Resisted supination	1. Individuals who are required to undergo imminent surgery or have had surgery to the elbow. 2. Individuals whose radiological examinations show abnormalities such as inflammatory arthropathy, arthritis, ligament tears, or calcification of the elbow joint. 3. Individuals who received blood injections in the last 6 months 4. Individuals who received corticosteroid injections or other physical therapies in the last 3 months 5. Individuals who work in a rural setting or other work setting where a worksite

6. Individuals with an approved workers' compensation claim or a pending claim that is likely to be approved. 7. Individuals with a First Medical Certificate from their medical practitioner.	visit by a hand therapist may not be permissible or feasible.

4.3 Interventions

The findings from Studies 1 and 2 and the researcher's clinical experience as an occupational therapist working in hand therapy in conjunction with the International Classification of Functioning, Disability and Health (ICF) framework (World Health Organization, 2001), the Person-Environment- Occupation-Performance (PEOP) model (Baum et al., 2015), and the Australian Clinical Framework (ACF) for the Delivery of Health Services (The Government of Western Australia, 2012) guided the development of the standard care hand therapy program and the workplace-based intervention.

The ICF is a universal framework and provides a common language for all those involved in the management of injured workers with LET. Since occupational therapists and physiotherapists work as hand therapists, the ICF is particularly useful as it is applicable to all health and allied health disciplines. Hand therapy literature primarily focuses on the 'body functions and structure' components of the ICF (Winthrop Rose et al., 2011), therefore we aimed to incorporate the other components such as 'activity', 'participation', and the environmental factors into our novel intervention.

To our knowledge, there are no treatments for the management of LET developed based on an occupational therapy model. The PEOP model is a top-down, client-centred, and holistic model that focuses on how the environment affects a person's occupational performance (Baum et al., 2015). The PEOP model emphasises that a dynamic interaction occurs between the person (i.e., intrinsic factors) and the environment (i.e., extrinsic factors) to present barriers and/or enabling factors that influence performance in chosen occupations (Baum et al., 2015).

A hand therapist can apply the PEOP model to identify the enablers and barriers within the person (intrinsic) and environmental (extrinsic) factors to optimise the injured

worker's occupational participation in their work duties and roles following a diagnosis of LET. The PEOP model was chosen for this research because to date, interventions to manage LET have primarily focused on addressing the physiological barriers of pain, reduced grip strength, and function and have rarely focused on the extrinsic factors that may be hindering their occupational performance (i.e., occupational risk factors in the physical work environment).

The ACF guidelines incorporates the ICF framework and outline five principles to assist allied health professionals who are working with injured workers in the Australian workers' compensation system to promote evidence-based practice (Government of Western Australia, 2012). These five principles are (i) measure and demonstrate the effectiveness of the treatment; (ii) adopt a biopsychosocial approach; (iii) empower the injured person to manage their injury; (iv) implement goals focused on optimising function, participation, and RTW; and (iv) base treatment on best available research evidence (Government of Western Australia, 2012).

Participants allocated to Group A (control group) received the standard hand therapy program delivered at the hand therapy clinic. Participants assigned to the Group B (intervention group) received the same standard hand therapy care **plus** the *Working Hands-ED* workplace-based education intervention within the first four weeks after their initial hand therapy appointment.

Figure 4.2 provides an overview of the three phases undertaken for the development, training, and implementation of the standard clinic-based hand therapy (control) and *Working Hands-ED* workplace-based interventions used in the RCT.

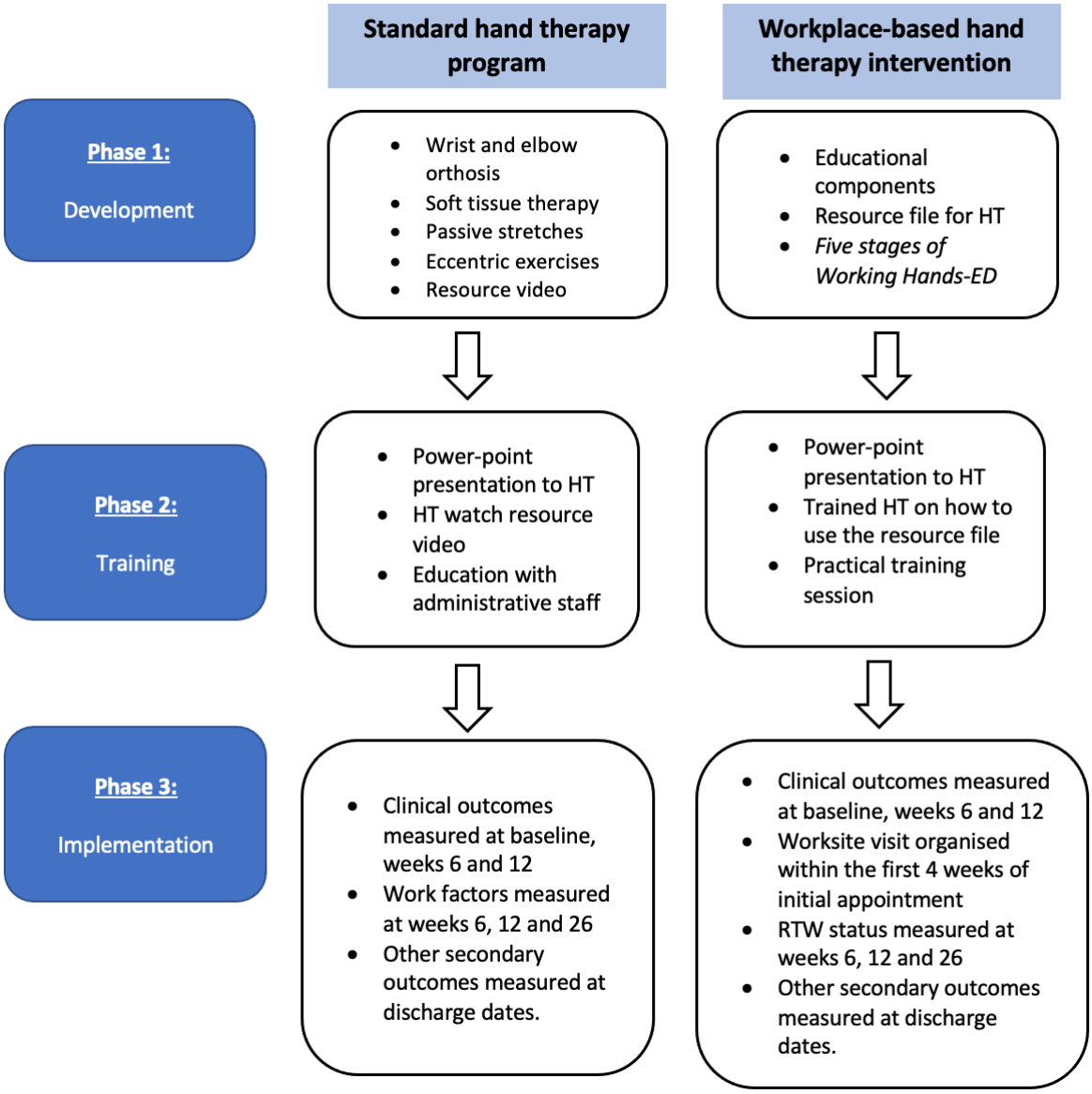


Figure 4.2 Overview of the development, training, and implementation phases for the interventions used in the RCT; HT = Hand therapists.

4.3.1 Standard hand therapy program

The development, training, and implementation of the intervention protocols that formed the standard hand therapy program are described below.

4.3.1.1 Phase 1: Development of standard hand therapy program

For the first 12 weeks, hand therapists were instructed to only use the treatments listed below to treat LET patients who were enrolled as participants in the RCT. After 12 weeks,

there was no control over the type of treatments included, therefore hand therapists may use any treatments based on their clinical reasoning. The treatments included for the first 12 weeks are:

- Prescription of orthoses (thermoplastic wrist orthosis, semi-rigid wrist braces and/or counterforce brace),
- Application of a heat pack,
- Soft tissue massage to the dorsal extensor muscles,
- Static wrist passive flexion and extension stretches, and
- Eccentric strengthening exercise program (pain-free) using weighted dumbbells.

As per the usual practice at the hand therapy clinic, hand therapists made a clinical judgement as to what specific standard care treatments they used and when to progress each participant in their hand therapy program, based on assessment of symptoms present at each clinic appointment. For example, not all RCT participants commenced eccentric exercises simultaneously, and some participants wore a wrist orthosis for longer, depending on their presenting symptoms and work task demands. Generally, participants were provided with a wrist orthosis for the first two weeks of hand therapy, a soft tissue therapy program commenced by week 2, and an eccentric strengthening program by week 4.

All participants were educated by their hand therapist about the anatomy, pathology, and risk factors for LET (see Appendix E) and given a list of general work recommendations and activity modification principles (see Appendix F). All participants received hard copy handouts with illustrations and clear instructions for their self-management program. The self-management program consisted of (i) a heat pack placed over the dorsal extensor bulk; (ii) followed by soft tissue massage to the dorsal extensor muscles (once daily); (iii) passive wrist flexion stretches with the elbow in flexion and then extension (see Appendix G); and (iv) an eccentric strengthening program (see Appendix H).

The primary researcher developed data collection forms for use in the RCT to ensure consistency in methods and reporting among the hand therapists (see Appendix I). For ease of accessibility, each clinic received a large lever arch file with all the handouts relevant to the study (i.e., data collection forms, participant information sheets and consent forms, exercise handouts, and education handouts). Copies of these handouts were also saved electronically via the intranet used by the multi-centred practice.

The multi-centred hand therapy practice used a software program called Front Desk for all their patient bookings and storage of patient information. The primary researcher developed tracking codes for "LET Study Group A" and "LET Study Group B" that were used by administrative staff and hand therapists after the random allocation of participants into the two groups (i.e., Group A= Standard hand therapy care; Group B= Standard hand therapy + Workplace-based education intervention). These tracking codes enabled the primary researcher to locate each participant's clinical information relevant to the study during the data analysis phase.

4.3.1.1.1 Rationale for the clinical treatments included

A multimodal approach is more effective than stand-alone physical treatments for management of LET (Bisset & Vicenzino, 2015; Coombes et al., 2015; Hong, 2003; Smidt et al., 2003). This multimodal approach was used in the standard hand therapy delivered in the RCT and included provision of wrist and elbow orthoses, heat packs, soft tissue therapy, passive stretches, and eccentric exercises based on participants' clinical needs.

Soft tissue therapy and stretching were used as part of a multimodal approach (i.e., not stand-alone treatments), which is reportedly common practice among hand therapists in the management of LET (MacDermid et al., 2010). Cross-sectional surveys across the USA and Australia confirmed that the use of soft tissue therapy and passive stretching were common practice in the management of LET despite limited research evidence available to support its effectiveness (MacDermid et al., 2010; Tran et al., 2020). To the best of our knowledge, there is insufficient evidence that soft tissue massage alone provides no additional benefit over other therapeutic interventions (Loew et. al. 2014). Future clinical trials should investigate the effectiveness of soft tissue therapy and passive stretching of the extensor muscles for the management of LET.

Two types of orthoses commonly used by hand therapists in clinical practice to manage LET are the wrist extension orthosis and the elbow counterforce orthosis (MacDermid et al., 2010; Tran et al., 2020). The goal of a wrist orthosis is to provide a period of rest for the forearm extensors, and the purpose of an elbow counterforce brace is to reduce the level of tension exerted over the common extensor origin (Garg et al., 2010; Heales et al., 2020) The most recent systematic review on the effect of elbow and wrist orthoses on pain and function in individuals with LET found there is low-quality evidence

available that elbow orthoses can immediately reduce pain during contraction and improve pain-free grip strength (Heales et al., 2020). That review concluded that the use of a static wrist orthosis did not improve pain-free grip strength or maximal grip strength in patients with LET (Heales et al., 2020). Anecdotally, hand therapists report that these orthoses help to settle patients' pain symptoms in the short-term when performing activities at home and work; thereby improving function. Hand therapists rarely immobilise the forearm wrist extensors for long periods of time because research evidence suggests that complete unloading of degenerative tendons can deteriorate the condition further; and so a strengthening program may be beneficial in treating tendinopathies (Boone et al., 2011). Therefore, in our RCT, hand therapists were instructed to immobilise their patient's wrist in a wrist orthosis for no longer than two weeks.

Eccentric strengthening is a treatment technique commonly used with other tendinopathies including the Achilles and patella tendinopathies, to load tendons mechanically and effectively reduce pain and improve function (Lim & Wong, 2018; O'Neill et al., 2015). Recent systematic reviews reported that eccentric strengthening was superior for treating LET over other forms of strengthening and pain-relieving modalities (Chen & Baker, 2020; Cullinane et al., 2014), although further studies are required to determine the optimal dosages of these strengthening exercises. The inclusion of this type of strengthening as part of a multimodal therapy program showed improved outcomes of pain, function, and grip strength when compared to other combined treatment programs (Cullinane et al., 2014). For our study, the dosages of repetitions and frequency of exercises were determined by the hand therapist based on their patient's individual clinical presentation.

There are various methods of performing eccentric exercises to manage LET, including with free weights (Lim & Wong, 2018), therapy resistance bands (Martinez-Silvestrini et al., 2005), and resistance bars (Tyler et al., 2010). Weighted dumbbells were used with workers with LET in the RCT because they were relatively inexpensive and easy to increase the weight incrementally. The cost of these dumbbells was covered by the insurers under the medical expenses of the WA Workers' Compensation system. The weight of the dumbbell prescribed, and the dosage of the exercises were also left blank on the strengthening program handout (Appendix H) for the hand therapists to determine, based

on their assessment of each patient's symptoms. Generally, the therapists prescribed 10-15 repetitions of the eccentric exercise, performed three times per day.

4.3.1.1.2 Development of a clinical resource video

To ensure consistency in the delivery of the standard hand therapy intervention, all hand therapists involved in the treatment of participants enrolled in the RCT reviewed a 10-minute training video. The video included demonstrations of the standardised approach to assess clinical outcomes of pain, grip strength, and function, and perform the clinic-based standard hand therapy (usual care). The primary researcher developed the content for this video. Figure 4.3 shows a still frame taken from the video. The entire 10-minute video can be viewed at:
https://www.dropbox.com/s/klr6cgfz6ij0dw9/LE%20Training%20Vid.mov?dl=0

Figure 4.3 Still frame from the hand therapists' training video

4.3.1.2 Phase 2: Training of standard hand therapy protocol

The primary researcher presented information about the RCT, including study aims, methods, procedures, and protocols, to the hand therapists employed by the multi-centred

practice as part of an in-house professional development session on 16 April 2016. The training video was shown, and hand therapists were provided with the opportunity to ask questions or raise concerns with the primary researcher about the study and the expectations of their involvement in delivering interventions and collecting clinical outcomes data for the RCT.

The primary researcher also met with the practice manager and administrative staff on 16 April 2016 to provide clear written and verbal instructions about the RCT procedures and explain their roles in the random allocation of participants to the two groups in the RCT. The pre-prepared opaque envelopes used for random allocation of participants to the intervention or control groups were kept in a box in locked storage at the practice headquarters where the practice manager and administrative staff could access them.

Newly hired hand therapists and administrative staff that joined the organisation over the course of the three years of the study participated in individual meetings with the primary researcher and received the same training delivered to the original cohort of hand therapists.

4.3.1.3 Phase 3: Implementation of standard hand therapy protocol

Data collection commenced after the delivery of the training (see 4.3.1.2). The primary researcher was not involved in any data collection but was available to answer any questions from the hand therapists and administrative staff throughout the data collection period from 16 April 2016 to 31 March 2019. The primary researcher conducted random monthly audits of the collected clinical outcomes data from the hand therapists' clinical notes to ensure that the therapists documented and provided the interventions correctly. This audit process was also to ensure that the relevant timeframes for measuring outcomes were adhered to, completed, and documented by the hand therapists.

4.3.2 Workplace-based hand therapy intervention

Using the ICF framework, PEOP model, and the ACF clinical guidelines, *Working Hands-ED* considered both the personal and environmental context affecting occupational performance among workers with LET, instead of only focusing on symptom management. This approach differed from traditional conservative and surgical treatments of LET because it is person-centred, holistic, and occupation-focused. *Working Hands- ED* aimed to enable hand therapists to focus on their patients' functional performance and participation in their

work roles whilst considering the physical, organisational, and social demands of the workplace throughout the therapy process. *Working Hands- ED* is comprised of five stages (see Figure 4.4):

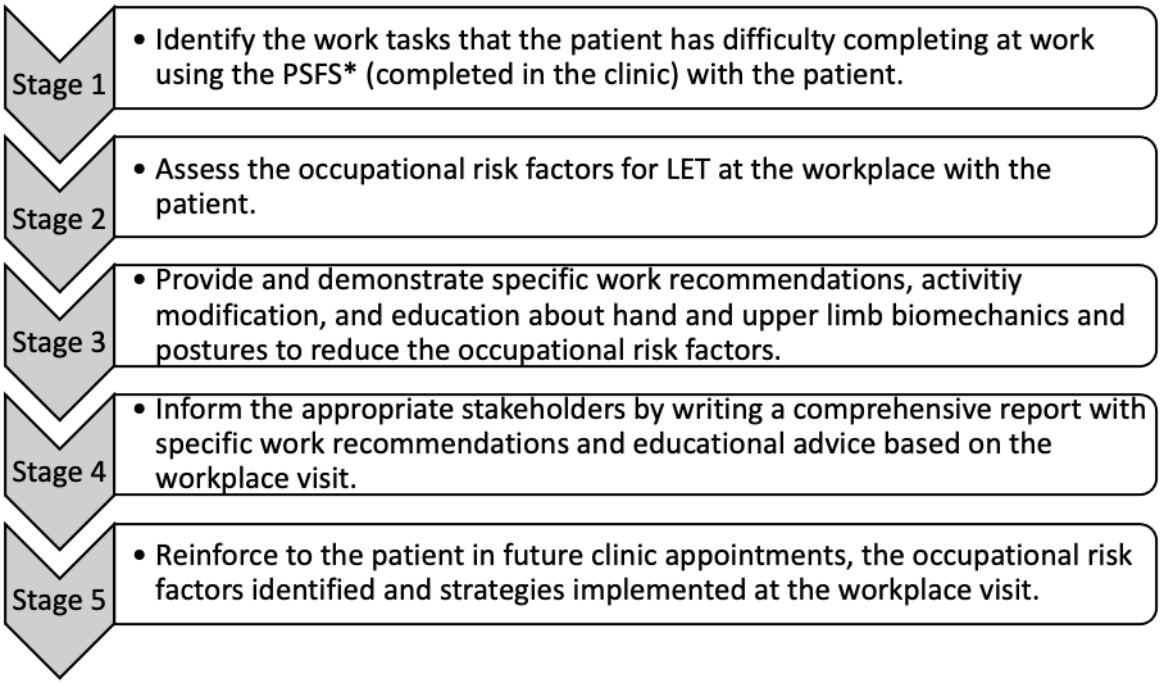


Figure 4.4. Stages of *Working Hands-ED* for hand therapists; *PSFS: Patient-Specific Functional Scale

Figure 4.5 provides a comprehensive breakdown of all stages of the workplace-based *Working Hands-ED* intervention trialled and evaluated in the RCT for this PhD.

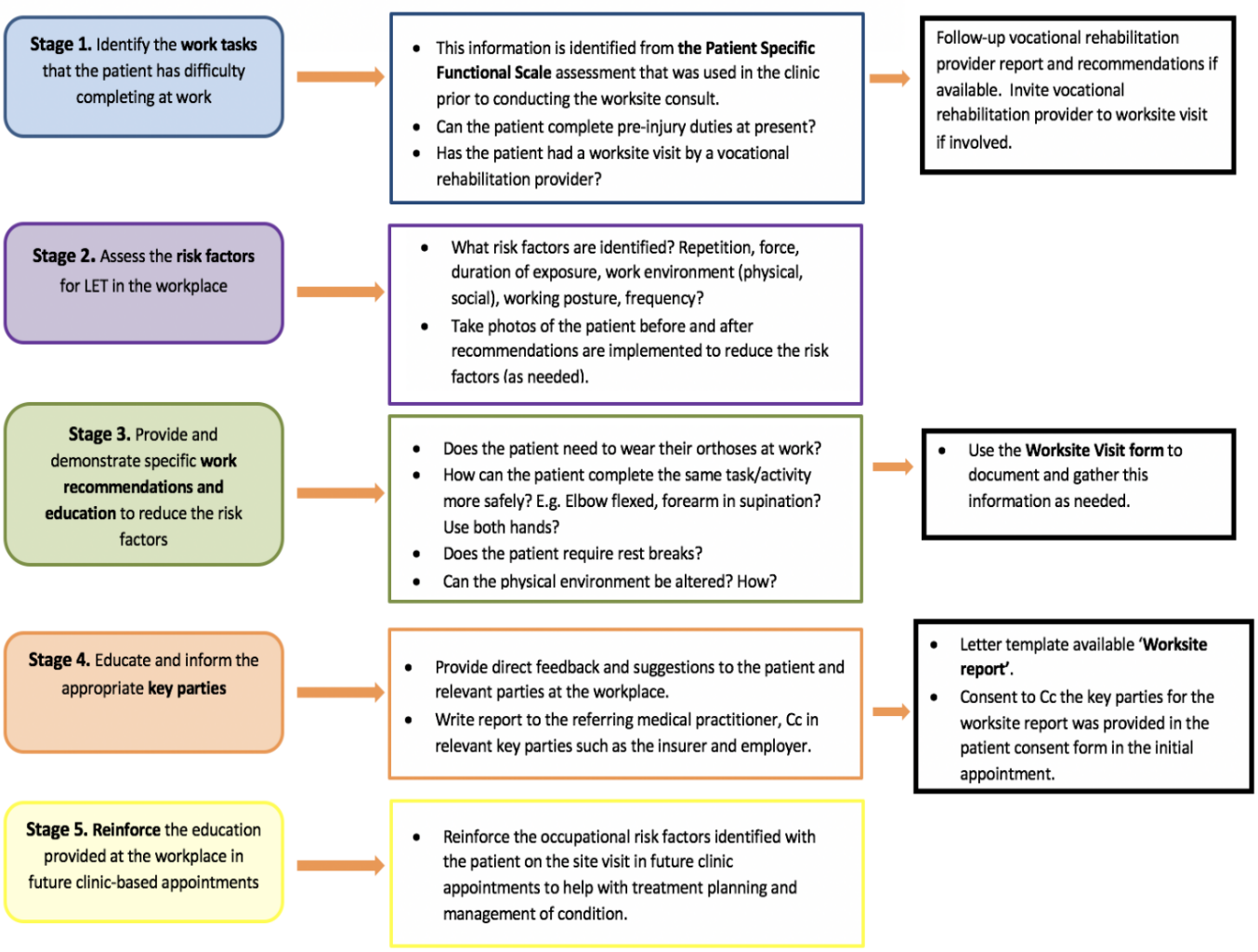


Figure 4.5 The five stages of *Working Hands-ED* in a flowchart handout provided to hand therapists involved in the delivery of the workplace-based intervention and measurement of clinical outcomes in the RCT.

4.3.2.1 Content of resource file

The primary researcher developed a resource file that contained (i) a handbook titled "Worksite information booklet for hand therapists" (Appendix J); (ii) Worksite visit flow chart (Figure 4.3); (iii) Billing procedure (Appendix K); and (iv) Worksite visit form (Appendix L) for the hand therapists to use when implementing the five stages of *Working Hands-ED*. For example, the handbook was provided to each hand therapist after they completed the training (as described in 4.3.2.2) and highlights all the important information presented in the training. The worksite visit form assisted the hand therapists during Stages 2 and 3 of *Working Hands-ED* and the billing procedure helped the hand therapists to correctly invoice the insurers for the workplace-based intervention.

4.3.2.2 Employer and supervisor information and consent form

The employers/supervisors of each injured worker with LET randomly assigned to the *Working Hand -ED* intervention group in the RCT were provided with a study information and consent form. These documents outlined the RCT study aims, procedures, voluntary nature of the injured worker's participation including their right to withdraw from the study, and costs and remuneration for participation (Appendix M). Consent from the employer/supervisor was required for the hand therapist to conduct a workplace-based hand therapy intervention.

4.3.2.3 Rationale for the development of *Working Hands-ED*

The findings from Study 1 (Chapter 2) found limited evidence regarding workplace-based hand therapy interventions for LET, however, the case study included in the systematic review used behavioural and ergonomic approaches to improve the participant's work tolerance (McCormack, 2010). Research indicates strengthening and endurance exercise programs (Tveito et al., 2004), multidisciplinary interventions consisting of workplace assessment, work modifications and case management involving all stakeholders of the workers' compensation system (Anema et al., 2007), and education to injured workers regarding risk factors for back pain at the workplace (Ree et al., 2016) significantly reduced work absences and improved RTW timeframes for low back pain.

The findings from Study 2 (Chapter 3) indicated that hand therapists and medical practitioners believed that education about LET pathology, the principles of activity

modification, postures to avoid, and work recommendations were perceived as the most effective treatment approach compared to other common clinical management strategies for LET (Tran et al., 2020). The importance of patient education when managing LET is supported by others (Amar et al., 2014; Bateman et al., 2018; MacDermid et al., 2010). Over a decade ago, MacDermid and colleagues proposed that future research needed to identify and incorporate the educational "active ingredients" to develop a well-defined educational intervention to manage LET (MacDermid et al., 2010). Recent evidence supports these concepts, including a recently published RCT that found a self-management program involving patient education and self-empowerment was effective in managing clinical outcomes of pain and function in patients with LET (McQueen et al., 2020). Furthermore, a recent literature review examining LET pathology, tendon and muscle biomechanics, and activities that may present with risk factors for developing LET, found benefits of reducing these risk factors during functional activities (Stegink-Jansen et al., 2021). The review authors postulate the benefits of educational and ergonomic interventions to minimise hazardous motions to prevent and manage LET (Stegink-Jansen et al., 2021).

Hand therapists frequently practice using a prescriptive treatment approach (Dale et al., 2002; Fitzpatrick & Presnell, 2004); however, it is important to empower injured workers with LET through education to enable them to take an active role to self-manage their symptoms. The workplace-based hand therapy intervention, *Working Hands- ED,* developed for this PhD represents hand therapy education delivered in the context of the patients' work environments.

The application of the ICF framework, PEOP model, and the five principles of the Clinical Framework for the Delivery of Health Services guidelines were used in the development of the workplace-based intervention *Working Hands-ED* and are summarised in Table 4.2.

Table 4.2 Application of the ICF framework, PEOP model, and Clinical Framework

Stage of *Working Hands- ED*	**Application of PEOP model to enhance occupational participation and performance** (Baum et al., 2015)	**Application of the ICF framework** (World Health Organization, 2001)	**Application of the Clinical Framework for the Delivery of Health Services** (The Government of Western Australia, 2012)
1. Identify the work tasks that the patient has difficulty completing at work.	The patient completes a self-report Patient-Specific Functional Scale (PSFS) (Hefford et al., 2012) assessment to identify the work tasks that they are having difficulty completing due to the impact of their LET symptoms (intrinsic and extrinsic barriers). Using the PSFS is a client-centred approach as it enables the patient to develop goals for themselves based on their individual needs. Therefore, the goal is functional and relevant to the person, allowing treatment to focus on the barriers impacting their occupational performance in their work tasks and roles. They are required to	There is a focus on activity and participation rather than just focusing on the injured workers' body functions and structures components. For example, the PSFS does not focus on the clinical outcomes of pain, grip strength and function, but instead primarily focuses on the injured workers' ability to execute a work task.	*Principle 1: Measure and demonstrate the effectiveness of the treatment.* The PSFS was measured at the baseline and then at the 12-week mark to demonstrate the effectiveness of *Working Hands-ED* on the participants' perceived level of difficulty completing their identified work tasks.

		score their perceived level of difficulty completing the work activity.		
2.	Assess the risk factors for LET in the workplace	The hand therapist organises a worksite visit alongside the patient and employer to assess the physical work environment for occupational risk factors. By identifying these occupational risk factors (extrinsic barriers), recommendations can be made to enable the patient to participate in their valued work occupations.	The risk factors identified in this stage considers the environmental factors that make up the physical, social, and attitudinal environment which can facilitate or hinder the injured worker from performing their work tasks and roles.	*Principle 2: Adopt a biopsychosocial approach* *Working Hands-ED* required the hand therapists to consider and deliver the intervention within each patient's work setting and consider contextual factors relevant to the patients with LET. This stage requires the hand therapist to identify risk factors across biological (i.e., LET pathology), psychological (i.e., patient having a passive role in recovery) and social domains (i.e., excessive work demands).
3.	Provide and demonstrate specific work recommendations and education to reduce the risk factors	The hand therapist provides and demonstrates specific work recommendations, and education regarding activity modification and postures to avoid with an aim of reducing the occupational risk factors identified in Stage 2. Modification of the physical	The education and work recommendations target the reduction of occupational risk factors and considers all the elements of the ICF: *Body functions and structures components*: Diagnosis of LET	*Principle 2: Adopt a biopsychosocial approach* *Working Hands-ED* requires the hand therapists to consider and deliver the intervention within each patient's work setting and consider contextual factors relevant to the patients with LET.

environment may also address some of the barriers identified (extrinsic enablers).

- Pain with provocative tests
- Grip strength with elbow in standard flexed position and in extended position.
- Function– using the self-reported Patient-Rated-Tennis Elbow Evaluation assessment (PRTEE)

Activity

- Work tasks that the injured worker has difficulty completing.

Participation

- The work roles that the injured worker is employed in.
- The impact of LET on their participation on leisure and activities of daily living.

<u>Principle 3:</u> Empower the injured worker to manage their injury

The main ways to empower an injured person are education, setting expectations, developing self-management strategies, and promoting independence from treatment. Education regarding pathology, activity modification, positions to avoid and work recommendations were made by hand therapists in *collaboration* with patients and other key parties (e.g., employer representative) that attended the worksite visit.

<u>Principle 4:</u> Implement goals focused on optimising function, participation and return to work.

The primary goal of *Working Hands-ED* was to provide relevant recommendations specific to each patient's identified work tasks to

Personal and environmental factors

- Personal: The injured workers' internal influences and attributes such as their age, gender, levels of motivation, self-efficacy, and coping skills.
- Environmental: The assessment and intervention are conducted at the workplace, which may have their employer and colleagues present. The injury is covered under the WA Workers' Compensation system and legislation.

promote function, enable participation, and facilitate RTW.

<u>Principle 5:</u> Base treatment on best available research evidence

Current evidence for LET management is primarily from clinic settings. It is a novel concept for hand therapists to take a biopsychosocial approach and attend patients' workplaces. The approach used in *Working Hands-ED* is supported by the ICF framework (Hoefsmit et al., 2014; Scholten et al., 2020). An educational approach to manage LET is supported by clinicians and researchers (MacDermid et al., 2010; Stegink-Jansen et al., 2021; Tran et al., 2020). Although limited evidence is avaiable regarding workplace-based treatments for LET, evidence is avaiable for other muscuolskeletal injuries (Franche et al., 2005; Ree et al., 2016; Tveito et al., 2004)

4.	Education and inform appropriate key parties	The hand therapist provides direct feedback and suggestions to the patient and relevant parties at the workplace (i.e., employers, colleagues). By addressing the social environment, increases the likelihood of implementing the recommendations provided safely and immediately, with the goal of enhancing the patient's occupational performance in their work tasks and role (extrinsic enabler).	This stage ensures that the social and attitudinal environmental components of the ICF are considered.	*<u>Principle 2:</u> Adopt a biopsychosocial approach* The employer/supervisor was present at the worksite visit; therefore, they were informed of the recommendations onsite. This information was then reinforced by a follow-up letter to all stakeholders (i.e., medical practitioner, insurer, vocational rehabilitation provider, employer, and injured worker) to highlight the recommended suggestions regarding changing the physical workstation and recommendations regarding activity modification.
5.	Reinforce the education provided at the workplace in future clinic-based appointments	The hand therapist will reinforce the education provided to reduce the occupational risk factors to the patient in future clinical appointments. This may enhance the patient's cognitive and decision-making abilities	All elements of the ICF are considered at this stage, as the hand therapists can focus on the body functions and structure components in the clinical setting for follow-up appointments but is also able to monitor and consider	*<u>Principle 3:</u> Empower the injured worker to manage their injury* By reinforcing the education provided, encourages injured workers to self-manage using strategies provided at the workplace.

	(intrinsic enabler) to be proactive and manage their LET symptoms at home and in the workplace.	the injured workers activity limitations and participation restrictions in their work tasks based on their worksite visit.	<u>*Principle 4:*</u> *Implement goals focused on optimising function, participation and return to work.* Although follow-up appointments are in the clinical setting. The hand therapists can continue to focus on the injured workers' functional goals by referring to the assessment and interventions provided at the workplace in stages 2 and 3 of *Working Hands-ED.*

4.3.2.4 Piloting *Working Hands-ED*

Working Hands-ED was piloted by the primary researcher to a 30-year-old first-year apprentice plasterer Mark* who was diagnosed with LET (name has been de-identified for confidentiality reasons) and this was presented as a case study by a final year occupational therapy student as part of an Honours project (Gibson et al., 2016). Mark* was not included in the final RCT. After the pilot study was completed, a panel discussion with the research team (TT, MC, and CH) was organised to evaluate the intervention stages. It was noted that the hand therapist (TT) referred to the worksite visit in future clinical appointments, and this was reportedly beneficial to the injured worker. All panel attendees agreed that a fifth stage "Reinforce the education provided in future clinical appointments" should be added to further encourage the injured worker to self-manage using the recommendations provided. This was added to encourage the injured worker to continue to self-manage his condition and considers principles #3 and #4 of the Clinical Framework for the Delivery of Health Services described in Table 4.2.

4.3.2.5 Phase 2: Training of *Working Hands -ED*

The next phase was to train hand therapists on how to implement this novel intervention. A one-hour education and practical training session was conducted on 5 April 2016 at a workplace with a patient diagnosed with work-related LET. Jason* (*name has been de-identified for confidentiality) was employed as an Irrigation Technician by the local council and had a current workers' compensation claim for a work-related LET injury. Jason was not included in the RCT but his personal and work factors were included for the purpose of training the hand therapists. Thirteen hand therapists attended this practical training session with the primary researcher and one of the project supervisors (MC). Before the practical session, the primary researcher reviewed the PSFS that had been completed with Jason to identify the activities and tasks that the hand therapists would likely focus on during the worksite visit (Stage 1 of *Working Hands-ED* – see Figure 4.5).

The primary researcher facilitated the practical workplace visit; however, all hand therapists were involved in observing and documenting the postures and movements Jason used to perform his work tasks, any tools and equipment used, and the nature and layout of physical environment in which the work was performed. The hand therapists then worked through Stages 2 and 3 of *Working Hands-ED* during the session to identify potential risk

factors that might exacerbate Jason’s LET symptoms and used their clinical reasoning and problem-solving skills to develop relevant recommendations about strategies to modify the activity. All hand therapists brought their allocated resource file to the worksite visit and used relevant forms and handouts during this practical session. Following the worksite visit, the primary researcher summarised all the hand therapists' recommendations and wrote a report as per Stage 4 of *Working Hands-ED*. This report was sent to all therapists and Jason's supervisor/manager, insurance company, and referring medical practitioner. A de-identified excerpt of the report is presented in Figure 4.6.

5th April 2016

Dear GP,

Re: **Jason*** **DOB: 10/1/1970**
Diagnosis: **Left Lateral Epicondylalgia**

Thank-you for referring Jason to Hand Works Occupational Therapy. As requested, I have completed a worksite consultation at XXX this morning at 8am to 9am.

Assessment
The following work tasks were assessed because Jason reported them on the Patient Specific Functional Scale Assessment Form to be the most difficult to complete due to his injury:

1. Dig up and remove old gear rotor sprinkler
2. Put apart and inspect old sprinkler
3. Unscrewed articulated elbow from riser
4. Replace bonnet on valve by unscrewing bolts

Overall, the work tasks that Jason performed this morning demonstrated:

- Moderate levels of forceful gripping,
- Moderate repetitive motions of the elbow and wrist on the affected side

Jason reports that the duration and frequency spent on these work tasks may vary depending on the workday.

Work Recommendations
I provided the following actions/recommendations for Jason during the worksite consultation today:

- Re-educated Jason on the pathology of LE and how the postures and movements he is currently performing at work will continue to place stress on the injured structures, and possibly re-aggravate the symptoms.
- Jason was advised to lean down closer to the ground when removing the sprinkler to encourage less stress on his elbow. It is recommended that he uses both hands when unscrewing the sprinkler to take less force off his left elbow.
- It was recommended that Jason takes frequent rest breaks when digging with shovel because this task requires moderate levels of forceful gripping.
- Jason should alternate the position of his right and left hands when digging with shovel to encourage postural variation and reminder to Jason to be conscious of his forearm and wrist position (e.g. encourage supination of forearm, with the elbow bent and neutral wrist).
- The possible benefits of using anti- vibration gloves when using the shovel were discussed, because this may reduce the load and vibrational force exerted during this work task.
- Jason is currently manually removing the bolts to replace the valve. This task presents a high risk for exacerbating the LE symptoms; therefore, I recommend Jason uses of a portable rechargeable hand tool to assist in the removal of these bolts. This will help reduce the load and force on his elbow and wrists.
- It is recommended that Jason wears a counterforce brace on his left elbow during these work tasks to disperse the force on the elbow tendon.
- Jason should attempt to schedule physically challenging tasks (e.g. changing sprinklers) throughout the day or week instead of completing all the work in one shift or at one time.

Figure 4.6 Work recommendations section of the report written for Jason* after the worksite visit.

4.3.2.6 Phase 3: Implementation of *Working Hands-ED*

The treating hand therapists contacted the employers and/or supervisors of participants allocated to the *Working Hands-ED* intervention group. The therapists provided information about the study and sought permission to organise the one-time worksite visit within the first four weeks of each participant's initial hand therapy appointment. As per Stage 1 of the *Working Hands-ED* program, the hand therapists conducted the PSFS assessment with each participant in the clinic before conducting the worksite visit. Hand therapists were responsible for scheduling, conducting the worksite visits, and ensuring that the relevant billing codes to insurance companies were used as per the study protocol.

4.4 Outcome measures

4.4.1 Primary outcomes

The primary clinical outcomes were (i) pain level, (ii) pain-free grip strength with the elbow in standard (flexion) position and in extension, and (iii) function. These outcomes were measured at the initial appointment (baseline), and again at 6 weeks and 12 weeks after the initial hand therapy appointment.

Each participant's pain level was measured during five provocative clinical assessments using an 11-point numeric rating scale (NRS), with scores ranging from 0=no pain to 10=worst imaginable pain. The NRS is a reliable and valid tool suitable for pain assessment in clinical practice (Karcioglu et al., 2018). The treating hand therapists verbally administered the NRS to the participants.

Physical diagnostic tests for LET reported in the literature include palpation of the lateral epicondyle and the common extensor origin, resisted wrist extension, resisted middle finger test, and resisted supination (Murphy et al., 2015; Vaquero-Picado et al., 2016). The highest level of sensitivity (95%) for diagnosing LET was achieved when using palpation of the lateral epicondyle together with resisted supination tests (Murphy et al., 2015). A good level of sensitivity (90%) was achieved when using palpation to the lateral epicondyle and resisted wrist extension provocative tests (Murphy et al., 2015).

Pain-free grip strength was measured using a calibrated Jamar Hydraulic Hand Dynamometer (200 lb; 90kg) with the participant seated, elbow in the standard position (flexed at 90°) and in extension (0°). Testing pain-free grip strength in the standard position is a reliable and valid measure that is more sensitive to change than testing maximal grip

strength (Stratford & Levy, 1994). Pain-free grip strength was also measured with the elbow in extension, and the wrist and forearm in neutral, because the common extensor tendon origin is taut in this position and limits function more when injured. Grip strength was tested three times with each hand; the average grip strength score was used to compare the affected and unaffected arms at the three measurement time points.

The Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire was used to measure participants' upper limb function (Poltawski & Watson, 2011). The PRTEE includes pain and function subscales that are combined to give a total score. Possible total scores range from 0 (no pain or disability) to 100 (worst possible pain and disability) (Poltawski & Watson, 2011). The PRTEE is one of the superior standardised patient outcome measures for LET (Evans et al., 2019) and has demonstrated excellent validity, reliability, and internal consistency with this population (Rompe et al., 2007). A minimum change of 11 points, i.e., 37% of the baseline score, is considered clinically relevant (Poltawski & Watson, 2011).

Participants allocated to the intervention group completed the self-reported Patient-Specific Functional Scale (PSFS) (Hefford et al., 2012) to identify any work duties that they had difficulty completing due to their LET. The PSFS is a valid, reliable, and responsive outcome measure of function for people with upper extremity injuries (Hefford et al., 2012). Participants rated each of their identified activities on an 11-point scale ranging from 0 (unable to perform the activity) to 10 (able to perform the activity at pre-injury level). A minimum clinically important difference of 1.2 is reported for the PSFS (Hefford et al., 2012). The PSFS was completed at baseline before the worksite visit and then again 12 weeks after their initial hand therapy appointment. The hand therapists used the activities and tasks identified on the PSFS to guide their workplace visits.

4.4.2 Secondary outcomes

The original RTW outcomes were (i) RTW status, (ii) total workers' compensation claims costs, and (iii) total workers' compensation claims duration. Due to logistical reasons and difficulty accessing data from insurance case managers, the primary researcher could not gain data on the total workers' compensation claims costs and durations for each RCT participant as intended. To overcome these challenges, the work outcomes were revised to be: (i) RTW status (ii) cost of hand therapy services, (iii) duration of hand therapy services, and (iv) number of hand therapy sessions attended by each participant. The RTW status of

participants were classified as unfit for work, performing modified duties for modified hours, performing modified duties for pre-injury hours, or performing pre-injury duties for pre-injury hours. The RTW status of participants in both groups were documented at baseline, 6-week, 12-week, and 26-week time-points. The total costs of hand therapy services, and the duration and number of hand therapy sessions were calculated for each group from the date the participants had their initial appointment to their respective discharge dates. These outcomes were chosen to contribute new evidence to answer the overall research question.

Participants allocated to the intervention group had an additional cost of AUD$366.40 for the worksite visit and costs associated with the hand therapists' travel time to the workplace and writing the worksite report. Hand therapy costs were based on the WorkCover WA rates during the study period (16 April 2016 to 31 March 2019).

4.5 Sample size

The RCT was originally designed to include a sample of 180 participants, based on an *a priori* power calculation using a critical α of 0.05 and a 1-β of 0.8 to detect a standardised difference of 0.4 between the control group and the *Working Hands-ED* intervention group. However, achieving this sample size was not feasible due to the slow enrolment of participants into the trial. A revised power calculation was performed in the G*Power calculator (Faul et al., 2007) and determined that a sample of 50 participants was required to identify a standardised difference of 0.8 between groups, using a critical α of 0.05 and 1-β of 0.8.

4.6 Data analyses

All outcome data were analysed using the Statistical Package for Social Sciences (IBM SPSS version 25). For all data sets, the Kolmogorov- Smirnov test of normality was used to determine whether the distribution of values was normal ($p>0.05$) or not normal ($p < 0.05$) to indicate whether parametric or non-parametric statistical analyses were warranted. Descriptive statistics for demographic characteristics were reported using means and standard deviations (SDs) for parametric continuous variables and frequency counts for categorical variables. Pearson chi-square tests were used to determine statistical differences between groups for demographic variables of age, gender, hand dominance,

injury to the dominant arm, smoking status, and duration of LET symptoms. All other demographic characteristics were analysed using Fisher's Exact tests.

The mean change between the baseline and week 12 PSFS scores for the intervention group were analysed using a one-sample t-test. The clinical outcomes were analysed using the Mixed Error-Component Model procedure (McCoy, 2017). This model was chosen because it considered the correlations between measurements taken on the same individual at different time points (McCoy, 2017). The dependent variables were pain, grip strength, and function. The independent variables were the three-time points, i.e., baseline (T1), six weeks (T2), and 12 weeks (T3), and the groups were standard care and the *Working Hands-ED* intervention. The terms in the mixed error-component model were group, time, and group-time interaction. The interaction term was included explicitly to test whether any significant changes over time influenced both groups similarly; if the interaction term was statistically significant, then this indicated that the groups behaved differently over time. The interaction term also allowed the comparison of the groups at specific time points for all outcomes.

A comparison of RTW status between the control and intervention groups at each time point was performed using the Fisher's Exact test because the sample size was small. A statistically significant $p<0.05$ p-value indicated that the work status profiles differed between the two groups. To compare the total hand therapy costs, duration and number of sessions, non-parametric Mann-Whitney U tests were used. These outcomes were compared according to the treatment received; therefore, the per-protocol grouping was used for these analyses. Statistical analyses were performed twice, first using intention-to-treat (ITT) analysis and then per-protocol analysis. A critical alpha level of $p \leq 0.05$ was used to determine statistical significance.

4.7 Discussion

Currently, hand therapy treatments to manage LET symptoms are delivered within clinic settings and rarely focus on the patients' work environments. Using the ICF framework to guide a biopsychological approach, a novel workplace-based educational intervention called *Working Hands-ED* that focuses on activity and participation and considers personal and environmental factors was developed.

It was hypothesised that participants allocated to the intervention group would have a better understanding of occupational risk factors and activity modification principles, enabling them to engage in work activities that were appropriate for their diagnosis and not exacerbate their LET symptoms. Furthermore, the knowledge they gained from this intervention may empower them to take an active role in managing their injury. Consequently, it was expected that they would have improved pain, grip strength, and functional outcomes compared to patients in the control group. It was hypothesised that the intervention group would also have better RTW outcomes. Currently, no other studies have quantified the costs, duration, and number of hand therapy sessions related to the management of work-related LET. The results from this study may be of interest to all key stakeholders in the workers' compensation system about the expectations related to managing work-related LET and the RTW process. Furthermore, the results of this study may also identify the feasibility and effectiveness of the multimodal standard hand therapy rehabilitation program. These findings may help inform future clinical management of LET patients without exposure to occupational risk factors.

4.8 Funding

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4.9 Trial Status

This trial commenced on 16 April 2016 and finished on 31 March 2019.

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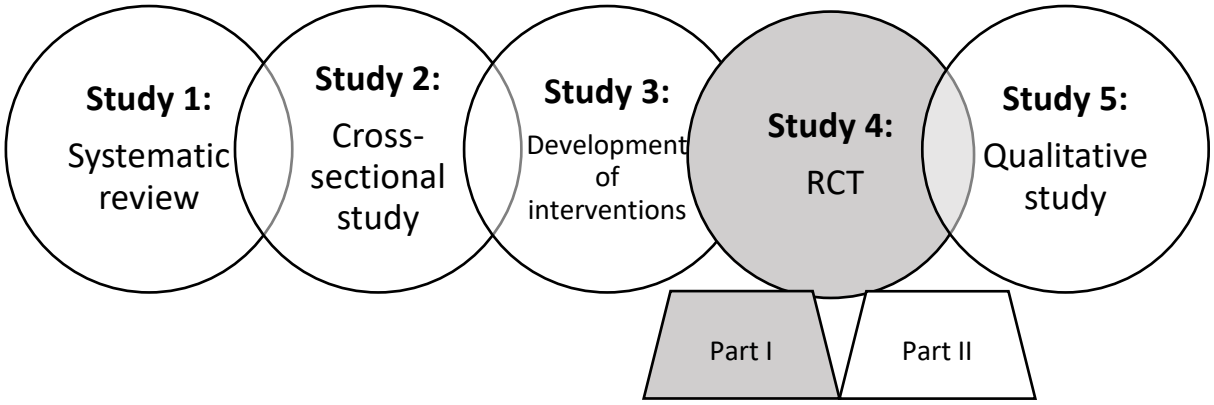
Chapter 5

Study 4 (Part I): Randomised Controlled Trial- Impact on clinical outcomes



Chapter 5 reports on the RCT that was conducted to identify the impact a novel workplace-based educational intervention (*Working Hands-ED*) added to standard hand therapy, compared with standard hand therapy only on the outcomes of pain, grip strength, and function among injured workers with LET. The development of the standard hand therapy package, the novel hand therapy workplace-based intervention, and the randomised controlled trial (RCT) study protocol were reported in Chapter 4 of this thesis.

This chapter contains the accepted version of a manuscript published in the Journal of Hand Therapy, which is available online:

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The spelling and wording contained within this chapter are that of the published manuscript. The referencing system used for this manuscript was AMA Manual of Style 11th Edition; however, for consistency of style used throughout this thesis, the referencing in this chapter uses the American Psychological Association 7th edition style.

Journal Manuscript 2

Title:

The impact of a hand therapy workplace-based educational approach on the management of lateral elbow tendinopathy: A randomized controlled study

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5.1 Abstract

Background: Lateral elbow tendinopathy (LET) is one of the most prevalent work-related musculoskeletal conditions. Management strategies for LET rarely consider patients' work environments and have limited focus on education regarding occupational risk factors. Workplace-based rehabilitation has shown benefits in the return to work (RTW) processes for injured workers with other health conditions, but no studies have investigated the impact of a workplace-based educational approach in the management of LET.

Purposes: Firstly, to identify the impact of an additional workplace-based educational intervention to standard hand therapy care on the outcomes of pain, grip strength, and function. Secondly, to identify the effectiveness of standard hand therapy on the same clinical outcomes.

Study Design: A randomized controlled trial.

Methods: Forty-nine participants were randomized to the control group (*n*=25) or intervention group (*n*=24). The control group received standard hand therapy for 12 weeks. The intervention group received standard hand therapy for the first 12 weeks plus an additional workplace-based educational intervention, '*Working Hands- ED',* delivered by a hand therapist. Pain levels for provocative tests, grip strength, and function were measured using a Numeric Rating Scale (NRS), Jamar Dynamometer, and the Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire at baseline, weeks 6 and 12. The Patient-Specific Functional Scale (PSFS) was also used for the intervention group.

Results: There were no statistical differences between both groups for all clinical outcomes by 12 weeks ($p > 0.05$). Pain levels for all provocative tests and PRTEE scores statistically improved within both groups ($p < 0.05$), however with small effect sizes observed. The PSFS scores statistically improved for the intervention group by 12 weeks ($p < 0.05$).

Conclusion: The addition of a hand therapy workplace-based intervention did not result in superior clinical outcomes for pain, grip strength, and function. The study identified that a multimodal self- management approach used by hand therapists improved their patient's pain and function regardless of whether the education was given in the clinic or the workplace.

KEYWORDS

lateral epicondylalgia, lateral epicondylitis, tennis elbow, workplace intervention, treatment

5.2 Introduction

5.2.1 Lateral elbow tendinopathy pathology

Lateral elbow tendinopathy (LET), commonly known as tennis elbow, is a prevalent work-related musculoskeletal condition affecting approximately 1-3% of the general population and is equally common among men and women aged 35-55 years (Shiri et al., 2006). It is characterized by pain and tenderness over the outer surface of the elbow causing reduced strength and upper limb function and can affect a person's ability to participate in daily self-care, leisure, and work occupations. Previously thought to be an inflammatory condition, histological studies confirm that this condition progresses into a degenerative state characterized by an absence of inflammatory cells (Ahmad et al., 2013).

5.2.2 Current treatment methods

Lateral elbow tendinopathy is usually managed conservatively by health professionals from different backgrounds including physical therapists, chiropractors, occupational therapists, and medical practitioners (Bachman, 2016; Bisset & Vicenzino, 2015b; Gliedt & Daniels, 2014; Lenoir et al., 2019). The diversity of disciplines may explain the different methods and dosages of treatment approaches used for LET (Amar et al., 2014; Bisset & Vicenzino, 2015a). Consequently, there are conflicting expert opinions about the treatment methods delivered by health providers (Eygendaal & Keijsers, 2019; Seo et al., 2018; Stasinopoulos, 2019). Treatments reported in the research literature focus primarily on the physiological management of pain, strength, and function; and typically include the provision of orthoses, exercise programs, use of electrical stimulation technologies, corticosteroid injections, blood injections, pain medications, manual therapy, joint mobilization, and surgical options (Bisset & Vicenzino, 2015b; Lenoir et al., 2019; Lucado et al., 2019; Taylor & Wolff, 2021). Despite numerous published clinical trials, no clear evidence for universally effective treatments is currently available.

5.2.3 Occupational risk factors

It was identified that work-related and psychosocial factors were two of the factors influencing the prognosis of LET and that the modification of physical factors could reduce the risk or improve the prognosis of the condition (Coombes et al., 2015). Previous studies found a moderate association between the occupational risk factors of forceful and

repetitive hand and arm use and the development of LET, suggesting that workload modification could reduce the risk and improve the prognosis (Haahr & Andersen, 2003; Shiri & Viikari-Juntura, 2011). Recent literature supports the idea of actively exploring and reducing postures and motions contributing to symptoms of LET and it was suggested that practitioners should include work-related factors as an important consideration for treatment of this common condition (Descatha et al., 2015; Stegink-Jansen et al., 2021).

Education and modification of physical factors in the workplace were previously suggested as inclusions in LET management programs (Coombes et al., 2015; MacDermid et al., 2010; Rahman Shiri & Viikari-Juntura, 2011; Tran et al., 2020). Strong agreement on the effectiveness of education interventions were identified in a large national survey (N=693) of American hand therapists over 10 years ago, (MacDermid et al., 2010) but there was little consensus regarding the content or delivery of these interventions (MacDermid et al., 2010). Therapists practising hand therapy across international contexts identified the importance of education interventions, with some believing that patient education is integral to the management of LET (MacDermid et al., 2010; Peterson et al., 2005; Tran et al., 2020). A recent cross-sectional study of 104 Australian hand therapists and 38 medical practitioners found that both of these health professional groups believed education about the pathology of LET, activity modification, and postures to avoid, and workplace recommendations were more effective than other clinic-based treatments in the management of LET (Tran et al, 2020). Furthermore, 81 per cent of the medical practitioners and 71 per cent of the hand therapists believed workplace-based education delivered by a hand therapist would be beneficial for patients with acute and chronic LET (Tran et al., 2020). Existing studies investigating the effectiveness of LET treatments have focused only on clinic-based interventions and rarely discuss the work environment or consider occupational risk factors that may contribute to the exacerbation of LET symptoms.

5.2.4 Application of the International Classification of Function, Disability and Health (ICF) Framework

We propose that hand therapists managing patients with work-related LET should consider how the patient's work environment and potential occupational risk factors contribute to the clinical presentation. This holistic approach to return-to-work interventions aligns with the International Classification of Function, Disability and Health

(ICF) framework (Hoefsmit et al., 2014). The ICF is a useful framework that can be used to describe how education in body functional biomechanics and activity modification may assist in the treatment of patients with LET and facilitate their return to pre-injury work roles (World Health Organization, 2001). The ICF considers health and disability at the individual and population levels, and considers personal factors (e.g., physiological, psychological, and cognitive), and environmental factors (e.g., social and physical work environments) involved in a person's functioning and participation in activities. Researchers support the idea of incorporating all these domains when investigating hand and upper limb assessments and interventions (Povlak & Valdes, 2020; Winthrop Rose et al., 2011).

5.2.5 Benefits of workplace-based interventions and significance of research

A recent systematic review of workplace interventions as part of RTW programs for musculoskeletal disorders, pain-related conditions, and mental illness found moderate to strong evidence that lost time from work was reduced when interventions comprised a multi-domain approach (Cullen et al., 2018). These studies also included interventions such as graded activities, service coordination, and work modification components (Cullen et al., 2017). Workplace-based rehabilitation offers many benefits in the return-to-work process for injured workers with other health conditions, (Cullen et al., 201; Oakman et al., 2018; Ree et al., 2016) but to our knowledge, no studies have investigated the effectiveness of this intervention approach for the management of work-related LET. Furthermore, no studies have examined the impact of a hand therapist providing education on activity modification, ergonomics, and reduction of risk factors for the management of LET within the context of the injured worker's workplace. A hand therapist's specialized knowledge and experience in upper limb rehabilitation combined with a biopsychosocial approach that considers the injured worker's social and physical environments may provide a more holistic approach to managing work-related LET aligned with the ICF framework.

5.3 Purpose

The primary aim of this study was to identify the impact of an additional workplace-based educational intervention to standard hand therapy care on the outcomes of pain, grip strength and function. The secondary aim was to identify the effectiveness of standard hand therapy on the same clinical outcomes.

5.4 Methods

5.4.1 Study design

The design was a randomized controlled trial. Hand therapists employed at a multi-centered hand and upper limb clinic in Perth, Western Australia delivered the interventions and collected the clinical outcomes data from participants. None of the authors were involved in data collection. This study was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12616000339459). The Curtin University Human Research Ethics Committee in Perth, Western Australia approved the study. Participants signed a consent form after being informed about the study aims, procedures, and potential risks, and benefits.

5.4.2 Participants

Participants were recruited from patients referred by their medical practitioners to a multi-centered hand and upper limb clinic for the management of LET. Participants were screened for eligibility for the study by the administrative staff at the clinic when scheduling their initial hand therapy appointment and invited to participate by their hand therapist, if eligible.

Injured workers aged 18 to 65 years with a diagnosis of acute or chronic unilateral LET who had a current approved workers' compensation claim were eligible for the study. Participants must have reported pain reproduced on at least two of the following clinical assessments: (i) palpation over the lateral epicondyle, (ii) palpation over the common extensor tendon origin, (iii) resisted wrist extension, (iv) resisted middle finger test, and (v) resisted supination. The diagnosis must have been confirmed via ultrasound or magnetic resonance imaging by a radiographer. Participants were excluded if they were expected to have or had undergone surgery; had other elbow injuries such as inflammatory arthritis or ligament tears; had blood injections within six months of commencing the study; if they received a corticosteroid injection or participated in other physical therapies within three months of commencing the study; were unable to understand or converse in English; had cognitive deficits; worked in a rural setting (where a worksite visit may not be possible to organize); or if their workers' compensation claim was declined.

5.4.3 Sample size

To determine the impact of adding a workplace-based hand therapy education intervention to standard hand therapy, a power calculation was conducted using the G*power tool. Using a 5% significance level, a power of 80%, and a moderate effect size of 0.8 a sample of 50 participants was needed.

5.4.4 Randomization process

A hand therapist assessed potential participants during their initial hand therapy appointment to confirm eligibility for the study. Upon receipt of informed consent, the administrative staff member (who was not part of the data collection process) randomized each participant into either the control or intervention groups using sealed opaque envelopes. Data were collected between 16 April 2016 and 31 March 2019. In total, 10 qualified hand therapists were involved in data collection. Participants randomly allocated to the intervention group had the same hand therapist during their clinic appointments and at their worksite visit.

5.4.5 Interventions

The development of the treatment for the intervention group was guided by the Australian Clinical Framework (ACF) for the Delivery of Health Services, (The Government of Western Australia, 2012) the ICF framework, (World Health Organization, 2001) the researchers' clinical experience, and available research evidence. The ACF guidelines outline five principles to assist allied health professionals working with injured workers under the jurisdiction of the workers' compensation system and incorporates the elements of the ICF to promote evidence-based practice (The Government of Western Australia, 2012). These principles are (i) measure and demonstrate the effectiveness of the treatment; (ii) adopt a biopsychosocial approach; (iii) empower the injured person to manage their injury; (iv) implement goals focused on optimizing function, participation, and return to work; and (iv) base treatment on best available research evidence (The Government of Western Australia, 2012; WorkCover WA, 2016). Current treatments for LET identify the level of functioning at the body and person levels; however, seldom consider the person-environment contextual factors that may impact participation in work occupations. The intervention for this study

incorporated the impact of the environmental factors as part of the treatment plan to optimise patient participation in work occupations and facilitate return to work.

Participants allocated to the control group received the standard hand therapy program for LET delivered at the clinic. The standard hand therapy program consisted of 10 x 1-hour sessions over a 12-week period (weekly for the first eight weeks, then every two weeks until the 12-week mark). Those allocated to the intervention group received the same standard hand therapy care; however, they also received two additional appointments. Firstly, they received an additional 30-minute session within the first two weeks of the initial hand appointment at the clinic to complete the Patient-Specific Functional Scale (PSFS). Secondly, these participants received an additional once-off workplace-based educational intervention called *Working Hands-ED* within the first four weeks after their initial hand therapy appointment.

5.4.5.1 Control group: Standard hand therapy

The clinical treatments for LET provided in the standard hand therapy in the clinic were prescription of orthoses (thermoplastic wrist orthosis, semi-rigid wrist braces and/or counterforce brace), application of a heat pack, soft tissue massage to the dorsal extensor muscles, static wrist flexion and extension passive stretches, and an eccentric strengthening exercise program (pain-free) using weighted dumbbells. As per normal practice at the clinic, hand therapists made a clinical judgement as to when to progress each participant's hand therapy program based on their assessment of symptoms at each appointment. For example, not all participants commenced eccentric exercises at the same time and some participants wore a wrist orthosis for longer, depending on their occupations. Generally, participants were provided with a wrist orthosis for the first two weeks of hand therapy, a soft tissue therapy program by week 2, and an eccentric strengthening program by week 4. All participants were educated about the anatomy, pathology, and risk factors for LET, and given a list of general work recommendations and activity modification principles. All participants received handouts with photographs and clear instructions for self-management programs comprised of application of a heat pack followed by soft tissue massage to the dorsal extensor muscles (once daily), and passive wrist flexion stretches with the elbow in flexion and then extension (see Appendix G). An eccentric strengthening

program (generally 10-15 repetitions performed three times daily; depending on symptoms) was provided to all participants (see Appendix H).

Hand therapists collecting data for this study reviewed and recorded each participant's progress and adherence to the standard hand therapy program weekly for the first eight weeks and then every two weeks until week 12. After 12 weeks, therapists used their clinical reasoning to decide the frequency of subsequent reviews until discharge.

To ensure consistency of usual care practice, all hand therapists treating patients enrolled in this study reviewed an educational video that demonstrated a standard approach to assess pain, grip strength, and functional outcomes, and to perform the clinic-based usual care. The first author developed the content for the video resource.

5.4.5.2 Intervention group: *Working hands- ED*

Participants in the intervention group all received the hand therapy usual care plus an additional workplace-based education intervention *(Working Hands-ED)* delivered by their treating hand therapist within the first four weeks of completing the initial assessment.

The purpose of this intervention was for the hand therapists to provide specific and individualized education and work recommendations about a participant's occupational risk factors in the context of their work environment. *Working Hands-ED* took a novel approach to patient education by incorporating the ICF factors of activity and participation within the context of the patients' work environments. The five stages of *Working Hands-ED* included a systematic process of assessment and treatment of the injured workers' occupational risk factors within their work environments.

The workplace-based education delivered by hand therapists within the context of the specific work environments provided an opportunity for workers with LET to adapt and modify the way they performed their current activities. It was anticipated this education would assist them to continue to participate in their pre-injury work tasks and roles. This intervention was unique compared to other management strategies for LET because it considered the environmental factors of the workplace; an ICF component that is rarely included as part of the hand therapy assessment and treatment process (Winthrop Rose et al., 2011). The five stages of *Working Hands-ED* for the hand therapist to implement are seen in Figure 5.1.

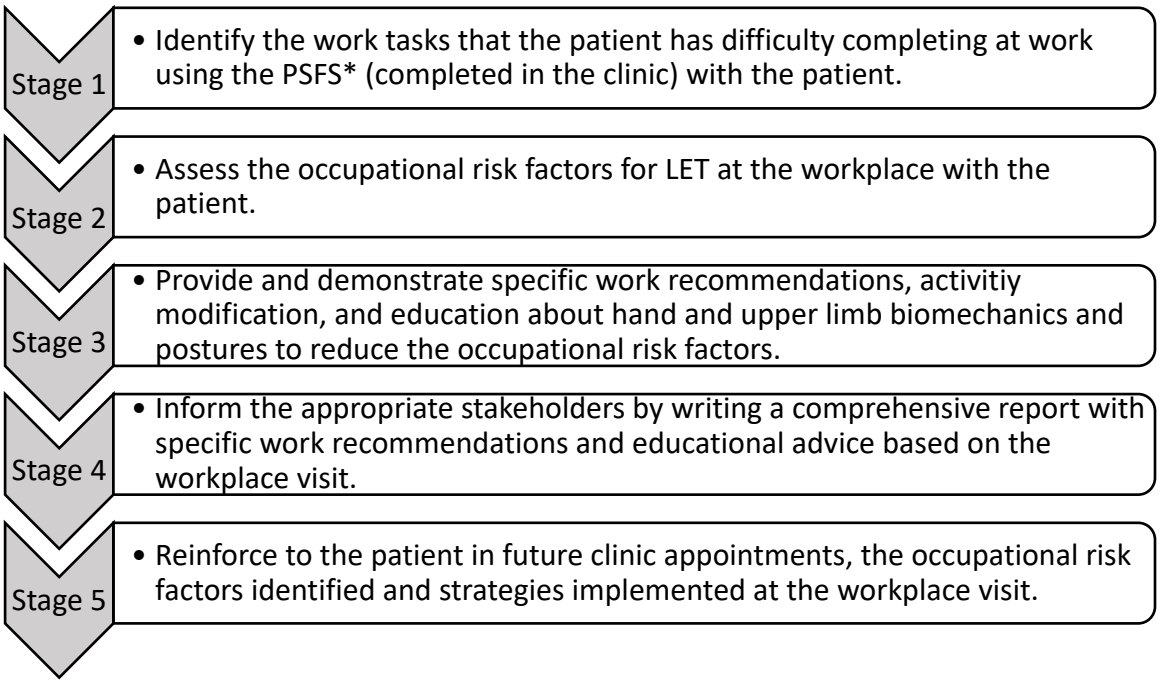

Figure 5.1 Stages of *Working Hands-ED* for hand therapists.
*PSFS: Patient-Specific Functional Scale

Stage three of *Working Hands-ED* had four principles for hand therapists to focus on during the worksite visit: (i) educate about pathology and demonstrate to the participant how certain occupational risk factors may aggravate symptoms; (ii) determine if there were any adaptive or alternative equipment that may assist the participant to complete the work tasks with less force and less risky upper limb postures; (iii) suggest and demonstrate alternative methods of completing work tasks to reduce load and stress on elbow and wrists; and (iv) modify the physical environment as needed and discuss the recommendations to supervisors to maximise compliance at an organisational level.

The final work recommendations provided were detailed in a summary report provided to the medical practitioner, insurance case manager, and injured worker in stage four of this intervention. An example of one section of the report with task-specific recommendations and work recommendations provided by the treating hand therapist to the employer of an injured worker employed at a retail warehouse can be found seen in Figure 5.2.

Task-Specific Recommendations

1. Using a manual pallet jack
    - Where possible, employ the use of an automatic pallet jack.
    - Use legs/body to drive the motion when having to utilize a manual pallet jack.
    - Take rest breaks every 30 minutes when performing repetitive tasks.

2. Wrapping pallets with a 'Nelson plastic roller'
    - Alternate 'pulling' and 'pushing' application direction if appropriate
    - New/heavy rolls to be used at waist height only; lighter rolls for high/low 'reaching'.
    - Note that the pole adds torque force to the elbow when applying plastic to top of pallets.
    - Consider 'bulking' out the grip/handle (e.g., apply tubing to current handles) to reduce grip force required to hold pole.

3. Utilizing a clipboard for sustained periods
    - Ensure regular forearm and elbow extension stretches when holding the clipboard for sustained periods- avoid prolonged elbow extension.
    - Rest the clipboard on boxes/pallets for short durations if completing short/repetitive stock counts.

4. Operating a forklift
    - Use legs to assist in pushing off the ground to reduce load on 'pulling' into the seat.
    - Avoid this task in the first instance and until further advised, as 'steering' is highly repetitive.
    - Consider alternating tasks. Take short (5-10 minutes) breaks every 30-60 minutes to perform forearm stretches.

Work Recommendations – Summary

- Use of thermoplastic wrist orthosis as required (aim to reduce hours of wear and progress to use of counterforce brace in forthcoming weeks)
- Complete variation of work tasks to minimize repetitive (e.g., alternate days/tasks, split shifts (e.g. Morning = administration, afternoon = stock count/ consolidation/ pallet-rider)
- Employ use of electric tools rather than manual tools (e.g., pallet jack)
- Consider upskilling worker to use pallet rider and perform administrative tasks.

Figure 5.2 Task-specific recommendations reported by the hand therapist for Participant #31 (Warehouse Store person).

All hand therapists attended a practical training session facilitated by the first author. During the training, hand therapists simultaneously completed each stage of the *Working Hands-ED* with the same injured worker with LET (a government-employed landscaper) at his workplace (i.e., community park). Specific education about the biomechanics and upper limb postures included advising the participant to avoid repetitive elbow and wrist extension movements in the context of their work duties. The first author also developed a document file for each hand therapist to use during the worksite visit. The file included (i) a worksite information booklet for hand therapists; (ii) detailed information on the stages of *Working Hands-ED*; (iii) a frequently asked questions (FAQ) information sheet; (iv) worksite visit flow chart; (v) billing procedure for the worksite visit to the workers' compensation insurer; and (vi) worksite visit form.

The employer, work supervisor, and vocational rehabilitation provider (if involved with each respective injured worker at the time) were invited to attend the worksite visit. The typical duration of a worksite visit was 45-60 minutes.

5.4.6 Outcome measures

The clinical outcomes measured were pain level, pain-free grip strength with the elbow in standard (flexion) position and in extension, and function. These clinical outcomes were measured at the initial appointment (T1), at 6 weeks (T2), and at 12 weeks (T3) after the initial hand therapy appointment.

Pain was measured during the five provocative clinical assessments using an 11-point Numeric Rating Scale (NRS) with scores ranging from 0 (no pain) to 10 (worst imaginable pain). The NRS was administered verbally and is a reliable and valid tool suitable for pain assessment in clinical practice (Karcioglu et al., 2018).

Pain-free grip strength was measured (with the patient seated) using a calibrated Jamar Hydraulic Hand Dynamometer (200 lb; 90kg) with the elbow in the standard position (elbow flexed at 90°) and in extension (0°). Testing pain-free grip strength in the standard position is a reliable and valid measure that is more sensitive to change than testing for maximal grip strength (Stratford & Levy, 1994). Pain-free grip strength with the elbow in extension and the forearm in neutral was also measured because the common tendon

origin is taut in this position and limits function more when injured (Pitts et al., 2021). Each participant completed each test three times with each hand; the average score was used to compare the affected and unaffected arms.

The Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire includes pain and function subscales that are combined to give one overall score. Possible scores range from 0 (no pain or disability) to 100 (worst possible pain and disability) (Poltawski & Watson, 2011). The PRTEE has been identified as one of the superior standardized patient outcome measures for LET (Evans et al., 2019) with excellent validity, reliability, and internal consistency (Rompe et al., 2007). A minimum change of 11 points, i.e., 37% of the baseline score, is considered clinically relevant (Poltawski & Watson, 2011).

Participants allocated to the intervention group completed the self-reported functional assessment – Patient-Specific Functional Scale (PSFS) (Hefford et al., 2012) to identify any work duties that they were having difficulty completing due to their LET. The PSFS is a valid, reliable, and responsive outcome measure of function for people with upper extremity injuries. Participants rated the identified activities on an 11-point scale from 0 (unable to perform the activity) to 10 (able to perform the activity at pre-injury level). A minimum clinically important difference of 1.2 is reported for the PSFS (Hefford et al., 2012). This self-assessment was completed prior to the worksite visit (baseline) and again at 12 weeks after the initial hand therapy appointment. The hand therapists referred to the activities and tasks identified on the PSFS by each participant to guide the workplace visits.

5.4.7 Data analyses

All outcome data were analyzed using the Statistical Package for Social Sciences (IBM SPSS version 25). For all data sets, the Kolmogorov- Smirnov test was used to determine normality of the distribution of values ($p>0.05$) to indicate whether parametric or non-parametric statistical analysis were warranted. Descriptive statistics for demographic characteristics were reported using means and standard deviations (SD) for parametric continuous variables and frequency counts for categorical variables. Pearson chi-square tests were used to determine statistical differences between groups for demographic variables of age, gender, hand dominance, injury to dominant arm, smoking status, and duration of LET symptoms. All other demographic characteristics were analyzed using Fisher's Exact tests.

The mean change between the baseline and week 12 PSFS scores for the intervention group was analyzed using a one-sample t-test. The clinical outcomes were analyzed using the Mixed Error-Component Model procedure. (Seltman, 2018) This model was chosen because it considers the correlations between measurements taken on the same individual at different time points. (Seltman, 2018) The dependent variables were pain, grip strength, and function. The independent variables were the three time points; i.e., baseline, 6 weeks, and 12 weeks, and the groups were usual care and the *Working Hands-ED* education intervention. The terms in the mixed error-component model were group, time, and group- time interaction. The interaction term was included explicitly to test whether any significant changes over time influenced both groups similarly; if the interaction term was statistically significant this would indicate that the groups behaved differently over time. The interaction term also allowed comparison of the groups at specific time points for all outcomes.

Analyses were performed twice; first using intention-to-treat (ITT) analysis and then with per protocol analysis. There were no significant differences in the outcomes when using the two data analysis methods and so results presented in this paper are those determined with ITT analysis. A critical alpha level of $p \leq 0.05$ was used to determine statistical significance.

5.5 Results

5.5.1 Demographic information

Fifty participants were assessed for eligibility; 49 met the inclusion criteria and were randomly allocated to one of the two groups. A diagram of the procedural flowchart of the study is shown in Figure 5.3. After the randomisation of participants, six participants in the intervention group did not proceed as their employer/supervisor declined a workplace-based intervention.

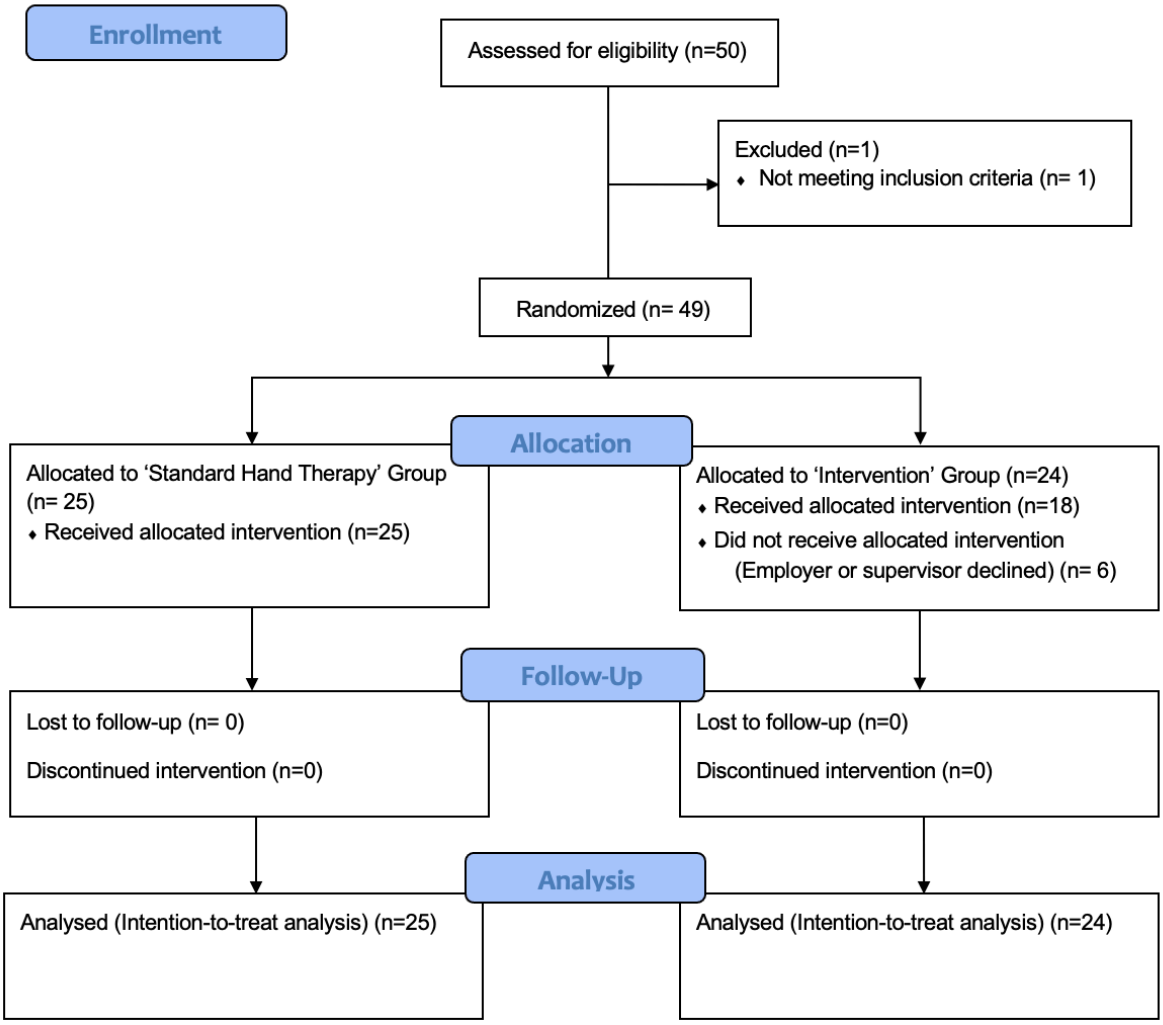

Figure 5.3 CONSORT flow diagram of participants allocated to the study.

No between-group differences for demographic characteristics (see Table 5.1) were observed at baseline ($p>0.05$). The main cause of LET injury in the control (76%) and intervention (75%) groups was repetitive movements. Manual labour workers accounted for 76% of participants in the control group and 88% in the intervention group. Participants worked in a variety of workplaces including retail shops, cafes, supermarkets, factories, and offices. Most participants in both groups presented with a first occurrence of LET symptoms.

5.5.2 Patient-Specific Functional Scale

Eighteen participants in the intervention group only completed the PSFS. The mean (SD) score at baseline was 3.3 (1.8) and the mean (SD) score at week 12 was 6.8 (2.8). The

mean (SD) change between the two time-points was 3.4 (2.4) and was statistically significant ($p<0.05$) and clinically relevant.

Table 5.1 Baseline characteristics of the participants (*N*=49)

	Control group *(n=25)*	Intervention group *(n=24)*	*p*
Age (years)			
Mean (SD)	48 (9.0)	46 (7.5)	0.453
Range	31-63	32-57	
Gender, *n* (%)			
Male	13 (52)	10 (42)	0.469
Female	12 (48)	14 (58)	
Hand dominance, n (%)			
Right	22 (88)	22 (92)	0.980
Left	3 (12)	2 (8)	
Injury to dominant arm, *n* (%)	22 (88)	20 (83)	0.162
Imaging, *n* (%)			
Ultrasound	20 (80)	22 (92)	
MRI	5 (20)	2 (8)	0.417
Smoker, *n (*%)	17 (68)	12 (50)	0.200
Occupation, *n* (%)			
Office-based	6 (24)	3 (12)	0.463
Manual	19 (76)	21(88)	
Cause of injury, *n* (%)			
Repetitive	19 (76)	18 (75)	0.578
Trauma	5 (20)	6 (25)	
Other	1 (4)	0	
Occurrence of injury, *n* (%)			
First	18 (75)	23 (96)	0.097
Recurring	6 (25)	1 (4)	
Duration of LET symptoms (weeks)			
Mean (SD)	18.3 (21.7)	10.9 (10.1)	0.606
Range	1-92	1-36	
Median (IQR)	12 (6.5-23)	7.8 (3-16)	
Acute LET (≤12 weeks), *n* (%)	15 (60)	17 (71)	0.342
Chronic LET (≥ 12 weeks), *n* (%)	10 (40)	7 (29)	
Received vocational rehabilitation services, *n* (%)	4 (8)	6 (12)	0.496

5.5.3 Intervention effects on clinical outcomes

5.5.3.1 Pain levels

A minimal clinical change of 1.1 was found for all pain outcomes in both groups (see Table 5.2). Although the mean scores for all pain outcomes statistically improved over the 12 weeks for both the control and intervention groups, there were small effect sizes (*d* <0.4). Furthermore, the interaction term for all pain outcomes were not statistically

significant (p>0.05), which indicated that there were no differences between the control and intervention groups. This means participants in both groups responded similarly over time despite the addition of the workplace-based education to the intervention group (T1-T3) (see Table 5.2).

5.5.3.2 Grip strength

The control group and the intervention group both had higher mean (SD) grip strength scores at T3 for the elbow in standard flexed position; 27.09 kg F (15.52) and 25.69 kg F (16.50) respectively, compared to the elbow in extension; i.e., 25.13 kg F (16.06) and 25.80 kg F (17.63), respectively. Those in the intervention group improved mean (SD) grip strength with the elbow in extension (5.2 kg F (11.83)) between T1 and T3, compared to the control group (2.41 kg F (17.45)), however this was not statistically significant (p>0.05). There were no significant differences in the mean grip strengths within and between the control and intervention groups over time (p> 0.05), indicating that both groups improved similarly for both grip strength outcomes.

5.5.3.3 Function

The T1-T3 change in mean (SD) scores for the PRTEE was 21.82 (18.73) for the control group compared to the T1-T3 change in the PRTEE score in the intervention group (26.65 (21.91); however, these differences were not statistically significant between the groups (p=0.538). There was a significant improvement within each group (p <0.0001), with a minimal change of more than 11-points, indicating that the improvement in PRTEE scores were also clinically relevant within each group.

Clinical outcomes	Control group (n=25) Mean (SD)			Change in mean score (SD) (95% CI) (T1-T3)	Intervention group (n=24) Mean (SD)			Change in mean score (SD) (95% CI) (T1-T3)	Within group differences (time) (T1-T3) *p*	Between group differences (group x time) (T1-T3) *p*	Effect size *d*
	Baseline (T1)	6 weeks (T2)	12 weeks (T3)		Baseline (T1)	6 weeks (T2)	12 weeks (T3)				
Pain with LE palpation	3.76 (3.00)	2.04 (2.46)	2.24 (2.10)	1.52 (2.79) (-0.14 – 3.18)	4.25 (3.14)	3.04 (2.69)	2.35 (2.89)	1.90 (4.70) (0.19 - 3.61)	0.005*	0.736	0.044
Pain with CETO palpation	4.96 (2.49)	2.72 (2.69)	2.24 (2.51)	2.72 (2.64) (1.33 - 4.11)	4.83 (2.68)	3.13 (2.53)	2.22 (2.86)	2.61 (4.45) (1.04 - 4.18)	<0.0001*	0.842	-0.007
Pain with resisted wrist extension	4.24 (3.15)	2.08 (2.25)	1.90 (2.21)	2.34 (3.05) (0.82 - 3.86)	5.04 (2.79)	3.52 (2.84)	2.61 (2.61)	2.43 (3.37) (0.9 - 3.96)	<0.0001*	0.768	0.294
Pain with MF test	2.72 (2.69)	1.72 (2.19)	1.14 (1.90)	1.58 (2.49) (0.53 - 2.63)	4.25 (2.85)	2.30 (2.64)	1.87 (2.26)	2.38 (2.87) (0.93 - 3.83)	0.0003*	0.588	0.350
Pain with resisted supination	3.12 (2.67)	1.84 (2.21)	1.62 (2.20)	1.5 (2.30) (0.14 - 286)	4.00 (2.57)	2.48 (2.43)	2.83 (3.02)	1.17 (4.30) (-0.42 - 2.76)	0.011*	0.865	0.459
Grip strength elbow flexed (affected arm) Kg F	25.15 (15.29)	27.66 (15.65)	27.09 (15.52)	-1.94 (15.9) (-6.3 - 2.42)	24.11 (16.05)	25.30 (14.96)	25.69 (16.50)	-1.58 (11.13) (-10.79 - 7.63)	0.797	0.977	-0.087
Grip strength elbow extend (affected arm) Kg F	22.72 (17.31)	26.36 (16.77)	25.13 (16.06)	-2.41 (17.45) (-11.66 -6.84)	20.60 (17.20)	22.23 (17.05)	25.80 (17.63)	-5.2 (11.83) (-15.05 - 4.65)	0.512	0.792	0.040
PRTEE score	51.47 (13.01)	31.48 (20.48)	29.64 (18.64)	21.83 (18.73) (12.92 -30.74)	60.22 (18.98)	44.41 (19.00)	33.57 (24.23)	26.65 (21.91) (17.46 - 35.84)	<0.0001*	0.538	0.182

Table 5.2 Analyses of mean (SD) change for clinical outcomes; time and time x group

5.6 Discussion

5.6.1 Main findings

Lateral elbow tendinopathy is a common upper limb musculoskeletal condition commonly affecting the dominant arm that can lead to pain and functional limitations. As a result, LET has been linked to reduced productivity, lost time from work, and residual disability (Korthals-De Bos et al., 2004; Struijs et al., 2006). There is a lack of consensus on the best treatment approach for LET and lack of research into the effectiveness of individualized workplace interventions. To our knowledge, this study is the first of its kind to measure the efficacy of including specific education within the context of the work environment as part of hand therapy management program for injured workers with LET. This RCT found that (i) the addition of a workplace-based educational intervention delivered by the treating hand therapist did not negatively or positively impact on the clinical outcomes of pain, grip strength, or function at 12-weeks, and (ii) a multimodal standard hand therapy program improved the patients' pain and function regardless of whether the education component was delivered in the clinic or the patients' workplaces.

5.6.2 Workplace-based intervention for LET

Although our study did not identify statistical differences between the two groups, the results from the PSFS demonstrated a statistical difference and clinical relevance at 12-weeks for the 18 participants that received the novel intervention. This suggests that the addition of *Working Hands-ED* to standard hand therapy may still be beneficial for some injured workers with LET. The findings of our study add to the current body of knowledge about workplace interventions for work-related upper extremity disorders that have yielded mixed outcomes (Hoosain et al., 2019; Van Eerd et al., 2016; Williams et al., 2004). A recently published review, which included studies of individuals with a range of work-related conditions, identified high-quality evidence for workplace exercise programs in various employment settings and mixed evidence for ergonomic training and behavioural counselling for upper limb conditions (Hoosain et al., 2019). That review concluded that while there is substantial evidence for workplace exercise programs, other workplace-based interventions require more high-quality research (Hoosain et al., 2019). Another systematic

review identified that workplace-based interventions had a positive effect on reducing lost time and costs associated with musculoskeletal, pain-related, and mental health conditions (Cullen et al., 2018).

The inclusion of *Working Hands-ED* to standard hand therapy added AUD$366.40 to the cost of delivering hand therapy services for injured workers in the intervention group, based on the medical fee schedule for delivering hand therapy services in the Western Australian workers' compensation system (WorkCover WA, 2015). The additional cost included the hand therapist's time to travel from the clinic to the workplace (and return) and the time spent delivering the workplace education. The workplace education typically took longer than the time spent to deliver education within with standard hand therapy treatment during a clinic visit. The majority of workers' compensation insurers who accepted liability for the participants allocated to the intervention group were agreeable to providing remuneration for the additional service delivery costs associated with including the worksite visit as part of the injured workers' hand therapy treatment because the insurers supported a workplace-based approach to interventions that focused on enabling a durable RTW.

Although the findings of this study indicated the intervention did not have superior clinical outcomes compared to standard hand therapy care, it is unknown if and how the workplace-based education provided affected work outcomes such as absence from work, RTW status, and costs associated with the overall workers' compensation claim. Furthermore, it is unknown if and how the intervention affected the participants' psychological health and patient-perceived outcomes.

5.6.3 Efficacy of a multimodal approach

Our study found that a multimodal approach, inclusive of the provision of wrist and elbow orthoses, use of heat packs, soft tissue therapy, passive stretches, and eccentric exercises based on the participants clinical needs, education about pathology and healing timeframes, general discussion of activity modification principles, and prescription of a self-management approach, yielded positive clinical outcomes of pain levels and function for both groups by 12-weeks. These findings are consistent with a recent study that found a self-management program consisting of education, stretches, activity modification, and pain management were effective in reducing pain and increasing function among patients with

LET (McQueen et al., 2020). The approach used by McQueen et al (2020) and in this RCT is consistent with the ICF guidelines, i.e., enabling patients with LET to self-manage their condition through educational resources and home exercise programs.

Our study included eccentric strengthening exercises as part of standard hand therapy care. There are mixed reviews in the literature regarding the effectiveness of eccentric exercises (Chen & Baker, 2020; McQueen et al., 2020; Stasinopoulos & Stasinopoulos, 2017). The results of our RCT indicated that the inclusion of eccentric exercises using weights within a multimodal program improved pain and function but did not affect grip strength.

The standard hand therapy treatment delivered in our study focused primarily on controlling elbow pain, preserving movement, and improving grip strength and function. These outcomes are consistent with common goals of LET treatments reported in the literature (Ahmad et al., 2013; Hudak et al., 1996). Prior studies also identified that a multimodal approach was more effective than stand-alone physical treatments (Bisset & Vicenzino, 2015b; Coombes et al., 2015; Hong, 2003; Smidt et al., 2003). Traditional treatments for LET primarily target pain reduction with other pain-focused interventions including corticosteroid injections; physical therapy modalities such as extracorporeal shock-wave therapy; bracing; and anti-inflammatory medications (Ahmad et al., 2013; Lenoir et al., 2019). Lateral elbow tendinopathy was previously considered an inflammatory condition, and this may explain the use of these traditional treatments. Recent histological research has determined LET is a tendinosis; a degenerative process rather than an inflammatory one (Bhabra et al., 2016; Waugh, 2005). Hand therapy treatments are typically delivered within clinic settings, with information about the injured worker's job duties, postures and movements required, and equipment/tools used obtained via verbal reports from the injured worker and sometimes from the employer. Our study findings suggest that education about occupational risk factors within the clinic setting provided similar clinical outcomes to education provided within the workplace.

5.6.4 Education about occupational risk factors

Our research findings suggest that education about LET pathology, healing time frames, positions to avoid, and activity modification principles discussed within the clinic setting are as effective in reducing participants' pain and improving function as an

additional workplace-based educational intervention. These findings were in contrast to our hypothesis that having the hand therapist provide more individualized education within the workplace setting would provide superior clinical outcomes than standard care. One explanation could be that the participants were of heterogeneous gender and worked in a variety of workplace settings and occupations. Future studies should focus on individuals with LET who work in high-risk occupations such as painters, plumbers, carpenters, auto workers, cooks, and butchers (Shiri et al., 2006; Shiri & Viikari-Juntura, 2011). Furthermore, due to the funding constraints of this study, the workplace-based intervention was delivered at a single visit. Future studies should explore benefits of at least two worksite visits in order to determine compliance with workplace recommendations made after the first visit.

The majority of participants in our study had a dominant arm injury and the main causes of their injuries were reportedly repetitive movements sustained while performing manual occupations. This finding is consistent with other studies that identified the risk of LET was highest for heavy manual labourers and workers whose jobs involved repetitive motions (Haahr & Andersen, 2003; Herquelot et al., 2013). There is strong evidence to indicate that occupational exposure to high hand force, repetitive elbow flexion and extension for >2 hours per day, and non-neutral elbow and wrist postures may lead to the development of LET (Descatha et al., 2013, 2015). A focus on occupational risk factors should be a priority in the hand therapy treatment of workers with LET. When implementing *Working Hands-ED*, the hand therapists were required to assess for these occupational risk factors with the injured workers at their workplaces and communicate their findings to other stakeholders in a summary report. This facilitated open communication with those involved with the return-to-work process about appropriate work recommendations. Each worker's medical practitioner can use this information to approve a graduated RTW aligned with the hand therapist's recommendations. Understanding the physical, organizational, and social demands of the workplace can help a hand therapist to understand the occupational risk factors present and guide the development of education and advice to manage those risk factors to increase the injured worker's functional capacity to return to work.

5.6.5 Study limitations

This study had several methodological limitations. Firstly, the study was comprised of a small sample due to the strict inclusion and exclusion criteria, and reliance on physician referrals to the hand therapy practice of injured workers with LET who were in receipt of workers' compensation. Consequently, the study may have been underpowered to detect between-group differences in clinical outcomes and therefore a study with a larger sample is required to confirm the results. Secondly, the PSFS was used only for participants in the intervention group in order to identify work duties appropriate for the worksite visit and not as an outcome measure for both groups; therefore, self-rated function could not be compared between the groups over time. Thirdly, there were no formal outcome measures to evaluate adherence or compliance to workplace modifications made for those in the intervention group; therefore, it is unknown if all the recommendations made by the hand therapists were carried out at the workplace. Research to understand the experiences of the hand therapists that delivered this intervention may provide valuable insights on ways to improve the workplace-based intervention.

Lastly, the RCT only measured short-term clinical outcomes (i.e., up to 12 weeks); therefore, the impact of the workplace-based intervention on long-term clinical outcomes with the participants is unknown. There is also the potential for confounding factors to influence the outcomes for participants allocated to both groups in the RCT. Other stakeholders within this study, such as the insurance case manager or medical practitioner are likely to prescribe other co-interventions such as a corticosteroid injection, trial of blood injections, acupuncture, dry needling and/or referral to orthopaedic surgeon for review if the injured worker's symptoms did not improve within the first 3-6 months of hand therapy. Many of these other interventions may have benefits in the short-term but not in the longer-term. Studies with a 6–12-month follow-up may provide better a better indication of any unique benefit of the workplace-based education on improving clinical outcomes in injured workers with LET.

5.6.6 Future recommendations for hand therapists

Hand therapists have comprehensive knowledge of upper limb anatomy, function, and biomechanics. This expertise combined with a biopsychosocial approach that incorporates the injured worker's work environment is a novel approach to hand therapy

that differs to the current prescriptive clinical management of LET reported in the literature. Previous reviews and cross-sectional studies have reported education about activity modification and ergonomics as part of a multimodal treatment program for LET (Bateman et al., 2018; Coombes et al., 2015; Greenfield & Webster, 2002); however, no previous studies have established the content, structure, and context of the education provided. Furthermore, to our knowledge, no previous studies have focused on a workplace-based education approach in the hand therapy management of this common work-related condition. The findings of this RCT suggest that the five-step approach of the novel *Working Hands-ED* intervention may be used as a future guide to manage work-related LET. The education provided through *Working Hands-ED* is unique because it is relevant to the individual injured worker and tailored to their specific work tasks and activities. Furthermore, the timing of the intervention (within the first four weeks of hand therapy) gave the opportunity for the hand therapists to assess for occupational risk factors that may inhibit early RTW. It also provided hand therapists with an earlier opportunity to identify other appropriate services that may be warranted, such as vocational rehabilitation.

5.7 Conclusion

The findings of this study suggest that the addition of a hand therapist-delivered workplace-based education to standard hand therapy to manage work-related LET did not result in superior clinical outcomes for pain, grip strength, and function. The study identified that a multimodal self-management approach used by hand therapists improved their patients' pain and function regardless of whether the education component was given in the clinic or the workplace.

5.8 Acknowledgements

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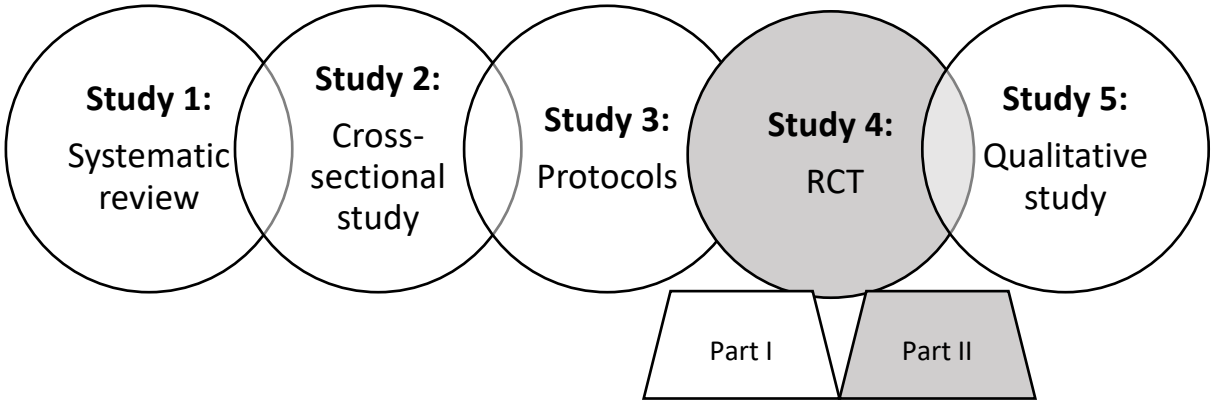
Chapter 6

Study 4: (Part II): Randomised Controlled Trial: Impact on work status, duration, and cost of hand therapy services.



Chapter 6 is titled 'The impact of a workplace-based hand therapy intervention on work status, and duration and cost of hand therapy services for injured workers with lateral elbow tendinopathy. The original secondary work-related outcomes of interest for the RCT reported in Chapter 5 were (i) return to work (RTW), (ii) total workers' compensation claims costs, and (iii) total workers' compensation claims duration. Due to difficulties accessing data on claims durations and costs from all insurance case managers of consenting participants, the secondary outcomes were revised to: (i) RTW status, (ii) duration of hand therapy services; (iii) number of hand therapy sessions; and (iv) cost of hand therapy services paid by the workers' compensation insurer. These outcomes were chosen to contribute new evidence to address the overall research question, which is "What is the impact of adding a workplace-based hand therapy intervention to standard hand therapy on clinical and RTW outcomes?" and are presented in Chapter 6. Data on the secondary

outcomes were collected concurrently with the clinical outcomes described in Chapter 5; however, they were collected beyond the 12-week follow-up of clinical outcomes in the RCT. Relevant information on the RCT methodology reported in earlier chapters of this thesis are referred to in Chapter 6 to minimise repetition.

6.1 Introduction

Lateral elbow tendinopathy (LET), commonly referred to as tennis elbow, has an incidence of 3.4 per 1000 people (Sanders et al., 2015) and a prevalence of 1-3% of the general population (Shiri et al., 2006; Torres da Costaa et al., 2015). An association between physical work factors and lateral elbow tendinopathy has been identified in population-based studies (Haahr & Andersen, 2003; Shiri et al., 2006; Walker-Bone et al., 2012). Work tasks requiring repetitive bending and straightening of the elbow (Walker-Bone et al., 2012), manual handling of heavy loads, high handgrip forces, or the use of a vibrating tool were associated with the development of LET (Shiri et al., 2006). Therefore, occupational groups at high risk of developing LET include those working in manually intensive jobs such as butchers, construction workers, painters, and automobile assembly workers (Walker-Bone et al., 2012).

There are numerous costs that workplace injuries incur for injured workers, employers, insurers, and society. The Australian Institute of Health and Welfare analysed the costs of injury and disease in Australia and found that musculoskeletal injuries were the fourth highest in terms of health expenditure, with an average of AUD$3 billion spent on direct and indirect health care costs (Australian Institute of Health and Welfare, 2020). Direct government costs of workplace injury include legislated incapacity payments for lost earnings, medical costs, and workplace rehabilitation costs. Indirect costs of workplace injury to the employer include potential loss of productivity; loss of worker skills, knowledge, and experience; absenteeism and presenteeism among injured workers; staff turnover; potential industrial relations conflict, and cost of recruitment and training of replacement staff (Australian Institute of Health and Welfare, 2020; Barnett et al., 2010). Direct and indirect costs for injured workers may include loss of income; loss of work skills; social isolation and secondary psychological problems; and reduced participation in self-care, work, and leisure activities (Australian Institute of Health and Welfare, 2020; Barnett et al., 2010).

Stakeholders in the Australian workers' compensation system (e.g., healthcare providers, medical practitioners, employers, insurance case managers and workplace rehabilitation providers) have a direct interest in the RTW process and share a common goal of facilitating the injured worker's return to work (Young et al., 2005). The primary aim of work rehabilitation is to return the worker to the same job and same employer following

injury, illness, or disease (Cook & Lukersmith, 2010; Workcover WA, 2020). Secondary aims are to reduce healthcare costs, decrease lost workdays, and increase worker satisfaction and productivity (Cook & Lukersmith, 2010). The RTW hierarchy (Figure 6.1) outlines the most-preferred to least-preferred RTW options and is commonly used to guide the decision-making processes among stakeholders (Cook & Lukersmith, 2010).

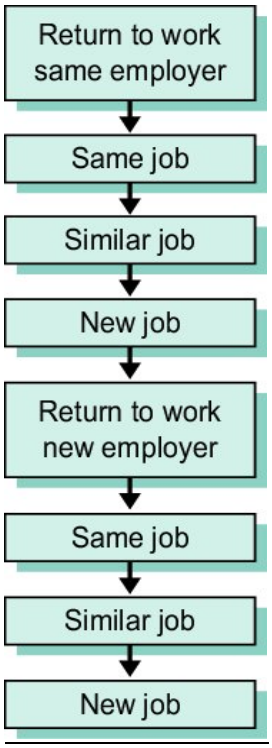


Figure 6.1 Return to work hierarchy (Cook & Lukersmith, 2010, p. 394).

If the medical practitioner has certified the injured worker as unfit for work, the employer is still required to pay weekly compensation payments to the injured worker. This amount is reimbursed by the insurer from the 'Prescribed Amount' that all employees are entitled to under the Workers' Compensation and Injury Management Act 1981. The Prescribed Amount as of 1 July 2022 is AUD$243,991 (WorkCover WA, 2022a). Injured workers receive their weekly workers' compensation payments (the amount depends on the award contract agreement) for the first 13 weeks and then after this period, the weekly payments reduce to 85% of the average weekly earnings (if not employed under the industrial award). Injured workers do not receive additional allowances, overtime, or bonuses while in receipt of workers' compensation payments (WorkCover WA, 2022b). The weekly compensation payments will reduce or cease if: (i) the injured worker has returned

to work at full capacity; (ii) the treating medical practitioner has certified the injured worker is totally or partially fit to return to work; (iii) the workers' compensation claim is finalised through a settlement; (iv) the injured worker pursues a common law claim; or (v) the injured worker has received the maximum limit on their entitlement to weekly payments (WorkCover WA, 2022b).

In complex claims or when an injury becomes chronic, the injured worker may be referred to a WorkCover WA-approved workplace rehabilitation provider (WRP) to assist in the RTW process (Workcover WA, 2020). Workplace rehabilitation providers are a variety of professional disciplines including occupational therapists, physiotherapists, chiropractors, exercise physiologists, or psychologists with expertise in addressing the physical, psychological, and workplace barriers that may prevent injured workers from returning to work (WorkCover WA, 2020). These services are covered under the 'Vocational Rehabilitation Expenses' (7% of the Prescribed Amount- AUD$17, 079; WorkCover WA, 2022a). Standard workplace rehabilitation services include a job task analysis to identify job duties and associated physical and cognitive demands, recommendations for modifications to the work environment or workflow, provision of ergonomic equipment and/or assistive technologies, and recommendations for a graduated RTW program that involves suitable alternative duties to maintain the injured worker at the workplace coupled with progressively challenging work duties and time on work shifts to build work capacity (Sharan, 2012). Given the diverse professional qualifications of workplace rehabilitation providers, they may or may not have specific knowledge or skills in the management of upper extremity musculoskeletal injuries, including LET.

Hand therapists are integral members of the multidisciplinary medical team and provide essential information to other stakeholders to assist with developing and implementing RTW interventions for workers with hand and upper limb injuries. As part of the process of assisting injured workers back to their pre-injury work and employer, hand therapists are required to complete a Treatment Management Plan (TMP) (WorkCover WA, 2019). The TMP is a document specific to work-related hand and upper limb injuries and is designed to clarify treatment options for workers who are likely to require more than 10 upper limb consultations or 4+ weeks of treatment. The TMP is a communication method that provides insurers with a mechanism to determine whether the upper limb treatments and associated costs for an injured worker are reasonable (WorkCover WA, 2019). Using

their expert knowledge of the upper limb condition and findings from a preliminary clinical assessment, hand therapists are expected to provide information regarding the anticipated timeframes and the total number of clinical appointments required for the injured worker (WorkCover WA, 2019). The cost of hand therapy and the completion of a TMP are covered under the 'Medical and Hospital Expenses' (30% of the Prescribed Amount – AUD$73,197; WorkCover WA, 2022a).

The most common hand therapy treatments to manage LET are typically delivered within a clinic setting, although hand therapists and medical practitioners have recently supported the idea of hand therapists providing workplace-based education (Tran et al., 2020). An RCT was conducted to investigate the impact of adding a hand therapy workplace-based intervention (*Working Hands-ED*) to standard hand therapy on the management of LET among injured workers with a diagnosis of work-related LET (see Chapter 5). This study found statistically significant improvements in pain and functional outcomes at 12-weeks for both the intervention group and the control group receiving standard hand therapy only (Tran et al., 2021). Furthermore, the injured workers in both groups improved significantly in their abilities to perform work tasks as reported on the Patient-Specific Functional Scale at 12-weeks compared to the initial assessment (Tran et al., 2021).

To date, no previous studies have investigated the financial impact and quantified the duration and number of hand therapy sessions received by injured workers with LET within the WA workers' compensation system. There is also no data available on timeframes and costs associated with delivering hand therapy services in the workplace. This information may shape expectations among key stakeholders, especially insurers who authorise payments for hand therapy services for compensable work-related hand and upper limb injuries, about clinic-based versus workplace-based hand therapy management of injured workers with LET as part of the RTW process.

6.1.1 Study aim

This study aimed to identify the impact of adding *Working Hands-ED* to standard hand therapy care on the RTW status of injured workers with LET; and the number and duration of hand therapy treatment sessions, and associated costs.

6.1.2 Outcomes

The revised secondary outcomes of the RCT were (i) the RTW status of the participants; (ii) total duration (in weeks) of hand therapy services delivered; (iii) total number of hand therapy sessions delivered; and (iv) total costs of hand therapy services delivered. The RTW status using the categories in the RTW hierarchy (i.e., unfit for work, performing modified duties for modified hours, performing modified duties for pre-injury hours, and performing pre-injury duties for pre-injury hours) of each participant in both groups was documented at baseline, 6-weeks, 12-weeks, and 26-weeks. The total costs and duration of hand therapy services were calculated for each participant from the initial appointment (baseline) to the date of discharge from hand therapy services.

6.2 Method

The secondary outcomes were measured during the RCT. Information about the RCT study design, the participants, and interventions in the RCT are described in sections 5.4.1 to 5.4.5 of this thesis. The CONSORT flow diagram for the RCT is presented in section 5.3 of this thesis.

6.2.1 Data analyses

The Statistical Package for Social Sciences (IBM SPSS version 25) was used to perform all statistical analyses. A comparison of work status between the control and intervention groups at each time point was performed using Fisher's Exact test because of the small sample size. A p-value of <0.05 was used to indicate statistically significant between-group differences. The non-parametric Mann-Whitney U test was used to compare the average total hand therapy costs, durations, and hand therapy occasions of service between groups. This was used in preference to the t-test because of the skewness in the distributions of the data for these outcomes (Seltman, 2018). The costs and duration of hand therapy services were compared according to the treatment received; therefore, a per-protocol approach was used for analysis of these outcomes.

6.3 Results

6.3.1 Demographic information

Please refer to section 5.5.1 and Table 5.1 of this thesis for the detailed demographic information of all participants in the RCT. Most of the participants (76%) worked in manual jobs and reported that the cause of their injury was repetitive movements (76%). Eighteen of the 24 participants randomly allocated to the intervention group received the additional workplace-based hand therapy intervention. Six of the participants randomly allocated to the intervention group did not receive a workplace-based intervention due to the employer or supervisor declining the service.

6.3.2 Work status of participants at baseline

Most participants were working 'Modified duties, pre-injury hours' when their baseline clinical measures were taken. There was an almost equal number of participants in each work status category for both the control and intervention groups at baseline as seen in Table 6.1

Table 6.1 Participants' work status' at baseline; N=49

Work status	Control group n (%) n=25	Intervention group n (%) n=24	Total n (%) N=49
Unfit for work	3 (12)	3 (12.5)	6 (12.2)
Modified duties, modified hours	4(16)	4(16.7)	8 (16.3)
Modified duties, pre-injury hours	14 (56)	14 (58.3)	28 (57.1)
Pre-injury duties, pre-injury hours	4 (16)	3 (12.5)	7(14.3)

6.3.3 Nature of work occupations

Information regarding the work roles of participants in the control and intervention groups and a description of how they sustained their LET injuries are presented in Tables 6.2 and 6.3.

Table 6.2 Work roles and cause of LET injury (control group)

Participant ID	Gender	Age (y)	Occupation	Cause of injury
1	Female	52	Personal assistant	Repetitive work (computer-based)
2	Male	39	Truck driver	Lifting heavy bin
3	Female	58	Coles service operator	Repetitive use
4	Male	43	Landscaper	Digging out stump
5	Female	34	Marketing consultant	Repetitive (computer-based)
6	Female	62	Cleaner	Trolley vs. arm
7	Male	68	TAFE lecturer	Repetitive lifting
8	Male	38	Truck driver	Repetitive lifting, carrying and pulleying trolley
9	Male	46	Butcher	Repetitive use
10	Female	56	Retail assistant	Repetitive use
11	Male	61	Handyman	Arm vs. trolley handle
12	Female	44	Retail manager	Heavy lifting
13	Female	43	Retail assistant (sales)	Gradual onset/ repetitive use
14	Female	50	Chemist	Repetitive use
15	Female	66	Sales assistant	Repetitive use
16	Female	52	Domestic assistant	Repetitive manual lifting
17	Male	61	Welder	Repetitive welding and grinding
18	Female	53	Lecturer	Computer use
19	Male	57	Sample preparer	Repetitive use
20	Male	50	Technician	Lifting supplies off conveyor belt
21	Female	55	Retail a assistant	Repetitive use
22	Male	52	Truck driver	Repetitive heavy lifting
23	Male	48	Boiler maker	Repetitive heavy lifting
24	Male	57	Diesel mechanic	Repetitive tool use
25	Male	64	Mechanical fitter	Repetitive lifting of materials

Table 6.3 Work roles and cause of LET injury (intervention group)

Participant ID	Gender	Age (y)	Occupation	Cause of injury
1	Female	51	Retail worker (Supermarket)	Repetitive lifting of crates
2	Male	37	Forklift driver	Operating forklift for long periods of time
3	Male	59	Truck driver	Getting in/out of truck
4	Male	39	Firefighter	Lifting heavy equipment
5*	Male	43	Stonemason	Lifting limestone block
6	Female	48	Administrative assistant	Busy work period (office-based duties)
7	Male	38	Paramedic	Lifting heart monitors repetitively for training

8	Female	50	Chef	Gradual onset – kitchen work
9	Female	41	Retail worker (Sales)	Repetitive work during busy Christmas period
10*	Male	58	Machinist	Catching falling steel bar
11	Female	44	Cleaner	Changing bedsheets and pillowcases repetitively
12	Male	46	Surveyor	Repetitive use of a sledgehammer
13	Female	41	Store person	Unstacking boxes repetitively
14*	Female	54	Carer	Manual work (client transfers)
15	Female	47	Kitchenhand	Repetitive lifting
16*	Male	52	Teacher	Spray painting sea containers for arts project
17	Male	59	Delivery driver	Lifting parcels repetitively
18	Female	61	Retail manager	Lifting bed mattresses
19	Female	56	Manager	Knocked elbow in doorframe
20	Female	57	Baker	Repetitive pulling and lifting of trays
21*	Male	55	Research officer	Repetitive lifting of PVC pipes
22	Female	51	Factory worker	Operating machinery in meat processing factory
23	Female	43	Gardener	Repetitive use of hedge trimmer
24*	Male	53	Traffic controller	Removing portable fences

* Did **not** receive workplace-based intervention

6.3.4 Work status

The work status of participants (by group) at baseline, 6-weeks, 12-weeks, and 26-weeks are presented in figures 6.2, 6.3, 6.4, and 6.5, respectively. At baseline, more than half of the participants in the control (n=14; 56%) and the intervention (n=14; 58%) groups were performing 'modified duties at pre-injury (PI) hours', with no significant difference in work status between groups (p=1.0).

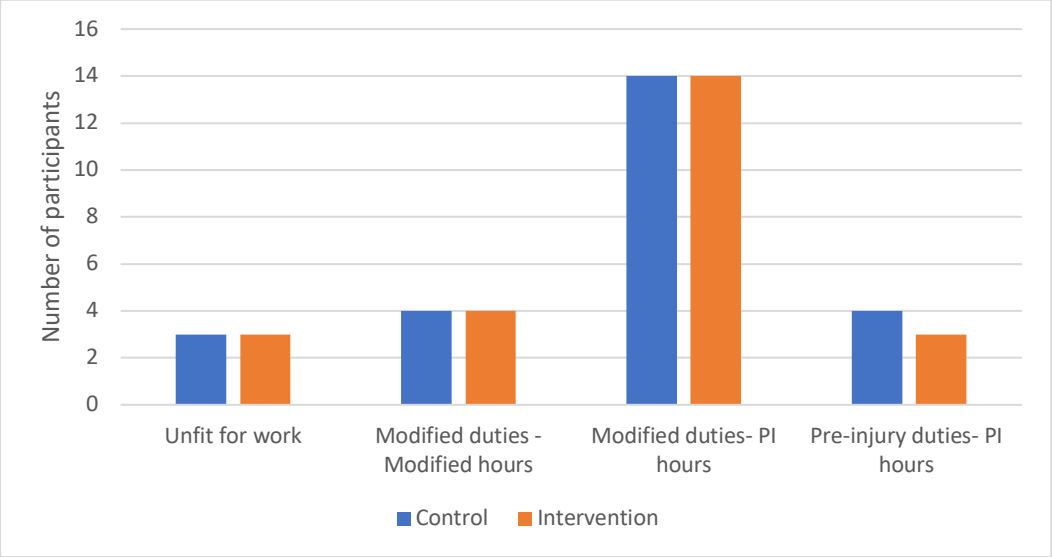


Figure 6.2 Participants' work status at baseline (N= 49); *p*=1.0

By week 6, similar percentages of participants in the control (n= 14; 58%) and intervention (n=13, 54%) groups retained a 'modified duties at pre-injury hours' work status. The work status for one participant (who was allocated to the control group) was missing as these data were not obtained by the hand therapist (i.e., the participant attended their appointment, but their data were not documented).

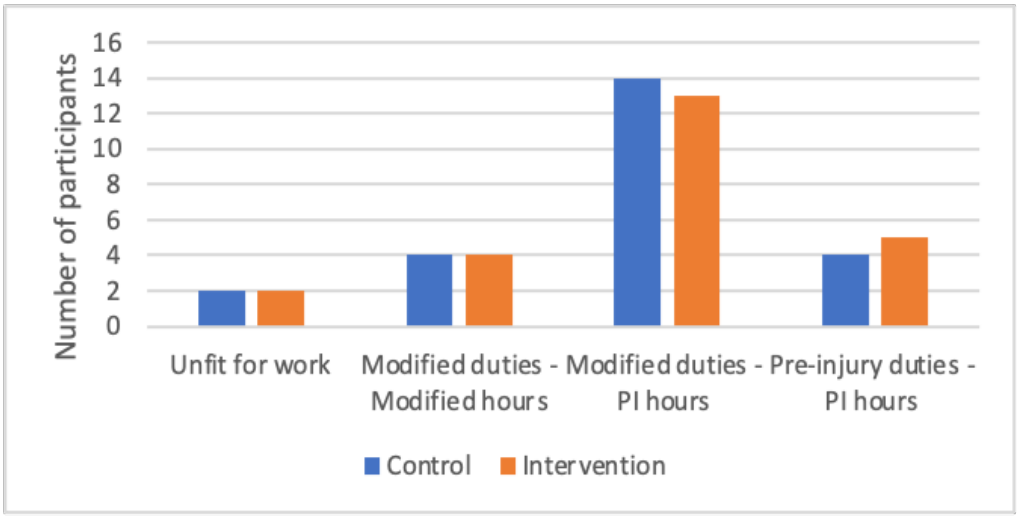


Figure 6.3 Participant's work status at Week 6 (N=48); *p*=1.0

At 12 weeks, more than double the number of participants in the intervention group (n=8; 36%) had returned to pre-injury duties at pre-injury hours compared to the control group (n=4; 17%); however, this difference was not statistically significant (p=0.56). The

work status for four participants (n=2 from the control group and n= 2 from the intervention group) are missing as this data was not obtained by the hand therapist (i.e., the participants attended their appointment, but this data was not documented).

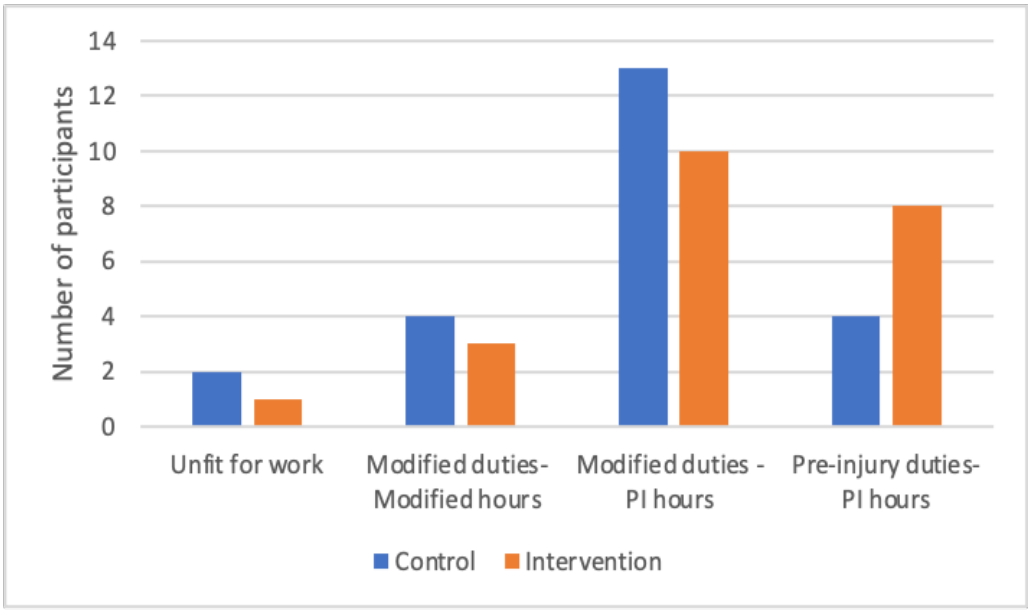


Figure 6.4 Participant's work status at Week 12 (N=45); *p*=0.56

There was a significant between-group difference in RTW status at 26 weeks (*p*=0.004). Most participants in the intervention group (63%) were working pre-injury hours and performing pre-injury duties, whereas most participants in the control group (69%) were working pre-injury hours but still performing modified work duties. There are missing data due to nine participants dropping out of the study, hand therapists not documenting the work status of six participants at this time point, or the discharge of five participants from hand therapy services prior to the 26-week time point.

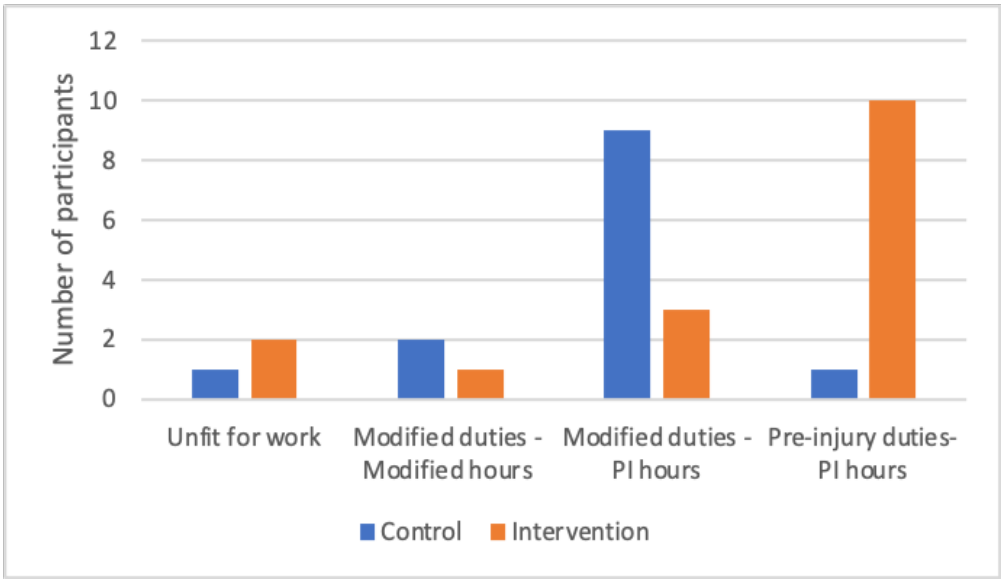


Figure 6.5 Participant's work status at Week 26 (N= 29); *p*=0.004

6.3.5 Total duration, number of hand therapy sessions, and hand therapy costs

Participants in the intervention group received on average, seven more hand therapy sessions compared to the control group (see Table 6.3), but this difference was not statistically significant. Hand therapy services were delivered to the intervention group for nearly six months longer than the control group. The cost of hand therapy services was AUD$1230.55 higher for those in the intervention group. The mean (SD) number of hand therapy sessions and total weeks of hand therapy services delivered, and the associated costs are summarised in Table 6.3.

Table 6.4 Total duration, number of hand therapist sessions, and hand therapy costs

	Control group (n=25) Mean (SD)	Intervention group (n =24) Mean (SD)	Between-group mean difference	*p*
Duration of hand therapy services (weeks)	30 (17.7)	55 (36.9)	25	0.013*
Number of hand therapy sessions	17 (8.2)	24 (12.8)	7	0.106
Total hand therapy cost (AUD$)	2917.68 (1458.59)	4148.23 (1975.94)	1230.55	0.032*

* $p = 0.05$ indicating statistical significance

6.4 Discussion

This study aimed to identify the impact of adding *Working Hands-ED* to standard hand therapy care on the RTW status, hand therapy costs, number of hand therapy sessions, and total duration of treatment. The main finding was that by 26 weeks, significantly more participants in the intervention group had returned to their pre-injury duties and hours; however, overall, they received more weeks of hand therapy service and had higher associated costs.

The benefits of having injured workers return to pre-injury duties are reduced health care costs, decreased lost workdays, and increased workers' satisfaction and productivity (Cook & Lukersmith, 2010). Within the workers' compensation context, the costs associated with payment of weekly wages and medical expenses to injured workers who are not performing their pre-injury roles at full capacity may be considered 'the tip of the iceberg'. There are many hidden costs associated with compensable work absence to the insurer, the employer, the injured worker, and the wider community.

6.4.1 Economic impact on insurers

The preliminary findings of our study indicate that the insurers may receive an economic benefit from the addition of *Working Hands-ED* to the standard clinical hand therapy management of injured workers with LET. In the RCT described in this chapter, the addition of *Working Hands-ED* incurred an extra cost of AUD$1230.55 to the costs of standard hand therapy, which was associated with delivering the hand therapy education at

the injured workers' workplace. However, a greater proportion of injured workers who received the *Working Hands-ED* intervention were able to return to their pre-injury duties and work hours at 26-weeks than those who received the stand hand therapy. Although insurance companies are not required to reimburse wages to an employer once an injured worker has resumed working at full capacity (WorkCover WA, 2022b), if injured workers are unable to work due to their injury, then the employer is required to pay weekly compensation payments in a normal manner and the insurance company reimburses this amount from the Prescribed Amount (AUD$243,991) (WorkCover WA, 2022a). Therefore, the longer the injured worker is not able to return to their pre-injury duties and roles, the more costs associated with compensating the loss of income is incurred by the insurer (WorkCover WA, 2022b).

The 2018/19 annual report of workers' compensation claims in Western Australia identified that the majority of claims were associated with musculoskeletal disorders, with one-third involving the upper limb (WorkCover WA, 2020). These musculoskeletal injury claims were characterised by an average of 110 days of lost time from work and an average cost of AUD$56 235 per claim (WorkCover WA, 2020). Therefore, from an economic perspective, the additional fee of AUD$1230.55 to perform the workplace education is a negligible added cost that has potential to reduce overall claims costs.

6.4.2 Direct and indirect costs to employers

It is estimated that Australian employers paid AUD$8.4 billion in workers' compensation premiums in the 2012/13 financial year that are calculated in part using previous years' claims costs for work-related injury and disease (Safe Work Australia, 2015). Direct costs incurred by employers include increased insurance premiums and legal costs associated with common law cases claiming worker injuries arising from employer negligence. Indirect costs include workplace absence and loss of productivity by injured workers. A provision of WA's workers' compensation legislation is that employers must provide an injured worker with suitable work duties that comply with the recommendations provided by the injured worker's treating medical practitioner (Workcover WA, 2020). To achieve this, the employer may have to pay additional wages to existing employees who work extra hours to fulfil some or all the elements of the injured worker's job duties. If an injured worker is deemed unfit for work there are additional costs for recruitment and

training of replacement staff, reduced team morale, and the time required to complete paperwork and administrative tasks associated with managing compensation claims (Safe Work Australia, 2015, 2022).

The findings from our study highlighted a higher proportion of injured workers with LET who received workplace-based education from a hand therapist returned to their pre-jury duties and hours than those who received clinic-based care only. This outcome has the potential to reduce some of the aforementioned direct and indirect costs incurred by employers following a workplace injury. The addition of *Working Hands-ED* to the standard hand therapy management of injured workers with LET yielded other potential benefits to the employer. The hand therapists were able to provide individualised education and recommendations on activity modification and changes to the physical environment to support the injured workers' RTW and reduce the risk of exacerbating the injury. They involved the supervisors and/or employer in this process to ensure all stakeholders received the same information. Evidence suggests that RTW is more successful when employees feel supported (Cancelliere et al., 2016; Hoefsmit et al., 2014) and when work accommodation is available (Franche et al., 2005).

6.4.3 Benefits to the injured worker

Engaging in paid and unpaid work can provide individuals with opportunities to contribute to society and develop a sense of belonging in the community (Cook & Lukersmith, 2010). Having a worker role contributes to a person's identity, quality of life, and provides meaning and satisfaction (Cook & Lukersmith, 2010). Conversely, absence from work following a work injury has been associated with depression, decreased participation in activities of daily living, social isolation, psychological distress, and negative impacts on family and social relationships (Hoefsmit et al., 2014; Ruseckaite & Collie, 2013; Young et al., 2005). The 'Health Benefits of Good Work' initiative has been used by Australasian occupational physicians over the past decade in achieving RTW following workplace injury (Australasian Faculty of Occupational and Environmental Medicine, 2015). This initiative recommends that injured workers remain engaged in their meaningful occupations (work) as part of their rehabilitation process to overcome injury illness or disease (Australasian Faculty of Occupational and Environmental Medicine, 2015).

The main cause for the development of LET among participants in our study was repetitive use of the upper limb to perform work tasks in mostly manual labour occupations. These findings are consistent with those of previous research (Safe Work Australia, 2015; Walker-Bone et al., 2012) that found that labourers, technicians, trade workers, and machine operators comprised 31 per cent of the workforce but contributed to 58 per cent of the total claims and 57 per cent of the total costs of work-related injury and illness (Safe Work Australia, 2015). A large percentage (60%) of workplace injuries result in musculoskeletal disorders, which are often a result of poor manual handling (Alavi & Oxley, 2013; Safe Work Australia,2016). Research indicates that strengthening and endurance exercise programs (Tveito et al., 2004); multidisciplinary interventions consisting of workplace assessment, work modifications, and case management involving all stakeholders (Anema et al., 2007); and education to injured workers regarding risk factors for back pain (Ree et al., 2016) at the workplace significantly reduced work absences and improved RTW timeframes for workers with occupational low back pain.

Most of the injured workers in our study returned to their pre-injury duties and hours by 26-weeks; however, data pertaining to lost time from work and individual workers' compensation claims costs could not be accessed by the researcher; therefore, comparisons to previous studies were not possible for these outcomes. Nonetheless, the return to pre-injury duties and working hours among participants who received the *Working Hands-ED* intervention indicate that the addition of a person-centred, occupation-focused, and holistic intervention may assist injured workers in their RTW. *Working Hands-ED* is a unique hand therapy treatment approach that is person-centred, occupation-focused, and holistic in nature because it was developed using the Person-Environment-Occupation-Performance (PEOP) model (Baum et al., 2015) and the International Classification of Functioning, Disability and Health (ICF) framework (World Health Organization, 2001). This novel intervention enabled the hand therapists to focus on the personal, environmental, and the occupational factors affecting their patients' occupational performance, rather than focusing solely on their LET symptoms. We therefore recommend that hand therapists adopt a greater focus on providing injured workers with LET with self-management programs, job-specific modifications to work tasks and workflow, and individualised education about postures and movements to avoid at the workplace.

6.4.4 Treatment management plans

This study was the first, to our knowledge, to quantify the average duration of hand therapy services for LET within the WA workers' compensation context. The average (SD) duration between the initial hand therapy appointment and date of discharge from hand therapy services was 30 (17.7) weeks (7.5 months) in the control group and 55 (36.9) weeks (13 months) for the intervention group; a mean difference of 25 weeks (5.5 months). These time frames are consistent with the reported durations of LET symptoms, which range from 6 months to 2 years (Ahmad et al., 2013). Data about the overall duration of hand therapy treatment did not indicate that the intervention group participants required more frequent appointments. Instead, the results showed that the injured workers who received the *Working Hands-ED* intervention and returned to their pre-injury duties by 26-weeks had an additional seven hand therapy appointments over the extra 5.5 months in which the hand therapists reviewed their clinical outcomes and RTW progress. Hand therapists are expected to document an estimate of the required number of appointments and timeframes of service delivery on a TMP (WorkCover WA, 2019). Whilst the estimates should be based on an initial assessment of an individual injured worker, the findings of this study may provide hand therapists with a reference point when predicting treatment durations and costs for clinic-based versus clinic plus workplace-based hand therapy services.

Since the hand therapists in this study conducted the workplace-based intervention within the first four weeks of the initial appointment, they were able to identify at an early stage their patients' occupational risk factors for LET including repetitive bending and straightening of the elbow (Shiri & Viikari-Juntura, 2011; Walker-Bone et al., 2012), and environmental factors associated with positive RTW outcomes such as stakeholder participation in the RTW process (Hoefsmit et al., 2014), work modification and accommodation, and RTW coordination (Cancelliere et al., 2016). Evidence suggests that activity limitations and work demands exceeding worker capacity are common factors with negative RTW outcomes (Cancelliere et al., 2016; Young et al., 2005). Using the *Working Hands-ED* protocol, the hand therapists in our study provided early behavioural and ergonomics education interventions, and recommendations for activity modification at the workplace. Furthermore, this gave hand therapists the opportunity to communicate with the medical practitioner and insurers (via the TMP) to engage a workplace rehabilitation

provider earlier in the RTW process if they believed that an injured workers' claim may become more complex.

A recent national survey identified that Australian hand therapists are often under-utilised in the workers' compensation RTW process due to barriers such as lack of allocated time and the additional costs associated with this role (O'Brien et al., 2022). This survey also identified that most hand therapists relied on formal assessments that focussed on the underlying body structure components (such as range of motion and grip strength) and rarely focus on a patient's ability to perform a work role or task. The authors of this survey proposed that there is a need to focus on activity, participation, and the work environment for RTW injuries and encourage hand therapists to contextualise the nature of a patient's injury within their usual occupational patterns and roles (O'Brien et al., 2022). Our study results concur with those of O'Brien et al., 2022, the use of a novel workplace-based intervention (*Working Hands-ED*), that aligns with the activity and participation domains of the ICF, indicated a potential to reduce the individual and societal burden associated with work-related LET.

6.4.5 Study limitations

There are some methodological limitations to this study that should be considered when interpreting the participants' work outcomes. Firstly, the primary researcher endeavoured to obtain the overall claims costs and itemised medical expenses of participants in the control and intervention groups for the purpose of comparison. Unfortunately, it was not possible to obtain this information from all the insurers managing the workers' compensation claims for the participants in this study. This was despite gaining consent from participants for the researcher to access their respective claims information. Furthermore, WorkCover WA did not maintain a database from which the researcher could access claims information. Secondly, although an RCT study design was utilised to minimise allocation bias, selection bias, and confounding factors (Pandis, 2011) 12 weeks after commencement in the RCT, all participants were able to receive any interventions provided by the hand therapist and medical practitioners based on their clinical reasoning (i.e., cortisone injections, Kinesio taping, and dry needling). These other interventions had the potential to influence RTW outcomes between 12-weeks and 26-weeks. Thirdly, the study sample size was small at baseline (N=49), and this was further reduced due to missing data

and dropouts from 12 weeks on. The small sample may have resulted in a Type II error (i.e., non-significant findings for RTW status outcomes at the 6-weeks and 12-weeks) and reduced generalisability of the study findings.

6.4.6 Future study recommendations

It is accepted that occupational risk factors are associated with the development of LET (Shiri et al., 2006; Stegink-Jansen et al., 2021; Walker-Bone et al., 2012), and so future studies on the hand therapy management of LET should focus not only on clinical outcomes but also on other outcomes affecting RTW such as medical costs, durable return to work rates and durations, and overall claims costs. The preliminary results from this study suggest that the addition of the five-step approach of the novel *Working Hands-ED* intervention may be used as a future guide to managing work-related LET; however, larger RCTs involving at least two worksite visits in the protocol, having a longer follow-up period (i.e., up to 2-years), as LET can last up to two years, and inclusion of functional outcome measures that focuses on activity and participation in work performance and quality of life such as the Disability of the Arm, Shoulder, and Hand (DASH) assessment (which also has a work module) (SooHoo et al., 2002) and the Patient-Specific Functional Scale (PSFS) (as this was only used for the intervention group for our RCT) (Hefford et al., 2012) is recommended to confirm the results of the present trial. Understanding the experiences of the hand therapists that delivered the *Working Hands-ED* intervention and the injured workers that were the recipients of this intervention may provide valuable insights on ways of improving the novel intervention.

6.5 Conclusion

This study identified that the addition of the *Working Hands-ED* intervention resulted in a significantly higher proportion of injured workers with LET returning to their pre-injury duties and hours at 26-weeks than those who received clinic-based standard hand therapy only. Workers who received the additional workplace-based intervention component to standard hand therapy received a significantly longer duration of hand therapy services but not a significantly different total amount of hand therapy sessions.

6.6 Acknowledgement

We would like to thank Dr Richard Parsons (Statistician) for his assistance with the data analysis, the hand therapists who assisted with data collection, and the participants involved in this RCT.

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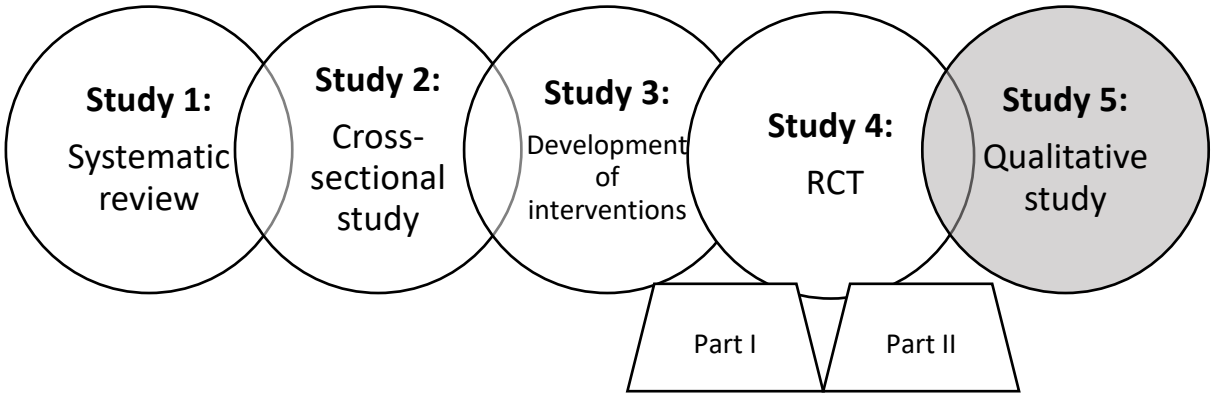
Chapter 7

Study 5: Qualitative study



The systematic review in Study 1 (Chapter 2) identified limited available evidence about workplace-based interventions for the management of LET. Study 2 (Chapter 3) confirmed that educational approaches were perceived as the most effective management strategies for LET by hand therapists and medical practitioners. They also supported the idea of hand therapists conducting workplace-based intervention for the management of LET. A hand therapy workplace-based intervention (*Working Hands-ED*) was developed in Study 3 (Chapter 4) using the International Classification of Functioning, Disability and Health (ICF) framework, Person-Environment-Occupation-Performance (PEOP) Model, and the Australian Clinical Framework (ACF) for the Delivery of Health Services. A randomised controlled trial in Study 4 (Chapters 5 and 6) investigated the impact of *Working-Hands-ED* on clinical outcomes, work status, and hand therapy costs and duration of services. The study found (i) no difference in the improvements in pain and function at 12 weeks between control group participants who received standard hand therapy and those who

received the additional *Working Hands-ED* intervention*,* and (ii) most of those in the intervention group returned to pre-injury duties and hours by the 6-month mark compared to those in the control group; however, this superior RTW outcome was associated with a longer duration of hand therapy services and higher costs for hand therapy services. .

Chapter 7 reports on a qualitative study (Study 5) that aimed to explore the experiences of the hand therapists who provided the novel hand therapy workplace-based intervention *Working Hands-ED* as part of a clinical management program for injured workers with LET. This chapter contains a manuscript that is currently under review. The spelling and wording contained within this chapter are that of the submitted manuscript. The referencing system used for this manuscript was the American Psychological Association 7th edition style.

Journal Manuscript 3

Title

Managing work-related lateral elbow tendinopathy: Australian hand therapists' experiences with workplace-based interventions

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7.1 Abstract

Introduction: Lateral elbow tendinopathy (LET) is one of the most prevalent work-related musculoskeletal conditions. Current treatments for LET focus mainly on the physiological symptoms of pain, grip strength, and function. Recently, a novel workplace-based hand therapy educational intervention, *Working Hands-ED*, was developed based on the International Classification of Functioning, Disability and Health framework and Australian Clinical Framework for the Delivery of Health Services. Combining a hand therapist's specialised knowledge and skills in upper limb rehabilitation with an approach that considers the injured worker's occupations and work environments may provide a more holistic approach to managing work-related LET. To the best of our knowledge no previous studies have investigated the *experiences* of hand therapists who perform workplace-based educational interventions for the management of LET.

Method: An exploratory, descriptive qualitative design using semi-structured interviews was used with hand therapists who delivered the novel hand therapy intervention *Working Hands-ED*.

Findings: Ten occupational therapists working in hand therapy were interviewed. Three main themes and eight subthemes were identified from interview data: Person-centred approach; opportunity for therapists to provide enhanced service; and improved stakeholder engagement in the return-to-work process. Logistical challenges such as the costs and time spent away from the clinic setting were identified.

Conclusion: All hand therapists reported delivering *Working Hands-ED* when managing work-related LET was a positive experience for them. They believed the novel intervention could provide a more holistic approach to care that added value to their service delivery; however, there were some logistical factors to consider including the additional time and costs associated with the intervention.

KEYWORDS

Tennis elbow, lateral epicondylitis, worksite intervention, rehabilitation, client education

KEY POINTS FOR OCCUPATIONAL THERAPY

- Hand therapists have the opportunity to provide a more holistic service.
- Individualised education that considers the work environment could benefit all stakeholders in the return-to-work process.
- A workplace-based hand therapy intervention may facilitate successful transition to work for individuals with LET

7.2 Introduction

Lateral elbow tendinopathy (LET), commonly known as tennis elbow, is one of the most prevalent work-related musculoskeletal conditions (Da Costa et al., 2015). It is characterised by pain and tenderness over the outer surface of the elbow and reduced grip strength and is equally common in both men and women, aged 35-55 years old (Ahmad et al., 2013; Bhabra et al., 2016). Individuals engaging in occupations that require repetitive flexion and extension of the elbow, heavy gripping and lifting, and forceful exertion of the wrist and forearm are at higher risk of developing LET (Fan et al., 2013; Shiri & Viikari-Juntura, 2011). There are currently over 40 different treatments to manage LET; however, to date, there is no consensus regarding the most suitable approach to manage this common condition.

An episode of LET may last an average duration of six months to two years; consequently, a person's ability to engage in meaningful occupations may be hindered during this time, including participation in their work roles (Coombes et al., 2015; Shiri et al., 2006). Recent studies identified that LET is a non-inflammatory condition and can become chronic (Bateman et al., 2018; Bhabra et al., 2016). Many individuals, including workers experience challenges associated with attempting to manage the condition in a way that enables them to function and return to work in a timely manner (Cullen et al., 2018; Oakman et al., 2018).

Standard treatments commonly used by hand therapists to manage LET primarily focus on the physiological management of pain, grip strength and upper limb function, and are typically delivered in a clinical setting (Bisset & Vicenzino, 2015; Lenoir et al., 2019; Tran et al., 2020). Education regarding ergonomic changes and activity modification are considered during the management process, with the hand therapist typically obtaining information about the injured worker's job duties, postures, and movements and equipment/tools used via verbal reports from the injured worker and sometimes the employer (Ma & Wang, 2020; Tran et al., 2020). Currently, the focus of LET treatment is on body functions and structures, with less emphasis placed on activities, participation, and environmental factors (Fitzpatrick & Presnell, 2004; Winthrop Rose et al., 2011; World Health Organization, 2001). However, researchers concur that clinicians should consider using the International Classification of Functioning, Disability and Health (ICF) framework to support a biopsychosocial approach when managing hand and upper limb conditions

(Scholten et al., 2020; Tran et al., 2021; Winthrop Rose et al., 2011). Hand therapy merges occupational and physical theory and practice, which combines comprehensive knowledge of the upper limb, anatomy, biomechanics, and function (Fitzpatrick & Presnell, 2004). Although hand therapists may have an occupational therapy or physiotherapy professional background; most hand therapists are occupational therapists (MacDermid et al., 2010; Tran et al., 2020). The Person-Environment-Occupation-Performance (PEOP) model is a holistic, person-centred, and occupation-focused model, which focuses on how the environment impacts a person's occupational performance (Baum et al., 2015). Using this approach, occupational therapists working in hand therapy may be able to identify enablers and barriers impacting the client's occupational participation in their work duties following a diagnosis of LET (Baum et al., 2015).

A recent survey study exploring the novel concept of having hand therapists conduct workplace-based intervention found that Australian hand therapists and medical practitioners supported this idea to educate patients about occupational risk factors and work postures to avoid when managing work-related LET within the work environment (Tran et al., 2020). However, most of the hand therapists surveyed reported that they had not conducted a worksite visit as part of their management program for LET. A novel intervention approach called '*Working Hands-ED'* was trialled by hand therapists who provided individualised education, work recommendations, and activity modifications suitable for their clients' work tasks at the workplace in a recent randomised controlled trial (RCT) (Tran et al., 2021). The RCT found that the addition of *Working Hands- ED* to standard therapy care for work-related LET did not result in superior clinical outcomes for pain, grip strength and function. However, the study may have been underpowered due to the small sample size, and due to funding constraints, there were no follow-up worksite visits to evaluate the adherence or compliance to workplace modifications in the intervention group (Tran et al., 2021). The intervention development was guided by the ICF framework, PEOP model, clinical experience in hand therapy, available research evidence, and provisions of the workers' compensation legislation in Western Australia.

The *Working Hands-ED* intervention is comprised of five stages: (i) identify the work tasks that the client has difficulty completing; (ii) assess the occupational risk factors for LET in the workplace; (iii) provide and demonstrate specific individualised work recommendations and education to reduce the risk factors; (iv) educate and inform the

appropriate key parties; and (v) reinforce the education provided at the workplace in future clinic-based appointments.

Working Hands-ED is unique because it considers both the personal and environmental context affecting occupational performance among workers with LET, rather than only focusing on symptom management. This approach differs from traditional conservative and surgical treatments for LET as it is person-centred, holistic, and occupation-focused. *Working Hands-ED* enabled the hand therapists in the study to focus on functional performance and participation while considering the environmental demands as part of the therapy process.

The overall aim of this study is therefore to explore the experiences of the hand therapists who provided *Working Hands- ED* as part of a clinical management program for injured workers with LET. The objectives are to (i) explore the attitudes towards providing this type of intervention; (ii) identify the nature of education provided at the workplace; and (iii) determine the perceived benefits and challenges of conducting this type of intervention.

7.3 Methods

7.3.1 Ethics

Ethics approval was gained from Curtin University Human Research Ethics Committee (Approval #: HR46/2016). Written informed consent was obtained from participants prior to data collection. All data collected were de-identified and securely stored.

7.3.2 Study design

An exploratory, descriptive qualitative design using semi-structured interviews was used. This method facilitated exploration of the experiences and attitudes of hand therapists' who provided the *Working Hands-ED* intervention to injured workers with LET. Obtaining a deep understanding of therapists' experiences using *Working Hands-ED* may inform future implementation of this intervention. A semi-structured interview guide consisting of open-ended questions was developed to direct the discussion and address the study objectives. The first author piloted the interview questions with an occupational

therapist with hand therapy experience. Subsequently, the wording of three questions were revised to improve clarity.

The use of semi-structured interviews provided hand therapists the opportunity to elaborate on their responses, whilst enabling the researcher to ask questions that were important to address the research objectives (Liamputtong, 2020). The Standards for Reporting Qualitative Research (SRQR) was used to guide this study (O'Brien et al., 2014).

7.3.3 Participants and recruitment

Participants were recruited using purposive sampling. The first author contacted the hand therapists after their involvement in piloting *Working Hands-ED* intervention as part of an RCT that was conducted from 16 April 2016 to 31 March 2019 (Tran et al., 2021). Participants were required to be registered occupational therapists with the Australian Health Practitioner Regulation Agency. Participants must have been employed at a private hand therapy practice in [removed for peer review] when the RCT took place. During the RCT, participants had (i) participated in or watched a recording of a video-recorded training session where the first author demonstrated the application of *Working Hands- ED* with an injured worker with LET; (ii) attended a workplace presentation about the practicality and logistics of implementing the RCT; (iii) reviewed the *Working-Hands-ED* information booklet provided by the principal researcher; and (iv) documented in a journal about their perceived experiences after they delivered at least one workplace-based intervention using *Working Hands-ED* with an injured worker with LET.

7.3.4 Data collection

The first author (TT) conducted four interviews in-person, and for logistical reasons between 22 February and 14 April 2020, six interviews were via video call. The interviews lasted between 25 and 65 minutes and were audio-recorded with permission. Two recordings were transcribed verbatim by TT and the remainder were outsourced to a commercial transcription service 'Rev'. All transcripts were checked by TT for accuracy.

Demographic information was gathered at the start of each interview to identify each participant's professional discipline, years of hand therapy experience, and their clients' occupations and workplaces. The interviewer used follow-up and probing questions

throughout the interview to gather additional information to gain a deep understanding of the topics discussed.

7.3.4.1 Trustworthiness

A number of strategies were used to enhance the trustworthiness of this study such as data triangulation, member checking of the interview transcripts with the participants to improve the credibility of the data; peer-review and feedback from all authors to improve confirmability; and use of a reflective journal to declare the interviewer's perspectives, experiences, and values and how these influenced her thoughts, perceptions, and interactions with the participants' (Liamputtong, 2020; Xerri, 2018). The primary researcher (TT) is a practising hand therapist, and all the participants were known to her, therefore there was a risk of social desirability bias influencing their reported experiences. However, a potential advantage was that the primary researcher had first-hand knowledge of the challenges faced, which may have provided participants to share their experiences freely. Furthermore, the reflective journal used helped improve the study findings' credibility and confirmability by making the first author aware of her biases and preconceived assumptions during data collection and analysis (Xerri, 2018).

7.3.5 Data analyses

NVivo v.12 software was used to manage the qualitative data. Data were analysed thematically and coded inductively using the six steps described by Braun and Clarke (Braun & Clarke, 2012; Maguire & Delahunt, 2017). The four authors independently read the first three transcripts to become immersed in the data and then discussed their preliminary codes as a group. Themes, patterns, and impressions derived from the data were explored and organised into broader categories to generate a coding scheme (Braun & Clarke, 2012, 2019; Maguire & Delahunt, 2017). Margin notes were used to identify recurring emerging impressions and patterns, which were subsequently identified as codes and organised into broader themes and subthemes (Braun & Clarke, 2012). The first author coded the remaining transcripts using the same process. The subsequent codes were collaboratively reviewed and discussed with the other three authors until consensus was reached on the final themes and subthemes.

7.4 Findings

Thirteen occupational therapists were involved with data collection for the RCT; however, 10 of these occupational therapists met the inclusion criteria and agreed to participate in the study. The majority of participants (90%) were female and had an average (SD) age of 39.4 (11.6) years. See Table 7.1 for participant demographic information.

Table 7.1: Participant demographic information

Participant*	Professional discipline	Gender	Age (years)	Hand Therapy experience (years)	Previous worksite visit experience	Client occupation /Workplace
Olivia	Occupational Therapist	Female	28	6	As part of university course	Baker /Supermarket
Tina	Occupational Therapist	Female	57	35	15 years in workplace rehabilitation	Factory worker/ Brick factory
Arthur	Occupational Therapist	Male	32	8	As part of university course	Retail worker/ Retail shop
Felicity	Occupational Therapist	Female	59	31	Work hardening 20 years ago	Factory worker/ Meat processing factory
Fran	Occupational Therapist	Female	30	7	As part of university course	Kitchenhand / Café + Store person /Warehouse
Sarah	Occupational Therapist	Female	29	6.5	As part of university course	Administrative staff/Office
Susie	Occupational Therapist	Female	26	4	As part of university course	Teacher/School
Hannah	Occupational Therapist	Female	28	3	As part of university course	Paramedic /Parked Ambulance
Michelle	Occupational Therapist	Female	29	5	As part of university course	Truck driver/ Truck depot station
Maddy	Occupational Therapist	Female	38	11	As part of university course	Retail worker/Retail shop

*Pseudonyms are used to maintain confidentiality of the participants and their patients.

Thematic analysis identified the three themes and eight subthemes presented in Figure 7.1.

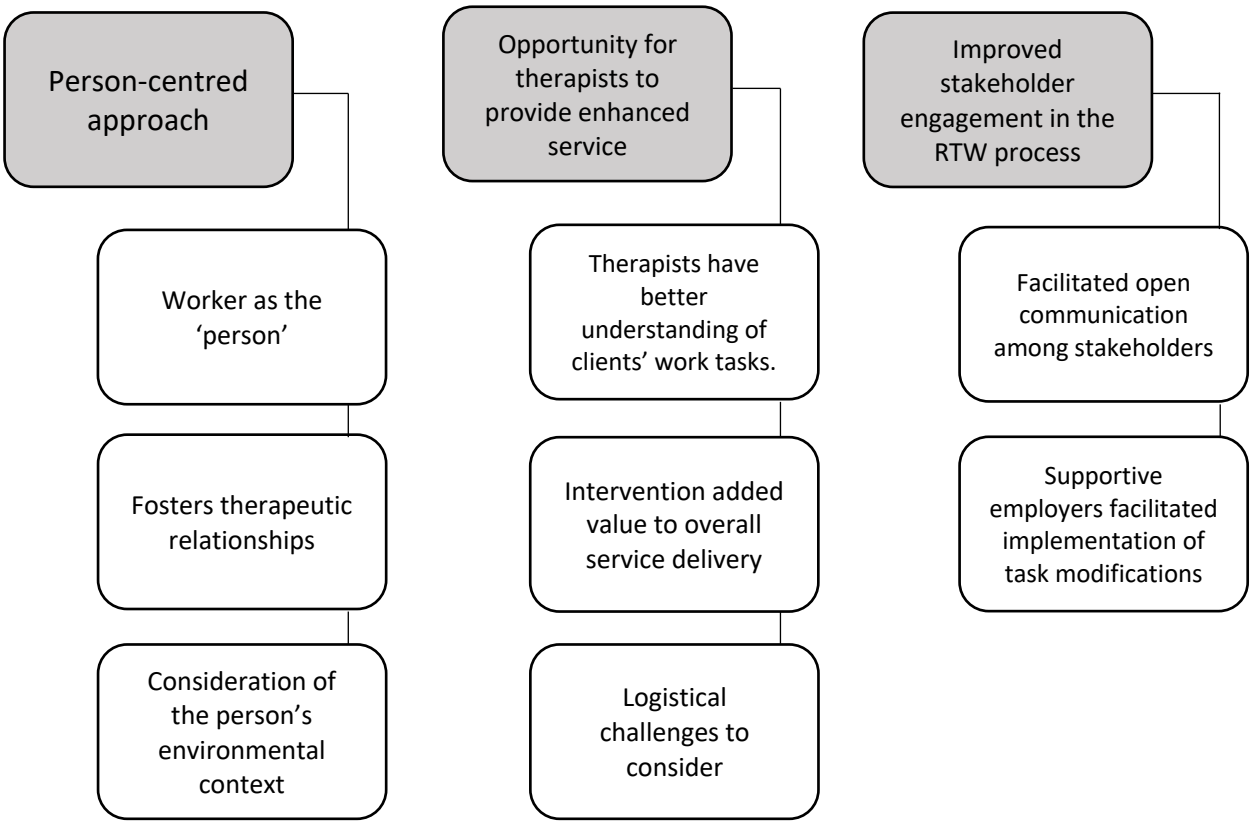

Figure 7.1 Themes and sub-themes

7.4.1 Theme One: Person-centred approach

7.4.1.1 Treat the worker as a 'person'

Participants acknowledged that *Working Hands-ED* provided them with the opportunity to adopt a person-centred approach with clients rather than only focusing on physiological symptoms. This was reflected in Sarah's comment, "*I often think that in the clinic we get so caught up on treating the symptoms that we don't always consider the entire person".*

Hand therapists delivered individualised education and specific work recommendations that were relevant to their clients' work tasks and duties. Many of the participants reported that the types of education provided in the workplace included activity modification, ergonomic advice, and upper limb biomechanical and postural advice.

Although they also offered this type of education in the clinic setting, participants felt their education was generic in nature and not always practical or relevant to the clients' actual work tasks. Participants were able to identify this gap in their knowledge about their clients' physical work demands, environment, and tools and equipment used when they attended the worksite and realised that previous recommendations made were not always suitable or realistic to implement. Olivia noted: "*So, during the worksite visit, I reviewed what we discussed in the clinic, but I felt that as it was in their workplace, the education provided was more relevant and client-centred".*

Participants believed that *Working Hands-ED* enabled their clients to feel more empowered during the therapy process by contributing to discussions about suitable work recommendations and task modifications. Olivia discussed how empowerment enhanced trust between the therapist and client: "*I think she [the client] felt more empowered and therefore trusted in me more, which in turn helped with her compliance for the rest of our therapy sessions".* Participants reported their clients identified a sense of feeling valued as they were given the opportunity to contribute to the therapy process. This is reflected by Michelle's quote, *"I think they [the client] benefit from it [Working Hands-ED] because they can be the expert in their field, rather than always coming to you as the expert".*

Overall, participants believed that this approach acknowledged their clients as the experts in their own work roles and considered the clients' opinions and thoughts regarding possible solutions to reduce occupational risk factors whilst considering their personal and environmental factors.

7.4.1.2 Fosters therapeutic relationships

Participants reported that they were able to collaborate with clients throughout the therapy process and this facilitated rapport building and fostered more positive therapeutic relationships. Fran stated, "*So, I think it [Working Hands-ED] made the patient feel really supported, and I think that they felt like we were really investing in their recovery".* A collaborative approach to identifying and mitigating work-related risk factors for LET also improved the client's compliance in future hand therapy sessions, as discussed by Michelle:

> One of the benefits I think that came out of this intervention was the rapport I had with her [client]. She also said that she appreciated me going to her workplace. It

was nice to be able to say, 'well, I now understand what you do', and from then, I felt that she trusted me more, and this helped with her being more compliant with the rest of the therapy program.

Participants reported that delivering *Working Hands-ED* enabled them to work alongside their clients at their workplaces to achieve the overall goal of returning to pre-injury work duties, rather than providing treatments only in the clinic. Susie discussed how physically attending the workplace impacted positively on the relationship with her client,

> One of my clients mentioned that I was the only one that had come out and seen what she did at work. She said that this made her feel really supported, especially feeling quite anxious going through the worker's compensation system for her injury.

7.4.1.3 Considers the client's environmental context

Participants reported that there were many benefits of providing education at the clients' workplaces. Firstly, the hand therapists were able to assess each client's ability to perform their work tasks within their respective physical work environments. They could also gauge the social and cultural workplace contexts, rather than making assumptions. This was reflected in Tina's comment,

> In the clinic, we'd talked extensively about his job and problem-solve ways around the obvious things. But when we went into the workplace, and I observed him doing things, I picked up things that he wasn't aware of. When you're doing it in the clinic, you're trying to imagine those tasks and that may or may not be accurate.

Secondly, relevant practical solutions and recommendations were made in collaboration with the client and workplace supervisors. Many participants reported they realised some recommendations made in the clinic were not realistic to implement and this was only identified after a worksite visit was conducted. As Sarah explained,

So, I found that all the advice I had given her [the client] at the clinic, when we went out to the workplace, I just thought to myself, how on earth would she have put any of that into practice? Because I obviously did not understand what she was telling me, and the advice I was giving her in the clinic was not going to work in her workstation and in the environment that she worked in.

7.4.2 Theme Two: Opportunity for therapists to provide enhanced service

7.4.2.1 Therapists have a better understanding of clients' work tasks

In the clinic setting, the hand therapists relied on clients to provide information about their work tasks and duties; however, clients often do not know the potential work-related risk factors associated with LET. Participants reported that one of the benefits of the worksite visit was their ability to better understand their client's work tasks and roles. Also, they were able to identify that some clients were visual learners and so provided 'hands-on' demonstrations of safe work practices in situ. Consequently, some clients could trial and implement changes immediately.

Hand therapists reported the knowledge and insight they gained from conducting *Working Hands-ED* helped inform their clinical reasoning in future therapy appointments in the clinical setting. Susie reflected, "*I found it really helpful that I could always refer back to the images and knowledge that I gained from the worksite visit of what his environment was like*".

7.4.2.2 Intervention added overall value to service delivery

Overall, participants reported that the training and the experience they received from using *Working Hands-ED* equipped them with new skills and knowledge to provide an extra service when managing work-related LET. They reported that assessments and treatments typically occurred in the clinic setting. Prior to this study, no participants had provided this type of intervention as a hand therapist. They believed that the novel intervention benefitted them, their clients, and all stakeholders (medical practitioner, workplace rehabilitation providers (WRP), insurance case managers and employers) in the worker's compensation system. Sarah shared how *Working Hands-ED* added overall value to service delivery, "*I just felt it was so beneficial to see exactly how that patient worked in her*

work environment and what she was working with; everything she was telling me then finally made sense, when I got to see it".

Participants reported the implementation of different methods of activity modification at the workplace improved client-reported pain and function. Some participants reported not all clients fully understood recommendations made in the clinic, but better understood them when presented in the workplace. Hannah explained,

> It was a lot easier to actually show her. I could get in her position and figure out what was going to be best to offload the tendon that was affected. So, it was a lot easier to physically demonstrate to her and show her, so that she could then practice, and I can see that she was doing it safely and accurately.

Some participants reported their clients had a WRP present during the worksite visit. These hand therapists agreed unanimously that this provided them opportunity to collaborate with the WRP and work collaboratively to provide a better service to the clients. Furthermore, the worksite visit provided some participants the opportunity to contribute their expertise knowledge of the hand and upper limb within the context of the workplace; specific knowledge that WRPs may not have. Olivia reflected, "*I didn't feel that I was taking over anyone else's role. I was just adding onto what they had already done. I think we just enhanced that whole process of the worksite review."* Collaborating with WRPs also increased the hand therapists' knowledge of when it was appropriate to refer their clients' with LET for workplace rehabilitation services in the return-to-work process.

7.4.2.3 Logistical challenges to consider

Participants reported some logistical challenges associated with spending time away from the clinic, including the additional costs and time required to deliver the worksite visit. Participants provided suggestions to overcome these challenges, such as scheduling multiple workplace visits on the same day to maximise the time available to see clients in the clinic and their respective workplaces. Olivia explained,

> It was sometimes hard to find time in my schedule to allow me to drive to the workplace. Also, we often work in different locations, so trying to tee it up on a day where you're probably closer to where the workplace is, was a little bit challenging too. Maybe if we planned to do multiple visits on one day and spend that day on the road, it would be more feasible.

Another challenge that arose was the extra time required to organise the worksite visits. Despite receiving a referral from the medical practitioner to conduct the worksite visit, hand therapists were required to also obtain written approval from the clients, insurers, and employers to conduct the worksite visit to ensure renumeration for this service.

7.4.3 Theme Three: Improved stakeholder engagement in the return-to-work process

7.4.3.1 Facilitated open communication among stakeholders

The last stage of *Working Hands-ED* required participants to write a report of the worksite visit detailing identified occupational risk factors for LET and recommendations to mitigate risks. Participants reported the information they included in this report was clearer and more accurate than in their standard clinic reports. Other stakeholders in the workers' compensation system were sent a copy of this report. Arthur reflected, "*my recommendations to the GP* [general practitioner] *was clearer and had more information, and that's because I was there, I've seen what she's [the client] done, and I could recommend activities the right way, in a more specific way.*" Participants highlighted that the worksite report instigated a forum for open communication among all the stakeholders in the early stages of the client's rehabilitation and return-to-work.

7.4.1.2 Supportive employers facilitated implementation of tasks modifications

All participants reported having a positive experience with the employers and supervisors, and identified this support positively influenced the outcome of the worksite visit. They believed the employers and supervisors played an essential role in this stage of the return-to-work process as they were responsible for implementing modifications to the

work tasks or environment based on the hand therapist's recommendations. Tina shared her experience, which captures the importance of the employer's support:

> The supervisor was really on board and took it on board as well, and this guy [the client] ended up going back to work; back to his usual job with quite a severe injury… and I'd like to think that the workplace visit played a significant role in that as well. If you don't have the workplace's support, it can be challenging because you can go out and make recommendations. But if the workplace is not supporting the patient or supporting your suggestions, it makes it more difficult to implement them.

7.5 Discussion

7.5.1 Main findings

This study aimed to explore hand therapists' experiences in providing a novel hand therapy workplace-based intervention, '*Working Hands-ED',* to manage work-related LET. An important finding was that participants were able to provide a more person-centred approach in the management of work-related LET than the traditional clinical approach. Some core concepts of person-centred care include honouring the person, being in a relationship, and facilitating participation and engagement (Waters & Buchanan, 2017). Hand therapists provided a workplace-based assessment and intervention in the context of the injured workers' work environments, focusing on their abilities to perform their work tasks. Previous research has discussed how occupational therapists working in the field of hand therapy follow a reductionist biomedical approach in their practice, which assumes function is restored when physical signs or symptoms, including pain, are reduced (Dale et al., 2002; Fitzpatrick & Presnell, 2004). Our study findings suggest that when managing work-related LET, there is an opportunity for hand therapists to provide individualised work recommendations tailored to their client's needs and circumstances within the workplace context.

7.5.2 Occupation-based practice

The hand therapists in the study treated work-injured clients from a variety of occupations; some more physically demanding that presented a higher risk for LET. *Working Hands-ED* enabled education and recommendations about postures to avoid and activity modification to be individualised and adapted to fit the unique demands of each patient. The hand therapists reported the education provided was more meaningful and relevant to their clients as it involved clients performing their work tasks as part of the intervention. Given, that *Working Hands-ED* was developed on an occupation-based model (PEOP model), it can be considered an occupation-based intervention that focused on the client's occupational performance and interaction within their daily living [work] environments (Fitzpatrick & Presnell, 2004).

Occupation-based intervention is well established in many areas of occupational therapy practice, and its effectiveness confirmed in different practice settings; however, only a few have examined the efficacy of this intervention approach in hand therapy practice (Colaianni & Provident, 2010). An RCT recently investigated the impact of adding occupation-based interventions to therapeutic exercises for common upper limb injuries and included activities such as typing on the keyboard, washing and wiping dishes, and picking up small objects as part of the therapy program to improve hand function (Che Daud et al., 2016). The integration of occupation-based interventions improved pain and functional outcomes for clients at 10 weeks post-intervention (Che Daud et al., 2016). These findings support including meaningful activities as part of hand therapy interventions. Our study findings demonstrated a focus on collaborating with the client and on their individual work tasks in the work environment, helped facilitate return-to-work progress.

7.5.3 Benefits of a person-centred and occupation-based intervention

The hand therapists in our study completed the *Working Hands-ED* training to expand their current knowledge and skills to deliver a holistic hand therapy service that is considered non-traditional in the context of the Australian worker's compensation system. The literature suggests that hand therapists rely on previously determined protocols and prescribed treatment methods, influenced by the medical model of practice, with little consideration of the physical, social, and organisational factors in the workplace that affect occupational participation (Grice, 2015). *Working Hands-ED* was based on the PEOP model

and ICF framework that considers the aforementioned factors, compared to standard treatments that only focus on body structures and function. Our study findings suggest it may be challenging for occupational therapists working as hand therapists in clinical settings to obtain accurate information about their clients' work tasks and duties. With relevant training, and support from the employer, medical practitioner, and insurance case manager, the hand therapists were able to provide a holistic approach in the management of LET.

Collaboration and communication between the stakeholders in the worker's compensation system are paramount to ensure a successful outcome; however, the interactions among the injured worker, health care providers, and insurance case managers in the return-to-work process can be challenging (Kilgour et al., 2015). Challenges include different perspectives of the stakeholders, confusion amongst health care professionals about their roles in the return-to-work process, and time constraints to complete written documentation and reports (Camden et al., 2015; Kilgour et al., 2015; Russell & Kosny, 2019). Our study found that by providing a comprehensive worksite visit report, all the key stakeholders involved were better informed of the required work recommendations and the injured worker's functional capacity. Furthermore, our study identified an opportunity for hand therapists to recommend earlier involvement of WRPs where necessary; collaboration between WRPs and hand therapists may enhance return-to-work outcomes.

Our study found that rehabilitation outcomes were improved if the client's employer or supervisors were supportive and willing to accommodate the hand therapists' recommendations. These findings support known key factors affecting a successful return-to-work including having a supportive employer willing to modify the job task and/or environment, with suitable alternative work duties available (Peters et al., 2020). *Working Hands-ED* facilitated in-person communication between the hand therapist, injured worker, and employer/supervisor. This provided the hand therapists the opportunity to discuss their recommendations directly with the employers/ supervisor at the workplace about suitable work duties and any modifications required, and some practical changes were made during the worksite visit. This collaborative approach may subsequently improve return-to-work outcomes.

The benefits from delivering this novel approach identified by the hand therapists included facilitating a collaborative therapeutic relationship with clients, and open communication with other stakeholders in the return-to-work process. These benefits

suggest that future interventions to manage LET should adopt a more holistic and occupation-based approach; however, there is limited hand therapy research literature to support this (Colaianni & Provident, 2010).

7.5.4 Challenges to consider

Some of the reported challenges of delivering *Working Hands-ED* included extra time and costs involved with travel. Generally, reimbursement for these workplace-based service costs are routinely paid to WRPs by insurers under workers' compensation; however, as this is a novel treatment approach for hand therapists, prior approval from insurance case managers was required. Other researchers have identified similar concerns that hand therapy practice prioritises cost-containment strategies (Colaianni & Provident, 2010; Dale et al., 2002). Dale et al., (2002) identified factors influencing occupational therapists' provision of holistic care within a specialised hand therapy practice context. They found that occupational therapists were able to overcome pressures and challenges by (i) *adapting* themselves and their work environment, such as modifying their work hours to schedule visits and meet the needs of the clients; (ii) *educating* clients, families, physicians, and other health team members; and (iii) *strategising* by negotiating with physicians for additional treatment time and justifying required services beyond the prescribed time frame to achieve functional goals (Dale et al., 2002). These strategies were similar to those used by our study participants who reported being strategic with scheduling the worksite visits and communicating with insurance case managers to reimburse the costs associated with delivering the intervention at the worksite. Our study findings support the provision of workplace-based interventions by hand therapists to manage LET. Further emphasis should be placed on how to incorporate this intervention approach in future hand therapy services for clients with work-related injuries.

7.5.5 A unique role for occupational therapists working in hand therapy

Occupational therapists have a unique role in managing work-related hand and upper limb injuries because of their ability to analyse the interaction between the worker's capacities and the environmental demands influencing their occupational performance and engagement (Baum et al., 2015). However, most hand therapy research are focused on the body function and structure elements of the ICF and rarely addressed clients' activities,

participation, and environmental factors (Winthrop Rose et al., 2011). Our study has identified a unique role for hand therapists working with client's with LET as they were able to significantly contribute to the injured worker's readiness for work by providing recommendations about functional capacity and suitable work duties within the client's work environments. They provided person-centred care and were flexible to work within different environments to the clinical setting. Overall, the hand therapists in this study identified mutual benefits and had positive experiences when delivering *Working Hands-ED* at their clients' respective workplaces. Although there were some logistical challenges to consider, there were also some solutions suggested to overcome these challenges.

7.6 Study limitations

There are some study limitations to be considered. Firstly, participants were interviewed approximately 12 months after conducting *Working Hands-ED*, which may have affected the recall of their experiences. This limitation was minimised by their use of the reflective journal during the RCT. Secondly, the study sample was limited to hand therapists involved in RCT and so no additional participants were recruited to achieve data saturation. However, a rigorous data analysis process was applied to improve trustworthiness of findings. Thirdly, the study only explored the hand therapists' experiences of the novel workplace-based education intervention. Exploration of the injured workers' experiences of *Working Hands-ED* would have provided important information about their perceived value of the intervention in their return-to-work. Lastly, the therapists' previous experiences in conducting worksite visits may have impacted their confidence to deliver the workplace-based intervention and make appropriate recommendations to reduce relevant work-related LET risk factors. This may have influenced the effectiveness of the workplace intervention in improving the clinical and return to work outcomes.

7.7 Future research

Future research should explore the perspectives of injured workers who receive the *Working Hands-ED* intervention. More strategies to overcome the logistical challenges discussed in our study to enable occupational therapists to provide more holistic services are needed.

7.8 Implications for practice

The study findings support hand therapists providing context –specific individualised education about positions to avoid and activity modification principles relevant to the occupations and work environments of work-injured patients with LET. Previous research has challenged hand therapists using a reductionist approach and more consideration should be focused on activity participation and function. Our research has indicated a potential unique role for occupational therapists working in hand therapy within the workers' compensation system using a novel occupation-based intervention.

7.9 Conclusion

Using the novel workplace-based hand therapy educational intervention (*Working Hands-ED*) may facilitate successful return-to-work for injured workers with LET. Occupational therapists can provide holistic, client-centred, and occupation-based hand therapy intervention in the management of work-related LET.

7.10 Authors' declaration of authorship contribution

All authors demonstrated roles and responsibilities defined by the International Committee of Medical Journal Editors (ICMJE). The first author (removed for peer-review) developed the proposal and conducted all parts of the study including writing the drafts of the manuscripts. All authors (removed for peer-review) assisted with the data analysis and discussion phases, contributed to the working drafts, and agreed on the final submission version of the manuscript.

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Chapter 8

Discussion and conclusion

Chapter 8 integrates and summarises the findings from each research stage in this thesis and discusses (i) the significance of the findings on clinical practice within the context of the WA workers' compensation system; (ii) the main strengths and limitations of the research; and (iii) recommendations for future research. A closing reflection follows this discussion.

8.1 Summary and discussion of findings

Lateral elbow tendinopathy is a commonly occurring upper limb musculoskeletal condition that usually affects the dominant arm and can lead to pain and reduces participation in daily activities (Vaquero-Picado et al., 2016). Individuals with work-related LET, have experienced reduced productivity, lost time from work, and residual disability (Bisset & Vicenzino, 2015; Korthals-De Bos et al., 2004), with numerous direct and indirect costs incurred to all stakeholders in the workers' compensation process (Australian Institute of Health and Welfare, 2020; Barnett et al., 2010).

Work tasks that involve repetitive bending and straightening of the elbow (Walker-Bone et al., 2012) and repetitive and forceful gripping of the upper limb (Shiri & Viikari-Juntura, 2011) have been identified as occupational risk factors for the development of LET. A recent review that investigated LET pathology and tendon function provided suggestions for modifying upper limb postures and movements during activities to minimise these risk factors (Stegink-Jansen et al., 2021). Education regarding activity modification is frequently provided by hand therapists in the management of LET and is perceived to be the most effective by hand therapists (MacDermid et al., 2010). However, there is little information on the aims, content, and type of education recommended (Greenfield & Webster, 2002; MacDermid et al., 2010).

There is a lack of consensus on the best treatment approach for LET. Clinical treatments primarily focus on the physiological management of pain, strength, and function, and may include a range of approaches including wrist and elbow orthoses (Heales et al., 2020), exercise programs (Cullinane et al., 2014; McQueen et al., 2020), corticosteroid injections (Coombes et al., 2013), and blood injections (Rabago et al., 2009; Wolf et al., 2011). Previous cross-sectional studies that explored the perceived effectiveness of LET

treatments by hand therapists and medical practitioners focused solely on clinic-based treatments (Greenfield & Webster, 2002; MacDermid et al., 2010; Peterson et al., 2005), and rarely considered the work environment and the occupational risk factors that may have contributed to the exacerbation of LET symptoms.

The main focus of this doctoral thesis was to develop and evaluate the impact of a novel workplace-based intervention *(Working Hands-ED)* to manage LET. The International Classification of Functioning, Disability, and Health framework (ICF; World Health Organization, 2001) and the Person-Environment-Occupation-Performance (PEOP; Baum et al., 2015) model were used to develop a holistic, occupation-focused, and person-centred approach to the treatment of individuals with LET. The research reported in this thesis involved patients who had sustained a diagnosis of LET from a work-related injury that was compensable within the Western Australian (WA) workers' compensation system.

Five studies using different research methodologies were conducted to answer the overall research question – *What is the impact of adding a hand therapy workplace-based educational intervention to standard hand therapy care on clinical and work outcomes among injured workers with LET?* This research project has provided a unique contribution to the evidence base in hand therapy because to our knowledge, no other published studies have examined the impact of a hand therapist conducting a workplace-based educational intervention when managing injured workers with LET. Table 8.1 presents a summary of the key findings from each of the five research stages presented in this thesis.

Table 8.1 Summary of research stages, study aims, and findings

Research stage	Study Design	Study aims and objectives	Summary of findings
Study 1	Systematic Review	3. Investigate existing evidence for workplace-based interventions for the management of LET. 4. Provide an overview of: iv. studies that used workplace-based interventions for workers diagnosed with LET, v. the content of these interventions, and vi. the method of delivery of these interventions.	• There is very limited available research on hand therapist-delivered workplace-based interventions for the management of LET. Only one study was included in the systematic review.
Study 2	Cross-sectional study	3. Identify, compare, and contrast the perceptions of Australian hand therapists and medical practitioners about the effectiveness of common treatments for LET. 4. Obtain hand therapists and medical practitioners' views on hand therapist-delivered workplace-based interventions.	• Educational approaches were perceived to be the most effective management strategies. • Most hand therapists and medical practitioners supported the idea of having a hand therapist provide a workplace-based intervention.

Study 3	Development of interventions and RCT study protocol	2. Develop the RCT protocol to be used to investigate the impact of adding a workplace-based hand therapy intervention to standard hand therapy. The objectives were to: iii. develop a standard hand therapy program. iv. develop a novel workplace-based hand therapy intervention.	• The development of a five-stage novel workplace-based hand therapy approach called *Working Hands – ED* was based on the ICF framework, PEOP model, and Australian Clinical Framework. • The development of a standard hand therapy program involving provision of a wrist orthosis, heat, massage to the dorsal extensor bulk, passive stretches, eccentric exercises, and patient education.
Study 4	Randomised controlled trial	4. Identify the impact of adding *Working Hands-ED* to standard hand therapy care on the clinical outcomes of pain, grip strength, and function. 5. Identify the effectiveness of standard hand therapy on the clinical outcomes of pain, grip strength, and function. 6. Identify the impact of adding *Working Hands-ED* to standard hand therapy care on the return-to-work status and hand therapy costs, duration, and total number of sessions.	• The addition of *Working Hands-ED* did not negatively impact on clinical outcomes of pain, grip strength and function. • Clinical outcomes of pain and function improved at 12-weeks regardless of whether the education was provided within the clinic setting or workplace. • A multi-modal hand therapy approach (consisting of wrist orthoses, heat, massage to dorsal extensor bulk, passive stretches, an eccentric strengthening program and patient education) at the clinic setting improved

			patients' clinical outcomes at 12-weeks. • The addition of *Working Hands-ED* resulted in more participants back to their pre-injury work roles and hours at 26-weeks. • The addition of *Working Hands-ED* costed more and resulted in a higher total number of hand therapy sessions than standard hand therapy.
Study 5	Qualitative study	2. Explore the experiences of the hand therapists who provided *Working Hands- ED* as part of a clinical management program for injured workers with LET. The objectives were to: iv. explore the attitudes towards providing this type of intervention. v. identify the nature of education provided at the workplace; and determine the perceived benefits and challenges of conducting this type of intervention.	• All hand therapists reported positive experiences when delivering *Working Hands-ED* to manage patients with work-related LET. • The hand therapists believed the novel intervention could provide a more holistic and person-centred approach to care that added value to their service delivery. • There were some logistical factors to consider including the additional time and costs associated with the intervention.

Study 1 (systematic review) identified there was limited evidence available on workplace-based interventions specifically for LET management. The systematic review findings confirmed that having a hand therapist conduct this type of intervention is a novel approach for treating this medical condition and target population. As a result of the limited evidence identified in Study 1, a cross-sectional survey was developed to determine the views of Australian hand therapists and medical practitioners regarding the range of interventions used to treat LET (Study 2). Both groups of health professionals unanimously rated educational strategies, particularly for understanding LET pathology, activity modification, postures, and workplace recommendations as the most effective for managing acute and chronic LET. These educational strategies were identified as the 'active ingredients' used in developing the workplace-based educational intervention (for Study 3). Overall, both health professional groups supported the idea of a workplace-based educational intervention delivered by hand therapists; despite most hand therapists (74%) reporting they had never conducted this type of intervention before (Tran et al., 2020).

Perceived benefits of workplace-based education reported by hand therapists in Study 2 included providing specialised, personalised, and contextualised education and recommendations specific to the injured workers' occupation, and open communication opportunities between the key stakeholders in the return-to-work (RTW) process regarding modifications to job tasks/ roles and agreement on the RTW plan. Some potential challenges to delivering this type of intervention identified by hand therapists included the extra time and costs associated with travel to the worksite and limited confidence and experience in delivering this type of intervention. The qualitative data provided by hand therapists in Study 5 after delivering *Working Hands-ED* confirmed some of the anticipated benefits and challenges reported by the hand therapists in the national survey in Study 2. The findings of Study 5 also confirmed that the participating hand therapists felt more confident after completing their first worksite visit and this may be attributed to the extensive training provided by the primary researcher in the development and implementation stages of the workplace-based intervention in Study 3.

Study 2 (cross-sectional survey) identified that most medical practitioners participating in the national survey reported they had never previously requested a hand therapist to conduct a workplace-based intervention. These findings further support the

concept that this is a novel and non-traditional approach and may explain the lack of published evidence found in Study 1. Medical practitioners reported in the survey that they generally referred injured workers for workplace rehabilitation to identify suitable work duties or if the injured worker had not progressed as well as anticipated. These findings highlight the opportunity for hand therapists to apply their specialised knowledge of the upper limb and the risk factors associated with the development of LET symptoms, within the work environment to better contribute to the injury management process.

The findings from Studies 1 and 2 provided information about the essential elements to include in the subsequent stages of the research. These essential elements included the opportunity to develop a workplace-based intervention delivered by hand therapists for the management of work-related LET that (i) consisted of ergonomic and behavioural educational strategies, (ii) was practical and feasible for hand therapists to deliver, and (iii) considered the provisions and requirements of the WA workers' compensation system. *Working Hands-ED* was developed in Study 3 by incorporating elements of the ICF (World Health Organization, 2001), the PEOP model (Baum et al., 2015), and the WorkCover WA Clinical Framework guidelines (The Government of Western Australia, 2012).

The next stage of the research (Study 4) aimed to identify the impact of adding *Working Hands-ED* to standard hand therapy on the primary clinical outcomes (pain, grip strength, and function) and secondary work outcomes (work status, total duration, and costs of hand therapy services) using an RCT methodology. Study 4 found that the addition of *Working Hands-ED* to standard hand therapy to manage work-related LET did not result in statistically significant superior clinical outcomes for pain, grip strength, and function (Tran et al., 2021). The study identified that a multimodal self-management approach used by hand therapists improved their patients' pain and function regardless of whether the education was given in the clinic or workplace. Due to the small sample size, it may be possible that a Type II error was present, and the analysis was unable to detect a statistically significant difference in outcomes between the two groups.

The results for the secondary work outcomes showed that a significantly higher proportion of injured workers in the intervention group than the control group returned to their pre-injury duties at 12-weeks and this difference was sustained at 26-weeks (i.e., 63% in the intervention group versus 8% in the control group). However, the intervention group

attended more hand therapy sessions, and their hand therapy service were more costly than the control group over the total treatment duration. Many factors may have contributed to the intervention group receiving more clinical appointments with associated higher overall costs after 12-weeks. One possible reason could be that the hand therapists may have continued monitoring the injured workers' progress after 12-weeks to ensure they continued performing pre-injury duties prior to discharge from hand therapy services. Since the hand therapists had an in-depth understanding of these participants' work duties obtained from the worksite visit, they had the opportunity to provide ongoing specific work recommendations in subsequent appointments, which may have prolonged the discharge date. As the intervention was not blinded to the therapists (who delivered the intervention and measured clinical outcomes), therapist bias may have influenced how therapists delivered the treatments and assessed the clinical outcomes for participants in each group.

The final study (Study 5) identified that hand therapists had a positive experience overall when delivering *Working Hands-ED* but they had some logistical challenges to consider. New evidence from this study suggested that this type of workplace-based hand therapy intervention to manage LET was more holistic and person-centred than traditional treatment modalities. Logistical issues included the additional time required to schedule worksite appointments and managing the time spent away from the clinic with their clinic-based appointments; however, the hand therapists who participated in Study 5 also provided some practical solutions to overcome these challenges such as rearranging the schedule and communicating with the insurance case manager for reimbursement of services provided.

8.2 Significance of findings

8.2.1 Implications for clinical practice

8.2.1.1 A biopsychosocial approach

The ICF is an internationally accepted framework that uses standard language to describe and measure health and disability (World Health Organization, 2001). Having this common language provides utility for its use across different health disciplines. Previous studies have recommended using the ICF to examine elbow injuries and as a conceptual framework to guide ergonomic interventions in occupational rehabilitation (Leyshon &

Shaw, 2008; MacDermid & Michlovitz, 2006). Despite these recommendations to focus on improving participation, the published hand therapy literature has primarily focused on the body function and structure components of the ICF (Dimick et al., 2009; Winthrop Rose et al., 2011).

As an occupational therapist working in hand therapy, the primary researcher applied the elements of the PEOP model (Baum et al., 2015) to ensure that the novel workplace intervention developed in this research project was occupation-focused and person-centred in nature, and with consideration of the physical, social, and institutional environments in the workplace context. To the primary researcher's knowledge, there is no published literature that focuses on hand therapists conducting educational interventions in work environments to manage LET. The harmonious elements of the ICF framework and the PEOP model are helpful to explain why *in situ* education on functional biomechanics and activity modification to reduce occupational risk factors might facilitate an injured worker's return to their pre-injury work roles (World Health Organization, 2001).

Although the ICF framework and the PEOP model include similar domains pertaining to personal, occupational, and environmental factors, the PEOP model focuses on the *interaction* between these factors and their influence on the person's occupational performance. Other studies have successfully applied the PEOP model to understand the complexities of the RTW process for people with spinal cord injuries (Dorstyn et al., 2021) and for work-related injuries and musculoskeletal disorders in the rail industry (Naweed et. al., 2020).

Figure. 8.1 illustrates the application and conceptualisation of the components of the ICF framework and PEOP model with the five stages of *Working Hands-ED.* The ICF framework assisted in describing the level of function a person has with consideration of the physical, social and attitudinal environments in which they live and conduct their lives. The PEOP model helped describe how participation and engagement in individual work activities are influenced by multiple factors (i.e., person, environment, and occupation). Work-related LET results from the complex interaction between the injured workers' intrinsic and extrinsic environments and the nature of the occupation undertaken. The five stages of *Working Hands-ED* provided a more holistic, occupation-focused, and biopsychosocial approach that was consistent with the workers' compensation clinical guidelines. By using an intervention

(Working Hands-ED) that was developed based on the ICF framework and PEOP model, the hand therapists were able to obtain a clear, more comprehensive, understanding of the injured workers' occupational performance in their work roles using the five stages of *Working Hands-ED*.

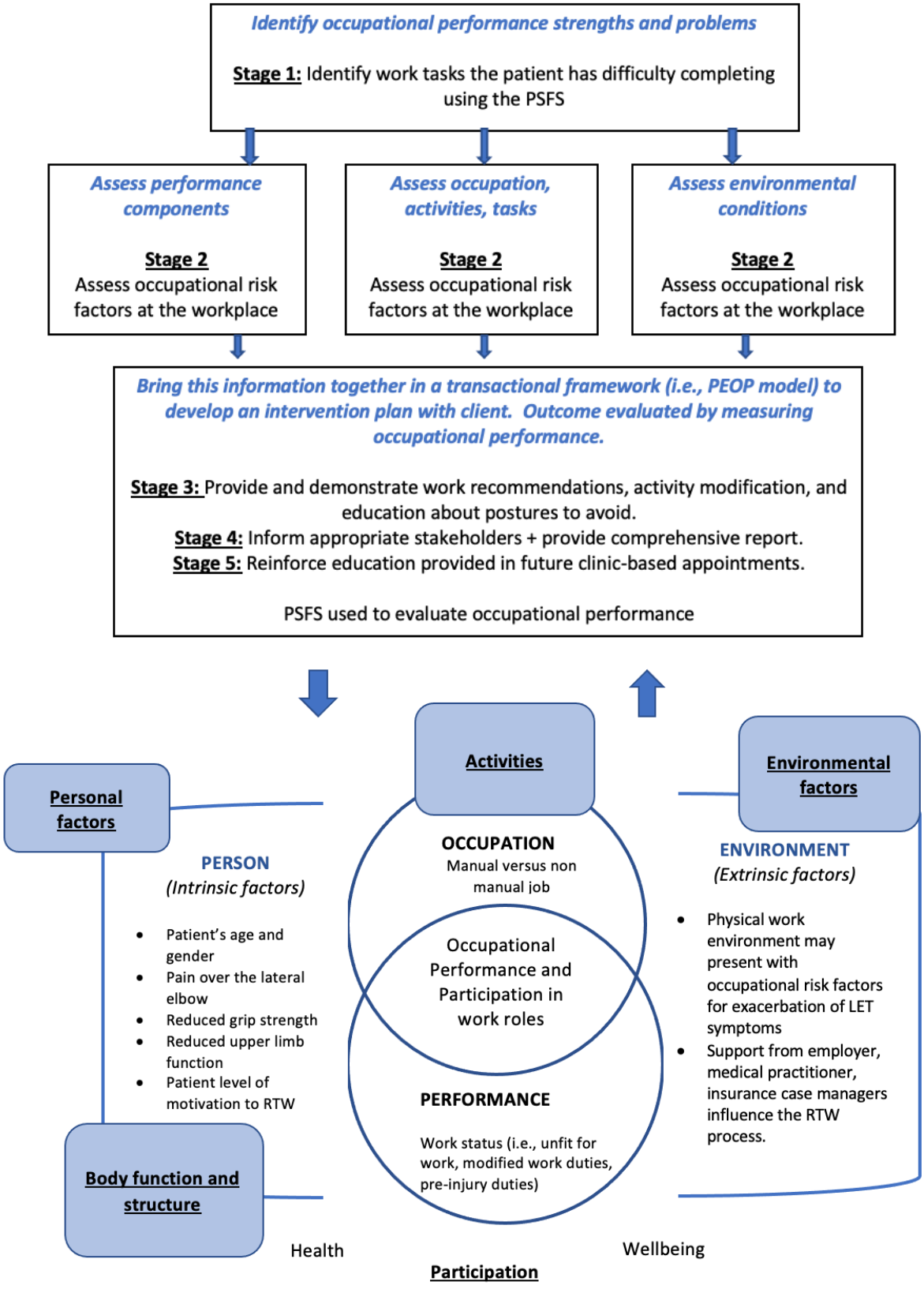

Figure 8.1 The application and conceptualisation of the ICF framework and PEOP model used for this research (Adapted from Baum et al., 2015; Strong et al., 1999; World Health Organization, 2001).

8.2.2.2 Functional assessments and self-management program

Common hand therapy goals in LET management are to reduce pain and improve grip strength and upper limb function. Standard hand therapy practice would benefit from incorporating all the ICF domains to work towards a biopsychosocial approach for managing this common occupational upper limb condition (Winthrop Rose et al., 2011). Historically, LET clinical outcomes and treatments have used a biomedical approach primarily focused on the body function and structure components of the ICF (e.g., pain present with palpation to lateral elbow and with resisted wrist extension, therefore treatment is provision of a wrist orthosis to reduce pain). Engel (1997) argues that the biopsychosocial approach can be used to obtain a better understanding of the injury and extends beyond looking only at the underlying pathophysiology of the condition but also considers the patient's individual circumstances. Therefore, from a biopsychosocial perspective, the primary focus of treatment should be on understanding how the person, occupation and environmental factors (as per the PEOP model and ICF framework) may impact on the individual's occupational performance in activities and roles that are meaningful for them.

A recent systematic review found that the most robust and commonly used patient outcome measures for LET were the Quick Disabilities of the Arm, Shoulder, and Hand (DASH), Oxford Elbow Score (OES), and Patient Rated Tennis Elbow Evaluation (PRTEE) assessments (Evans et al., 2019). The RCT in this thesis used the PRTEE within the clinic setting to identify activity limitations in daily tasks among participants in the intervention and control groups. For those allocated to the intervention group, the Patient-Specific Functional Scale (PSFS)was used in Stage 1 of *Working Hands- ED*, to enable individuals to self-identify limitations and restrictions affecting their participation in work roles. The use of the PSFS empowered injured workers to actively engage in the RTW process by enabling them to identify relevant and meaningful work duties and tasks that were difficult to complete in their work environments because of their LET.

The results of the RCT in Study 4 indicated that those in the intervention group significantly improved in their functional abilities from baseline to 12-weeks as per the PSFS scores. Based on this finding, it is recommended that hand therapists working with injured workers with LET should consider including this functional measure as part of their assessment process to help injured workers with their individual RTW goals.

The RCT found that a multimodal self-management approach that included provision of a wrist orthosis, self-massage and stretches, eccentric strengthening program, and education about occupational risk factors associated with developing LET, effectively reduced pain and improved function by 12-weeks. These findings are consistent with previous studies that identified a multimodal approach was more effective than stand-alone physical treatments in the management of LET (Coombes et al., 2015; McQueen et al., 2020). The addition of an individualised hand therapist-delivered workplace-based educational intervention did not improve clinical outcomes significantly more than standard hand therapy management; however, it improved the participants' work status by 26-weeks. By considering factors in the social, institutional, and physical environments into the hand therapist delivered education, a greater proportion of participants in the intervention group than the control group had resumed their pre-injury duties by 26-weeks. This study revealed that modifications to the work environment to reduce risky postures and movements may positively benefit workers' RTW outcomes including financial costs incurred by the insurer, employer, and the injured worker. These findings align with recent literature about the importance of considering the work environment and adopting motions and postures that minimise risk factors for LET (Stegink-Jansen et al., 2021).

The findings of the RCT (Study 4) highlighted that hand therapy treatment goals in LET management should not focus solely on the body structure and function components of the ICF and the person factors of the PEOP model. Hand therapists are encouraged to develop treatment goals *with* their patients to improve their overall functional abilities to participate in their work and life roles, despite having LET symptoms. For example, an individual employed as a chef might experience elbow pain (i.e., body function and structure; intrinsic barrier) but still be able to cut food and cook using utensils (activities; occupation) and remain engaged in their work role (participation in work role; occupational performance) when given the appropriate education. This education includes recommendations for modifying work tasks and workflow (modifying work hours and scheduled breaks -modifying components in the institutional environment), standing closer to the stove with the elbow bent and palm facing up (changes to posture - personal factors), and using a smaller saucepan with a built-up handle (modifying components in the physical work environment).

8.2.1.3 Person-centred education

Lateral elbow tendinopathy was once thought to be an inflammatory condition; however, intraoperative observations have confirmed that LET is degenerative in nature (Bhabra et al., 2016; Waugh, 2005). Given this knowledge, and that LET symptoms can last between 6 months and two years (Ahmad et al., 2013), LET treatments should not only focus on managing the symptoms in the short term but also on minimising occupational risk factors associated with developing and exacerbating LET symptoms. The second study (cross-sectional study) presented in this research identified that medical practitioners and hand therapists believed education to be the most effective management strategy compared with other treatment options such as wrist and elbow orthoses, strengthening exercises, corticosteroid injections, and blood injections. Education is often used as part of a hand therapy program; however, the content, nature and type of education provided is rarely specified (MacDermid et al., 2010). Study 2 presented in this thesis identified that education about LET pathology, postures to avoid, activity modification and work recommendations were key elements to include in the educational approach developed in Study 3.

Activity modification principles used in this study were based on available evidence and each hand therapist's knowledge of the LET anatomy, pathology, and upper limb biomechanics (Fan et al., 2013; Shiri et al., 2006; Walker-Bone et al., 2012). It was not until the final stages of conducting this PhD research, that another literature review was published that had similar ideas about promoting postures to minimise occupational risk factors for LET as a first step to manage this common condition (Stegink-Jansen et al., 2021). The recommendations regarding the modification of postures and activities for the study presented in this thesis are consistent with some of those suggested (Stegink-Jansen et al., 2021) such as lifting objects with affected elbow supinated and flexed. Recommendations to modify work activities were discussed with the participants in the intervention and control groups in the RCT (Study 4) (Appendix F). Recommendations included avoiding repetitive hand, wrist, and elbow motions, and gripping with the elbow when in extension and pronation (Fan et al., 2013; Shiri & Viikari-Juntura, 2011).

The specific educational principles in the *Working Hands -ED* intervention applied the existing evidence on occupational risk factors reported in the literature, which included

repetitive use of the upper limb for more than two hours/day, handling tools over 1kg, handling loads heavier than 20kg for more than 10 times a day, participating in activities demanding high handgrip forces, and the use of vibrating tools (Shiri et al., 2006; Shiri & Viikari-Juntura, 2011; Walker-Bone et al., 2012)

Participants in the intervention group received additional practical education within their work environments, and this education was tailored to their specific occupational (work) duties. The third stage of *Working Hands- ED* enabled the hand therapists and injured workers to collaborate with supervisors to implement ergonomic changes at the workplace. Although the RCT found no significant differences in the participants' clinical outcomes, the qualitative study (Study 5) findings confirmed the benefits of having the hand therapist conduct a worksite visit. The reported benefits were (i) the education provided was individualised, practical, and relevant to the patient and their context, (ii) the employers/supervisors were engaged and supportive of the implementing the recommendations made during the worksite visit, and (iii) that this collaborative team approach maximised their patient's occupational performance, potentially yielding long-term cost-benefits and improved productivity.

Existing research evidence has identified that ergonomics training and participatory ergonomics programs were the least costly of ergonomics interventions for managing musculoskeletal conditions in the workplace (Burgess-Limerick, 2018; Heidarimoghadam et al., 2020). Study 4 (Part II) found that a significantly greater proportion of participants in the intervention group (63%) returned to their pre-injury roles and duties at 26-weeks compared to those in the control group (8%). The benefits of having injured workers return to pre-injury duties include reduced health care costs, decreased lost workdays, and increased workers satisfaction and productivity (Cook & Lukersmith, 2010).

Within the workers' compensation context, the costs associated with payment of weekly wages and medical expenses while injured workers are not performing their pre-injury roles at full capacity may be considered just 'the tip of the iceberg'. There are many hidden costs associated with compensable work absence to the insurer, the employer, the injured worker, and the wider community (Safe Work Australia, 2015; Sanders et al., 2015, 2016). The overall mean hand therapy cost for participants in the educational intervention group was AUD$ 1230.55 more than those in the standard hand therapy group. However, to

put this into perspective, each injured worker with a musculoskeletal injury claim costs an average of AUD$ 56, 235 (WorkCover WA, 2020). From an occupational rehabilitation perspective, workplace rehabilitation services can cost up to AUD$17, 079 per worker (WorkCover WA, 2022), which is substantially more than the medical costs available for hand therapy, inclusive of a workplace-based intervention. Furthermore, improved collaboration between the hand therapist and the workplace rehabilitation provider may reduce the overall claims costs as suitable duties and an appropriate RTW program may be developed to assist the injured worker back to their pre-injury duties. The longer the injured worker is not able to return to their pre-injury duties and roles, the more costs associated with compensating the loss of income is incurred by the insurer (WorkCover WA, 2022). Future studies are required to confirm this hypothesis. The findings of the research contained in this thesis suggest new information about the content nature and type of educational strategies provided within the hand therapy clinic setting and the workplace to facilitate the management of LET.

8.2.1.4 Collaboration between key stakeholders

One of the identified key benefits of *Working-Hands – ED* was the successful collaboration between key stakeholders in the WA workers' compensation system (i.e., medical practitioners, hand therapists, workplace rehabilitation providers, employers/supervisors, insurers, and the injured worker). Communication and collaboration between key stakeholders is paramount for a successful occupational rehabilitation outcome (Camden et al., 2015; Kilgour et al., 2015; Russell & Kosny, 2019). Each stage of *Working Hands-ED* involved collaboration between all stakeholders, with the injured worker central in the rehabilitation process. The information gained from the worksite visit equipped hand therapists with additional knowledge regarding occupational risk factors, the nature of work tasks that the injured worker would be returning to, and the environment in which they were performed. Hand therapists can then make more accurate and realistic work recommendations to the medical practitioner to assist them with the decision-making process regarding the injured worker's functional capacity.

In the final stages of completing this PhD research, the primary researcher (TT) was invited by workers' compensation insurers to present the key findings of this doctoral

research to their injury management consultants. Furthermore, insurers and medical practitioners have directly contacted TT requesting a worksite visit to implement *Working Hands-ED* for injured workers with LET and other common upper limb work-related injuries such as ECU tenosynovitis and Triangular Fibrocartilage Complex (TFCC) injuries. Anecdotally, this demonstrates the perceived value of this novel intervention among some of the key stakeholders in the WA workers' compensation system.

8.2.1.5 Hand therapists' role in facilitating occupational performance

This study has identified a novel LET management approach for occupational and physiotherapists practising hand therapy. The primary researcher trained the 10 hand therapists involved in piloting *Working Hands-ED* and provided them with resources to help them deliver this novel intervention. The results from Study 5 (qualitative study) identified that the hand therapists perceived the experience as positive, with common themes suggesting that this intervention approach was person-centred and provided them with an opportunity to expand their hand therapy skills. Although the workplace-based intervention is a non-traditional approach, it presents a unique role for hand therapists in managing work-related LET by focusing on occupational performance in work tasks and roles, rather than on the symptoms of LET.

Hand therapists have traditionally followed a reductionist biomedical approach to their practice that perceives function has been restored when physical signs or symptoms are resolved (Dale et al., 2002; Fitzpatrick & Presnell, 2004). The findings of the research contained in this thesis challenge these beliefs and provide an opportunity for hand therapists managing work-related LET to expand on their role and skills in the RTW process. A recent survey that aimed to identify Australian hand therapists' current practices, skills, and the need for additional training in management of the RTW process, found that almost all respondents considered they had a role in the RTW process; however, this role was limited to liaising with the treating practitioner and discussing a graded program with the patient (O'Brien et al., 2022). Hand therapists have specialised knowledge and skills in upper limb rehabilitation, and by using a biopsychosocial approach, they can provide person-centred educational strategies to minimise the risk factors associated with LET.

Furthermore, this translation of knowledge to injured workers may empower them to take a more active role in long-term self-management of LET.

The findings of Studies 2 (cross-sectional study) and 5 (qualitative study) identified that the hand therapists rarely conducted worksite visits in their practice; however, after attending at least one worksite visit and implementing the five stages of *Working Hands-ED*, the hand therapists experienced increased self-confidence and had better insight to their patient's work tasks and roles. Based on the positive experiences reported by the hand therapists delivering this novel approach in this study, future hand therapy management of work-related LET should consider if this type of intervention would be appropriate and beneficial for their patients with LET in the RTW process.

The lack of time and the extra costs involved with travel were two logistical challenges reported by the hand therapists who delivered the *Working Hands- ED* intervention. These findings are consistent with those of a previous survey of hand therapists who identified they are not using occupation-based assessments and interventions as much as they would like due to time constraints (Grice, 2015). The hand therapists in Study 5 (qualitative study) reported that these challenges can be overcome by (i) rearranging their clinic schedule to prioritise the worksite visit, and (ii) communicating early with the insurance case manager to negotiate remuneration of the hand therapist's time for travel and to conduct the worksite visit. Making these small adjustments enabled the hand therapists involved in the RCT to implement the novel intervention in their daily practice.

8.3 Strengths and limitations

8.3.1 Study 1: Systematic Review

A strength of the systematic review in this thesis was that it was that a literature search was first performed in 2014 and then again in 2020 using the same search terms. This allowed for any newly published research to be included in the final reporting of the systematic review. Despite undertaking a rigorous process to search for and review the quality of eligible studies, the search was limited to studies published in English language, which may have excluded relevant studies. Restricting the target population to patients diagnosed with LET and excluding studies that included other upper limb musculoskeletal

conditions resulted in an almost empty review. Consequently, this review yielded one study that presented low-level evidence, limiting its use to guide clinical practice for hand therapists treating patients with work-related LET. Furthermore, having a strict inclusion criterion resulted in an almost empty review, and consequently, a lack of guidance on how to report these types of reviews is reported (Yaffe et al., 2012).

On reflection, as this study focussed on a novel concept, a scoping review may have been more appropriate when searching the literature. Scoping reviews help investigate emerging evidence and clarify critical concepts in the literature (Munn et al., 2018). Nonetheless, the rigorous systematic process undertaken for this review highlighted the lack of research available about workplace-based hand therapy interventions in the management of LET.

8.3.2 Study 2: Cross-sectional survey

There are two main strengths of the cross-sectional study. Firstly, this was the first survey to investigate the perceived effectiveness of LET treatments since the last survey conducted over a decade ago in the USA (MacDermid et al., 2010). Secondly, this study was the first of its kind to explore medical practitioners and hand therapists' perceptions of the value of workplace-based hand therapy interventions. The survey was conducted within the Australian context, where workplace-based interventions are integral to RTW in the workers' compensation system.

Limitations of this study included small sample sizes with low and undefined response rates, which may reduce the representativeness of the sample to the two target populations. Although not all treatments included in the survey were selected by respondents; there was an "other" response category for respondents to specify other treatments they used so as to accurately report their assessment and treatment practices. The medical practitioners surveyed were recruited from Western Australia only, and so their responses may not be representative of medical practitioners from other Australian States and Territories.

8.3.3 Study 3: Development of interventions and RCT study protocol

As discussed throughout this thesis, the WorkCover WA Clinical framework outlined five principles to guide allied health workers in the RTW process that supports optimal recovery and RTW outcomes for injured workers. The principles are:

1. Measure and demonstrate the effectiveness of treatment
2. Adopt a biopsychosocial approach
3. Empower the injured person to manage their injury
4. Implement goals focused on optimising function, participation, and RTW
5. Base treatment on best available research evidence (The Government of Western Australia, 2012).

The use of the ICF framework (Work Health Organization, 2001) and PEOP model (Baum et al., 2015) addresses these core principles and are applicable and relevant to hand therapists in managing work-related LET. The ICF framework and the PEOP model adopt a biopsychosocial approach; however, the application of the PEOP model to the hand therapy management of injured workers with LET further focused on optimising function, participation, and RTW. Another strength of applying the PEOP model in the development of the workplace-based educational intervention was that it enabled the hand therapists to consider the complexities of their patients' work occupations and task demands with consideration of the environmental (social, physical, and institutional) factors. The process to train the hand therapists to deliver the workplace-based education, as described in section 4.3 of this thesis, was developed to be suitable equally for occupational therapists and physiotherapists practising in hand therapy.

In developing the workplace-based intervention, the primary researcher (TT) liaised with workplace rehabilitation providers and conducted two worksite visits alongside senior workplace rehabilitation providers to determine if this type of intervention may be practicable to implement.

The standard hand therapy treatment provided to the control group was standard practice in the clinics where the RCT was performed. However, some participating hand therapists found it challenging to adhere to the strict list of standard interventions for the purpose of the RCT. For example, in clinical practice eccentric exercises can be performed by

patients using (hand) weights, Theraband, or Therabar; however, the hand therapists treating patients with LET who were enrolled in the RCT were instructed to prescribe eccentric exercises using the weights only. Similarly, some hand therapists may have preferred to include co-interventions (such as InterX neurostimulation and Kinesio taping) but had to refrain from these to adhere to the standard hand therapy intervention for purpose of the study. Furthermore, there was no mention of assessment or management of factors that may have contributed to the individual's pain state. For example, psychosocial contributors such as fear avoidance, catastrophising, negative pain beliefs may negatively influence prognosis but were not formally assessed.

All procedures and protocols for the RCT were developed and presented to all administrative staff members and hand therapists involved at the multi-centred hand therapy practice to ensure consistent recruitment, allocation to intervention, treatment delivery, and measurement of outcomes. Online documents were available for ease of reference by all clinic staff involved in the RCT. Having these organisational systems in place enabled the RCT to run smoothly across the eight clinic sites when the primary researcher was not physically present.

A limitation of the RCT was that some insurers did not approve funds to reimburse the time for the participating hand therapists to conduct the worksite visit. Their rationale was that this was a novel intervention with the benefits unknown. However, TT secured research funding from the Western Australian Occupational Therapy Association (WAOTA) and the Australian Hand Therapy Association and used these funds to cover the costs associate with the worksite visits when an insurer declined payment of the additional funds. This enabled the worksite visits to be delivered to the intervention group as planned.

8.3.5 Study 4: Randomised Controlled Trial

Study 4 used a pilot RCT study design to explore the effectiveness of adding a workplace-based hand therapy education intervention to standard hand therapy care to support the RTW of injured workers with LET. The pilot was appropriate to validate the feasibility of the workplace intervention, and control for the wide variability in the clinic-based hand therapy treatments used to manage LET.

In this study, seven participants randomly allocated to the intervention group did not receive a workplace-based intervention due to the employer not granting site access to the hand therapist. In this instance, a strength of this study was that intention-to-treat analysis was used as it analyses the participants according to their assigned (intended) intervention rather than what they received, giving an unbiased estimate of the treatment effect (McCoy, 2017). This approach to data analysis is important as it preserves the benefits of randomisation and reflects what can happen in a real-life setting.

Although an RCT study design was utilised to minimise allocation bias, selection bias, and confounding factors (Pandis, 2011). There are several methodological limitations to consider when interpreting the RCT findings:

Small sample size

The RCT was initially designed with the planned recruitment of 180 participants, based on an *a priori* power calculation using a critical α of 0.05 and a 1-β of 0.8, to detect a standardised difference of 0.4 between the intervention and control groups. However, the recruitment process was unexpectedly slow and was due to the strict inclusion criteria and reliance on physician referrals of injured workers with LET who were in receipt of workers' compensation to the hand therapy practice where the RCT was performed. The minimum sample size required was re-calculated using the G*-power calculator to N=50. As a result of the small sample, the RCT may have been underpowered to detect a statistically significant difference between groups on some of the clinical outcomes. Another RCT using a larger sample is required to confirm the results.

Limitations to outcome measures used

The Patient-Specific Functional Scale (PSFS) was completed only by participants in the intervention group to identify their work duties in preparation for the worksite visit. Since the PSFS was not used with the control group, it was not possible to compare PSFS results between the groups. There were also no formal outcome measures used to evaluate adherence among the intervention group to the hand therapists' recommendations for modifications to work tasks, the physical environment, and workflow. Consequently, compliance by the injured workers and/or the employers with strategies to minimise

workplace risk factors for LET were not objectively confirmed. Furthermore, patient adherence to the exercise program was not assessed for both groups, therefore it is unknown how compliant the participants were with the home self-management exercise program.

The primary researcher endeavoured to obtain the overall claims costs and itemised medical expenses of participants in the control and intervention groups for the purpose of comparison. Unfortunately, it was not possible to obtain this information from all the insurers managing the workers' compensation claims for the participants in this study. This was despite gaining consent from participants for the primary researcher to access their respective claims information. Furthermore, WorkCover WA did not maintain a database from which the researcher could access such claims information. Therefore, it was not possible to determine the impact of adding *Working Hands-ED* on the injured workers' total claims cost and durable RTW outcomes. The drop-out rate at the 6-month follow-up for the RTW status was very high (41%), which should also be considered when interpreting the results.

The study only measured short-term clinical outcomes (i.e., up to 12 weeks); therefore, the measurement of long-term outcomes with the participants who were in receipt of medical care through workers' compensation was challenging due to the potential for confounding factors. Other stakeholders within this study, such as the insurance case manager or medical practitioner may have prescribed other co-interventions such as a corticosteroid injection, trial of blood injections, acupuncture, dry needling, and/or referral to orthopaedic surgeon for review if the injured worker's symptoms did not improve within the first 3-6 months of hand therapy. Therefore, intervention bias may have influenced the results of the secondary outcomes after 12-weeks.

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8.3.5 Study 5: Qualitative study

A key strength of Study 5 was the method of data analysis used; that is, reflexive thematic analysis using the systematic six steps described by Braun and Clarke (Braun & Clarke, 2019). A number of strategies were used to enhance the trustworthiness of the study findings: data triangulation of the transcriptions to confirm emerging themes and member checking of the interview transcripts with the participants to improve the

credibility of the data; peer-review and feedback from all authors to improve confirmability; and to improve dependability, the use of a reflective journal to declare the interviewer's (TT) perspectives, experiences, and values and how these influenced her thoughts, perceptions, and interactions with the participants (Liamputtong, 2020; Xerri, 2018)

There are some study limitations to be considered. Firstly, participants were interviewed approximately 12 months after delivering the *Working Hands-ED* intervention with the RCT study participants, which may have affected the recall of their experiences during the work-site visits and subsequent interactions with the relevant stakeholders. The reason for the delay in interviewing the hand therapists was because the recruitment for the RCT (Study 4) was slower than intended and the primary researcher (TT) was on maternity leave by the time the RCT data collection was completed. This limitation was minimised by asking the hand therapists to use a reflective journal during the RCT to help with their recall. Secondly, the study only explored the experiences of the hand therapists who delivered the novel workplace-based education intervention. Exploration of the experiences of the injured workers who received the *Working Hands-ED* intervention would have provided important information about the value of the intervention in the RTW process from the workers' perspectives. Understanding the injured workers' experiences as recipients of the novel intervention may have assisted the researcher to identify strengths and weaknesses throughout the implementation stages to improve the acceptability and feasibility of future iterations of the intervention.

8.4 Future directions

The preliminary results from the RCT identified that the addition of a workplace-based intervention did not make a difference to the clinical outcomes of pain, grip strength, and function at 12-weeks, and this non-significant finding may be attributed to the methodological limitations described in section 8.3. An important finding in support of the novel workplace intervention was that a significantly greater proportion of workers in the intervention group returned to and retained their pre-injury work duties and hours compared to the control group at 12-weeks and this superior RTW outcome was sustained at 26-weeks follow-up. However, it is unknown whether the clinical and work outcomes

were sustained after 26-weeks, and so there is a need for further investigation into the long-term benefits of the novel workplace intervention.

A recommendation from this doctoral research is that research methodologies similar to those used in Studies 3, 4, and 5 are repeated within other multi-centred hand therapy practices in Australia to validate our research findings. This will provide evidence of the feasibility and effectiveness of using this novel intervention in other Australian hand therapy practices. Each state and territory in Australia have its own workers' compensation scheme and injury management process, in addition to the Commonwealth scheme for Australian federal government employees. Consequently, workers' compensation arrangements and legislative provisions may differ across jurisdictions. Collaboration between all stakeholders of the workers' compensation system and remuneration support from insurance companies is needed for any future trials investigating the impact of *Working Hands-ED* on RTW outcomes for injured workers with LET.

8.5 Conclusion

The body of work contained within this thesis has contributed new evidence about using an educational approach that considers the work environment in the hand therapy management of LET. The study identified that adding a workplace-based education intervention (*Working Hands-ED*) to standard hand therapy was no more or less effective than standard hand therapy only in improving the clinical outcomes of pain, grip strength, and function; however, it improved the RTW status of injured workers with LET compared to standard hand therapy. Hand therapists believed that this novel type of intervention enabled them to provide a more holistic and person-centred approach when managing LET.

Despite several methodological limitations to consider, this doctoral research has (i) provided information about the key 'active ingredients' to include in patient education for the management of LET, (ii) presented a novel five-stage hand therapy workplace-based educational intervention that may be used as a guide for future RTW programs, and (iii) has added to the very limited available evidence for hand therapy workplace rehabilitation specifically for the management of LET.

In summary, this doctoral research presented a novel workplace-based hand therapy intervention based on the ICF framework and the PEOP model within the workers'

compensation context. The intervention aimed to enable workers with compensable work-related LET to continue participation in valued work activities and roles, while self-managing exposure to occupational risk factors associated with LET pathology.

8.6 Closing reflection

"*I often think that in the clinic, we get so caught up on treating the symptoms that we don't always consider the entire person."*

(Sarah*, 2020).

Having started my thesis with this quote, I now return to reflect on what it means to me after having completed my research project. I started my PhD journey as a new graduate occupational therapist with two years of hand therapy experience. Now in the final stages of this journey, I have accumulated a decade's worth of hand therapy clinical experience, and now teach hand and upper limb rehabilitation to occupational therapy students. I have learned so much throughout this journey, both professionally and personally.

In my professional opinion, it is often challenging to provide hand therapy services using a biopsychosocial approach because of the medicalised context in which hand therapy is practised. For example, patients are often referred by medical practitioners to a hand therapist to "treat" the injury, and the outcomes of interest are heavily influenced by the medical model of care. After completing an undergraduate occupational therapy honours degree, I was drawn to this practice area but my clinical experience of working in hand therapy was at times incongruous with the values and theories that I learned in my degree. I started this PhD journey because I wanted to explore how to better apply my occupational therapy values of person-centred care and a top-down approach to hand therapy practice.

Lateral elbow tendinopathy is a challenging musculoskeletal condition to manage; however, after this PhD journey, I not only have a stronger understanding of the pathology, occupational risk factors, and expected recovery timeframes but also an appreciation of how to apply core occupational therapy theory in this area of practice. There are many ways to manage this condition clinically, but my research has taught me that educational approaches that empower patients to self-manage are important. Patients can be educated about occupational risk factors within their individual work contexts; be provided with opportunities to identify activities they find challenging and be involved in the process to find and implement solutions. The quote by Sarah* resonates with me because it represents that hand therapists often get caught up in treating symptoms. However, we must focus on

how an individual's LET symptoms are influenced by the postures and movements they perform in their environments and their impact on overall occupational performance in meaningful (work) activities.

The knowledge I have gained from this PhD journey has been shared with occupational therapy students and new graduate therapists working in hand therapy. Although university curricula content remains focused on hand and upper limb conditions, assessments, and treatments, I ensure that students I teach and graduate therapists I supervise understand the importance and benefits of applying a person-centred approach to hand therapy practice, including participation in meaningful activities. I remind them to return to their occupational therapy theory, including the PEOP model, and encourage new graduate therapists working in hand therapy to work towards a biopsychosocial approach. My doctoral research has taught me that hand therapists are not limited to working in the clinic but can also provide quality care at their patients' workplaces. It is possible to practice as a hand therapist using an evidence-based approach with consideration of person factors, environment factors, and occupation factors not just a focus on the presenting symptoms.

8.7 References

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Copyright statement

Appendices

Appendix A Treatment Management Plan

Occupational Therapy – Upper Limb Treatment Management Plan

Contact details

Worker's name _____ **Claim No.** _____

Occupation _____ **Employer** _____

Referring medical practitioner _____ **Insurer** _____

Workplace rehabilitation provider (if applicable) _____

Clinical assessment

Date of injury _____ **Date of initial consultation** _____

Number of consults to date _____ **Number of consults since last surgery** (if applicable) _____

Provisional Diagnosis/Diagnosis _____

Area/s treated _____

Clinical Evaluation/Objective Assessments

Presenting complaint

Objective measurements *e.g. Observation, ROM, Strength, Sensation, Provocative Testing and Pain & Function.*

Screening Tools/Questionnaires *(e.g. Orebro/DASH etc)- comment on change over time*

Functional/ Return to Work Limitations *E.g.: Impairment(s) preventing full work performance*

Biopsychosocial Factors

Have you have identified, or are you aware of any factors that may impact the workers return to work/barriers for return to work? If so, what are they and do you have any recommendations for addressing them?

E.g. diagnostic imaging, specialist referral or referral to other AHP, reassurance, education regarding injury and treatment expectations, work site assessment, etc.

Current Work Status

Hours

Pre-injury hours at work _____ per week

Current hours at work _____ per week

Current duties

☐ Pre-injury duties

☐ Alternative/modified duties

☐ Not working

☐ I would like more information about the duties and the associated physical demands of the workers pre-injury occupation/available duties

Return to Work Progression

Has the worker's hours and/or duties progressed in the last six weeks? ☐ Yes ☐ No

Provide details

Is the worker likely to return to the functional capacity required to perform their pre-injury duties?

☐ Yes Anticipated timeframe

☐ No Comment:

☐ Unsure Comment:

Do you have any comments to assist the medical practitioner certify capacity for the worker?

e.g. consider current functional measures, modifications to the workplace

Proposed Management plan

Future Goals – Treatment should be specific and focused on improving function and return to work.

Treatment Type	Frequency	Estimated Timeframe

Have self-management strategies been implemented? ☐ Yes ☐ No

Occupational Therapist's Details

Name Telephone

Email address

Practice Date:

A copy of this form has been sent to (please tick):

☐ Insurer/Self-insurer ☐ Medical Practitioner ☐ Worker ☐ Other (Specify)

Insurer approval

Note to insurer: It is expected that a response be provided to the therapist within three to five business days of receipt of this TMP.

☐ Approved ☐ Not Approved ☐ Further information required (specify)

Insurer contact name Telephone

Signature Date

Appendix B Search terms

	CONCEPT 1	CONCEPT 2	CONCEPT 3
Key Terms	lateral elbow tendinopathy; elbow tendinopathy; tennis elbow; epicondyl*; workers; elbow.	workplace; work-place; worksite; work-site; onsite; on-site;	education* interven*; work rehab*; vocational rehab*; occupational rehab*; return-to-work; RTW; health education; ergonom*; rehabilitation; vocational; return to work; occupational therapy therapy;
Subject headings **Medline**	Tennis Elbow/ OR Elbow Tendinopathy/	Workplace/	Physical Therapy Modalities/ OR Ergonomics/ OR Occupational Health/ OR Occupational Medicine/ OR Return to Work/ OR Occupational Therapy/
Embase	Tennis Elbow/	Workplace/	Physiotherapy/ OR Ergonomics/ OR Occupational health/ OR Occupational Medicine/ OR Return to work/ OR Occupational therapy/rehabilitation/intervention
CINAHL	Tennis Elbow	Work Environment	Physical Therapy OR Ergonomics OR Occupational Health OR Occupational Medicine OR Job Re-Entry OR Occupational Therapy OR rehabilitation OR intervention
ProQuest	Keywords only NOFT		
Scopus	Keywords only TITLE-ABS-KEY ("elbow tendinopathy" OR "lateral epicondyl*" OR tennis elbow)	AND TITLE-ABS-KEY ("workplace" OR "work-place" OR "worksite" OR "work-site")	AND TITLE-ABS-KEY ("treatment" OR "rehabilitation" OR "ergonomics" OR "management") AND PUBYEAR > 2000
Wiley Online Library	(tennis elbow OR lateral epicondyl* OR elbow tendinopathy)	AND (workplace OR work-place OR worksite OR work-site OR work environment)	AND (intervention OR management OR treatment OR therapy)
Pedro	Key words only		
PubMed	Keywords only		
Cochrane library	Epicondylitides, Lateral Humeral; Tennis Elbows; Lateral	Work Location; Place, Work; Sites, Job; Work Places; Work-Sites;	Treatments; Therapeutic; Treatment; Therapies; Therapy

MeSH	Humeral Epicondylitides; Lateral Humeral Epicondylitis; Epicondylitis, Lateral Humeral; Lateral Epicondylitides; Elbows, Tennis; Epicondylitis, Lateral; Humeral Epicondylitides, Lateral; Epicondylitides, Lateral; Humeral Epicondylitis, Lateral; Elbow, Tennis; Lateral Epicondylitis	Workplaces; Location, Work; Site, Job; Worksites; Places, Work; Work Locations; Locations, Work; Work-Site; Work Place; Worksite; Job Site; Job Sites; Work Site	
OTseeker	Keywords only tennis elbow OR lateral elbow tendinopathy OR epicondyl*	workplace OR worksite OR work environment	intervention OR ergonomics OR therapy OR treatment OR rehabilitation
ScienceDirect	Keywords only: ("tennis elbow" OR "lateral epicondylitis" OR "elbow tendinopathy") 8 max Boolean per field	AND ("workplace" OR "work-related")	AND ("management" OR "therapy" OR "ergonomic" OR "interventions")

Appendix C Participant consent form (Study 4)

Curtin University

CONSENT FORM FOR PATIENTS

Treating tennis elbow injuries at work

- I have read, the information statement and I understand its contents.
- I believe I understand the purpose, extent and possible risks of my involvement in this project.
- I voluntarily consent to take part in this research project.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand that this project has been approved by Curtin University Human Research Ethics Committee and will be carried out in line with the National Statement on Ethical Conduct in Human Research (2007) – updated March 2014.
- I understand I will receive a copy of this Information Statement and Consent Form
- I provide consent to completing an additional standardised quality of life self-reported questionnaire during the treatment period and also up to 1 year after the initial appointment (even though I may have been discharged from the hand therapy services).
- I consent to have my information stored and used as part of an approved study investigating the benefits of workplace-based education in improving return to work for injured workers with LE
- I consent to having the hand therapist contact my employer to organise a worksite visit within the first four weeks of my initial consultation at Hand Works by my treating hand therapist **if I am allocated in the group that requires a worksite visit.**
- I consent to having the hand therapist contact the insurance company to determine the total claims costs associated with my work injury to assist in the primary outcomes of this study.
- I consent to be contacted about future research projects that are related to this project.
- I understand that I can withdraw from this study at any time and will let the treating hand therapist know if this action is required.

Participant Name	
Participant Signature	
Date	

Declaration by Researcher: I have supplied an Information Letter and Consent Form to the participant who has signed above, and believe that they understand the purpose, extent and possible risks of involvement in this project.

Researcher Name	
Researcher Signature	
Date	

Appendix D Participant information sheet (Study 4)

Curtin University

Participant Information Statement

Treating tennis elbow injuries at work

What is the Project About?

Lateral epicondylalgia (LE) also known as tennis elbow is a common condition that causes pain and discomfort when using the wrist and elbow. It is often a work-related injury and can affect the way necessary job tasks are performed. Workplace-based rehabilitation is important in the process of returning to work; however, we do not know how effective it is in the management of work-related LE.

This is a study to find out if there are any benefit for workers suffering from tennis elbow if they get workplace-based education aimed at improving pain, grip strength and functional disability by their treating hand therapist.

Who is doing the Research?

Thuy ("Twee") Tran, staff therapist and research coordinator at Hand Works Occupational Therapy is completing this project as part of her PhD studies at Curtin University. She is supervised by Professor Torbjorn Falkmer, Associate Professors Marina Ciccarelli and Courtenay Harris. Sara Gibson, a fourth year honours Occupational Therapy student from Curtin University will also be assisting during the initial stages of this study.

This research project is funded by a grant from the School of Occupational Therapy and Social Work at Curtin University. There will be no cost to you for taking part in this research and you will not be paid for taking part.

Why am I being asked to take part and what will I have to do?

You have been asked to take part in this study because you have work-related LE and have an existing worker's compensation claim. Your participation will involve receiving clinical care for LE by trained therapists from Hand Works. We will ask you questions about your LE, such as how long you have had it and how severe your symptoms are, as well as your ability to do everyday activities; in particular job-related tasks.

You will be randomly allocated into one of two groups (this is out of the hand therapist's control). One group will receive usual clinic-based care for LE at Hand Works. The other group will receive the same clinic-based care but will also have a one-time workplace education consultation delivered by a hand therapist from Hand Works at their place of work within the first four weeks of hand therapy.

In this project we will collect and use health information that is in your medical records at Hand Works for research purposes. This information will include: age, gender, duration of LE symptoms, whether this is your first or a recurrent episode of LE, your type of occupation (e.g. manual work or office-based), your pain severity, pain-free grip strength and your level of function. We will also require information from the insurance company to find out the total claims costs involved with your workers compensation claim so that we can compare the total costs of both treatment groups.

Are there any benefits to being in the research project?
By participating in this project you will receive usual clinical treatment for LE, and so may experience benefits in pain levels and your ability to do everyday tasks. We hope the results of this research will further add to knowledge we have about effective workplace rehabilitation strategies for work-related LE.

Are there any risks, side-effects, discomforts or inconveniences from being in the research project?
There are no foreseeable risks from this research project. Qualified hand therapists will provide your treatment and measure any changes in your pain, grip strength and functional abilities. Apart from the time involved in receiving treatment, we do not expect that there will be any risks associated with taking part in this study. If you are allocated to the group that requires a worksite visit, then we will ask if a hand therapist can attend your place of work for up to one hour on one occasion to provide you with education for LE that is relevant to your usual work and specific to your work environment. We will obtain permission from your employer to attend the workplace. This study will collect your data until you no longer require hand therapy treatment.

Who will have access to my information?
The information collected in this research will be stored in two locations. Any clinical information that therapists at Hand Works record will be with the patient records at their clinics. This information will be identifiable, which means that any information that the therapists at Hand Works collect can identify you. This will be treated as confidential. Information about your treatment and progress will also be stored on a password-protected server in the School of Occupational Therapy and Social Work at Curtin University. This information will be re-identifiable (coded), which means we will remove identifying information (such as your name, date of birth and place of work) on any data or sample and replace it with a code. Only the research team have access to the code to match your name to the data if it is necessary to do so. Any information we collect will be treated as confidential and used only in this project unless otherwise specified. The Curtin Ethics Office may access the data for audit purposes. This information will be kept under secure conditions at Curtin University for 25 years after the research has ended and then it will be securely destroyed. You have the right to access and request correction of your information in accordance with relevant privacy laws. The results of this research may be presented at conferences or published in professional journals. You will not be personally identified in any results that are published or presented.

Do I have to take part in the research project?
Taking part in a research project is voluntary. It is your choice to take part or not. If you decide to take part and then change your mind, that is okay, you can withdraw from the project. You do not have to give us a reason; just tell us that you want to stop. If you choose not to take part or you start and then want to stop being in the study, it will not affect your treatment at Hand Works. If you choose to leave the study we will use any information collected unless you tell us not to.

What happens next and who can I contact about the research? If you decide to take part in this research we will ask you to sign the consent form. By signing it you are telling us that you understand what you have read and what has been discussed. Signing the consent indicates that you agree to be in the research project and have your health information used as described.

Curtin University

Please take your time and ask any questions you have before you decide what to do. You will be given a copy of this information and the consent form to keep. If you have any questions please contact Associate Professor Marina Ciccarelli on 9266 3692 or email m.ciccarelli@curtin.edu.au

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number HR46/2016). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

Appendix E Participant LET information handout

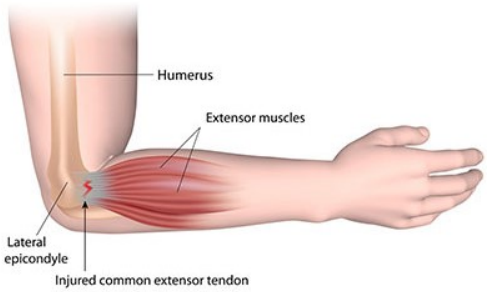
HAND WORKS Occupational Therapy
Specialists in hand and upper limb rehabilitation
ABN: 82 101 306 790

Lateral Epicondylalgia

Anatomy:
Lateral Epicondylalgia (LE) also known as "tennis elbow" usually occurs from repetitive use of the common extensor tendon of the forearm. The extensor muscles that allow you to extend your wrist and digits collectively form this tendon. Overuse of the wrist and digits may cause partial or complete tears at the common extensor tendon, and if left untreated may cause chronic degenerative changes at that site.

Cause of injury
- Overuse of the common extensor tendon of the forearm
- Acute trauma to the common extensor tendon insertion point

Symptoms
- Gradually increasing pain on the outside aspect of the elbow
- Worse pain with activities that involve gripping and extension of the elbow and wrist
- Reduced range of motion
- Reduced grip strength



Hand Therapy Treatment:
The goal of therapy is to reduce pain and improve function by allowing the affected wrist and digit extensor muscles to rest and avoid further aggravation. This is usually done by eliminating wrist movements with the use of a wrist orthosis/support. An elbow brace can also be prescribed to help ease direct elbow pain. Your therapist will teach you self-management soft tissue techniques, provide appropriate exercises, may use physical modalities, taping and provide you with education on activity modification and postures to avoid for home, work and leisure activities.

Home Program:
As your symptoms settle, you will be provided with a home program consisting of different stretches, exercises and activity recommendations.

A home program generally includes:
1. Gradual weaning from your counterforce brace and/or wrist orthosis/support
2. Gradual increase in range of movement stretches and strengthening exercises
3. Education on ways to prevent the injury from reoccurring through education and activity modification.
4. Advice on the management of your LE symptoms during functional use at home, work and leisure activities.

Worksite/home visit:
In some instances, a worksite/home visit may be arranged depending on the cause of injury allowing the hand therapist to assess you in your work or home environments. This enables the therapist to provide specific education and advice on activity modification and postures to avoid in order to prevent the risk factors that may exacerbate the symptoms of LE.

3/ 31 Outram St West Perth WA 6005 | 12 Leghorn St Rockingham WA 6168 | 3 / 209 Warwick Rd Duncraig WA 6023 | 106 Anstruther Rd Mandurah WA 6210 | 6/77 South Tce South Perth WA 6151 | Suite 16, Level 1 Wexford Medical Crcl Barry Marshall Pde, Murdoch WA 6150

Phone: 1300 887 798

Appendix F General work recommendations handout

Lateral Epicondylitis (Tennis Elbow)
Activity Recommendations

1 Avoid tight grasping, particularly with a straight elbow. If needed, move closer to the task to allow the elbow to bend.

2 Avoid heavy impact activities such as hammering, jack-hammering, rattle guns or machinery with heavy vibration.

3 Avoid lifting with the palm turned down. Hand turned up is better. Move closer to the task/load to allow the elbow to bend.

4 Avoid turning and twisting taps, tight handles, valves etc against a resistance. Use assistive devices and tools such as wrenches and handles if they are available or make short turns rather than a full twist of the wrist.

5 Avoid very repetitive grasping.

6 Avoid very repetitive wrist movements, lifting the wrist back or turning/twisting the hand.

7 Use your orthosis for all activities until you are instructed by your hand therapist to begin reducing the wearing time.

8 Exercises for stretching and strengthening will be gradually added by your therapist. It is important that you do not over-do them, or avoid them.

9 Activities will be gradually added to your list of duties as the injury recovers.

Should you have any questions please do not hesitate to ask.

Appendix G Self-management program handout

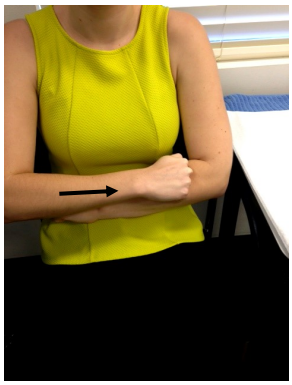
HAND WORKS Occupational Therapy

Specialists in hand and upper limb rehabilitation
ABN: 82 101 306 790

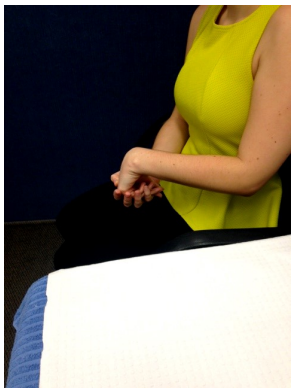
LATERAL EPICONDYLALGIA:
Self Management Program

Please complete the following ____times a day.

1. Apply heat pack along the back of your forearm and over the outside of your elbow. Leave on for 5-10 minutes.



2. Bend your affected elbow in towards your body at 90°.
- Form a fist with your other hand and apply firm but not painful pressure starting at the wrist level and moving up the forearm towards the elbow.
- Once you get to the top of elbow region, start from the wrist level again, always going in the one direction.
- Moisturiser or anti-inflammatory creams can be applied to reduce friction if too painful to rub directly on dry skin.



3. **Stretches:** Curl wrist and fingers forwards and straighten out elbow. Hold the stretch for 30 seconds.

16/3 Barry Marshall Pde Murdoch WA 6152 Phone: 1300 887 798
6/77 South Tce South Perth WA 6151 Phone: 1300 887 798
Level3 / 31 Outram St West Perth WA 6005 Phone: 1300 887 798
3 / 209 Warwick Rd Duncraig WA 6023 Phone: 1300 887
37 Elizabeth Street Kalamunda WA 6076 Phone: 1300 887 798
12 Leghorn St Rockingham WA 6168 Phone: 1300 887 798
106 Anstruther Rd Mandurah WA 6210 Phone: 1300 887 798

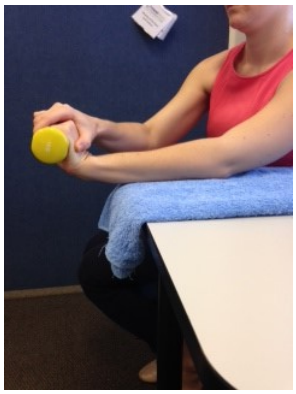
Appendix H Strengthening program handout

HAND WORKS Occupational Therapy

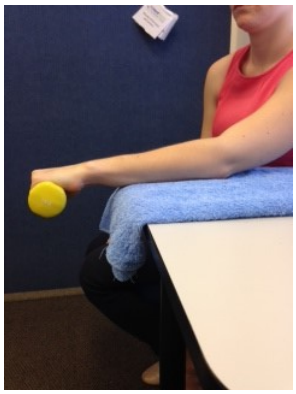
Specialists in hand and upper limb rehabilitation
ABN: 82 101 306 790

LATERAL EPICONDYLALGIA:
Eccentric Exercises

Please complete the following exercises
____repetitions, ____sets per day

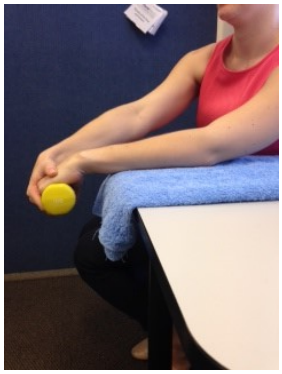


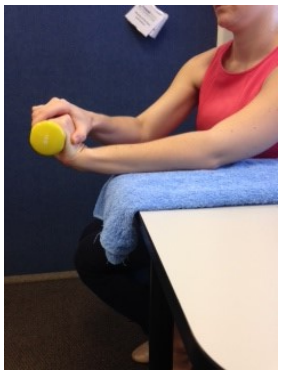
1. **Starting position:** Ensure elbow is at approximately 30° angle (if this is too painful, then you can have it at 90° instead). Hold ____kg dumbbell.



2. Start to bend wrist downwards at a comfortable pace (not too fast)

3. Continue to bend wrist downwards until you reach your full wrist flexion position (steps 2 and 3 should take approx. 4 seconds in total)





4. Use **your unaffected hand** to lift the wrist upwards, back to the starting position.

CAUTION: *Do NOT lift the wrist upwards with the affected arm, you must use the unaffected hand to assist with this motion to prevent re-aggravation of symptoms.*

16/3 Barry Marshall Pde Murdoch WA 6152 Phone: 1300 887 798
6/77 South Tce South Perth WA 6151 Phone: 1300 887 798
Level3 / 31 Outram St West Perth WA 6005 Phone: 1300 887 798
3 / 209 Warwick Rd Duncraig WA 6023 Phone: 1300 887
37 Elizabeth Street Kalamunda WA 6076 Phone: 1300 887 798
12 Leghorn St Rockingham WA 6168 Phone: 1300 887 798
106 Anstruther Rd Mandurah WA 6210 Phone: 1300 887 798

Appendix I Data collection form

Hand Works Occupational Therapy

Curtin University

INITIAL APPOINTMENT

Date: _____ **Week: 0**

☐ Client's **workers' compensation claim** submitted

☐ Client supplied with **participant information statement** and **consent form** (signed and collected)

S: _____

_____

_____

_____

_____

_____

_____

Duration of current LE symptoms: _____ **Episode (circle):** first / recurrent

Occupation: _____

Pre-injury work duties: _____

_____

_____

_____

Current work duties: _____

_____

_____

_____

O:

Imaging ☐ Yes: _____ ☐ No (therapist to follow up)

Pain	**Provocative Test**	**Value (0-10)**
	Palpation over LE	
	Palpation over CETO	
	Resisted wrist extension	
	Resisted middle finger	
	Resisted supination	

Patient-Related Tennis Elbow Evaluation (PRTEE) ***Weeks 0, 6 and 12 ONLY***

PRTEE Total Score: _____

Hand Works Occupational Therapy

Curtin University

Pain-Free Grip Strength ***Weeks 0, 6 and 12 ONLY***

	Elbow Flexed 90˚	Elbow Extended
Left	Trial 1: Trial 2: Trial 3: **Average:** _____	Trial 1: Trial 2: Trial 3: **Average:** _____
Right	Trial 1: Trial 2: Trial 3: **Average:** _____	Trial 1: Trial 2: Trial 3: **Average:** _____

A: ☐ Orthoses

- ☐ wrist gauntlet
- ☐ semi-rigid wrist brace
- ☐ counterforce brace

Wearing regime: _____

☐ Heat pack (10 mins) over DEB/CETO **combined with:**

- ☐ deep transverse friction massage **OR** ☐ soft tissue massage
- ☐ self-management program handout provided (heat, massage, stretching)

☐ Static stretching

- ☐ self-management program handout provided (heat, massage, stretching)

☐ Eccentric strengthening exercises

- ☐ handout provided
- ☐ dumbbells (weight: _____ reps: _____)

☐ Education

- ☐ LE pathology handout provided
- ☐ activity recommendations handout provided

Details of education provided: _____

_____

_____

Review **Group A** in 1-week and **Group B** within next 5 days for pre-worksite interview

P: _____

_____

_____

_____

_____

☐ Follow up on imaging (if required) ☐ Letter to GP ☐ Organise worksite visit (**Group B**)

Therapist Name and Signature: _____

Appendix J Worksite information booklet

HandWorks Occupational Therapy
Specialists in hand and upper limb rehabilitation

Curtin University

Worksite Information Booklet for Hand Therapists

The impact of a workplace-based hand therapy treatment on the return to work and clinical outcomes of injured workers with Lateral Epicondylalgia

Thuy ("Twee") Tran
PhD Candidate
Occupational (Hand) Therapist

March 2016 1

THE EVIDENCE

What does the evidence say about Lateral Epicondylalgia (LE) in the workplace?

Work-related upper limb conditions are a leading cause of compensation and disability in Western countries. In 2013/14, WorkCover WA reported a total of 35,562 work-related compensation claims. Of these, 16,957 claims involved lost time from work of one or more days/shifts, with injuries to the upper limb accounting for 35.5% of all lost-time claims. In the same financial year, traumatic injuries of the joints, ligaments, muscles, and tendons were the most common causes of disease and injury; comprising 56.3% of all lost-time claims.

LE is one of the most prevalent upper extremity disorders and is associated with work absences and long durations of incapacity to complete work-related tasks. It is estimated that work activities are responsible for 35-64% of all LE cases with specific risk factors being:

(i) performing repetitive activities involving the wrist and forearm for a minimum of two hours per day;
(ii) manual handling of loads > 20kg for more than two hours per day;
(iii) manual handing of loads > 5kg twice per minute for a minimum of two hours per day;
(iv) performing tasks involving the use of vibration tools; and
(v) undertaking activities requiring strong handgrip forces.

LE is frequently a work-related injury and the average duration of each episode is between six months and two years. There is a substantial financial burden on employers and insurance companies to cover direct medical costs of treating LE, and indirect costs such as administrative expenses, productivity losses, psychosocial costs incurred by injured workers, and costs of training replacement employees. It is imperative that injured workers return to work when ready because employment provides an individual with a sense of purpose, satisfaction, and financial stability; thus is it important to treat LE in the most effective way possible.

What does the study aim to do?

The primary aim of this study is to investigate the impact of adding a workplace-based hand therapy intervention to the usual clinic-based approach on the return to work outcomes of injured workers with LE, compared to a usual clinic-based hand therapy intervention only.

Why should hand therapists be involved in worksite visits?

Hand therapists aim to assist injured workers to re-engage with their self-care, leisure, and work roles. The current practice trends of hand therapists that are reported in the literature indicate that treatments used to manage LE are targeted at the level of body structure and function only, with little to no regard for the impact of the work environment. Using the International Classification of Disability, Functioning and Health as a basis, a holistic educational approach focusing on changes in functional biomechanics, that considers both personal and environmental factors, may provide hand therapists with a comprehensive and evidence-based approach to the management of injured workers with LE.

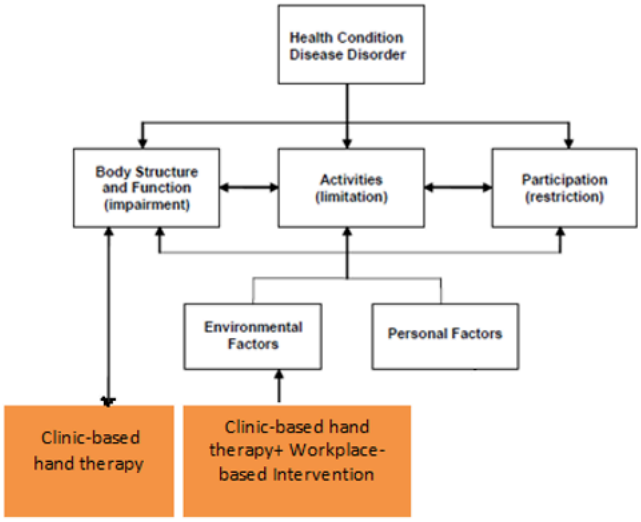


Figure 1: Application of the ICF to the proposed management of LE

A different approach to the management of LE is proposed that uses a hand therapist's specialised knowledge in the anatomy and pathology of the condition and skills about postures and movements that present as risk factors for LE.

What is the significance?

The study findings will directly benefit other stakeholders within the worker's compensation system (i.e. employers, medical practitioners, insurers and workplace rehabilitation providers) and has the potential to reduce the claims costs and claims duration related to return to work outcomes for injured workers with LE. Furthermore, a more holistic approach to the management of LE may improve communication between the treating hand therapists and other stakeholders, positively impacting on the outcomes of all aspects of the rehabilitation/compensation system.

What do hand therapists think about this idea?

A national survey in 2015 of the members of the Australian Hand Therapy Association and the OT WA Hand Interest Group found that two-thirds of hand therapists treat work-related LE and that 81% believed that having a hand therapist complete a workplace-based intervention would be valuable in both the acute and chronic phases of LE. They also believed that the most effective treatment in the acute and chronic phases was **education** about pathology, postures to avoid, activity modification and work recommendations.

What are the main differences between a vocational rehabilitation provider and a hand therapist?

Both hand therapists and vocational rehabilitation providers have an important role within the workers' compensation system to assist the injured worker in their return to work process.

The proposed workplace-based hand therapy intervention will be designed to ***complement*** any of the other return to work initiatives undertaken by the key stakeholders and/or vocational rehabilitation providers. It is not designed to duplicate other services, but rather to provide targeted education and advice on safe work practices at the workplace to reduce the presence of symptoms related to LE. The table below describes the key differences between the two health professionals.

Vocational Rehabilitation Providers	Hand Therapists
An approved workplace rehabilitation provider (WRP) can assist the employer and injured worker if there are problems with the return to work process. WRPs are commonly health professional such as occupational therapists, physiotherapists, exercise physiologists or psychologists who have expertise in addressing the physical, psychological and/or workplace barriers that may prevent an injured worker returning to work (WorkCover WA, 2016)	Hand therapy is the merging of occupational and physical therapy theory and practice, which combines comprehensive knowledge of the upper limb, anatomy, biomechanics and function. In Australia, hand therapists are either occupational therapists or physiotherapists who specialise in treatment of the hand and upper limb.
Common vocational rehabilitation services include conducting a job task analysis, environmental modifications and provision of ergonomic equipment, and prescription of a graduated return to work program.	Hand therapists are equipped with specialised skills in assessment, planning and treatment. They provide therapeutic interventions; prescribe appropriate orthoses and education to prevent dysfunction, restore function and/or reverse the progression of pathology of the upper limb in order to enhance an individual's ability to execute tasks and to participate fully in meaningful activities.
Payment for services come out of the 7% of the prescribed amount for vocational rehabilitation expenses (currently $15,258; WorkCover WA 2016).	Payment for hand therapy services comes out of the 30% of the prescribed amount for medical and hospital expenses (currently $65,391; WorkCover WA 2016).

WORKSITE VISIT IN FIVE STEPS

STEP 1: Identify the work tasks that the patient has difficulty completing at work

- The hand therapist will book a 30-minute appointment in the clinic to complete the Patient Specific Functional Scale (PSFS) with the patient.
- This assessment will allow the patient to identify specific work tasks that they are having most difficulty completing.
- They will score each of the work tasks from 0 to 10, where 0= unable to perform activity, and 10= Able to perform activity at the same level as before injury.
- Ask if the patient has had a vocational rehabilitation worksite assessment. If so, get a copy of the report from the vocational rehabilitation provider or insurance case manager. This information will assist the hand therapist to complete their worksite visit.

STEP 2: Assess the risk factors for LE in the workplace

- Now that the hand therapist has identified the work tasks that the patient has difficulty completing, they will ask the patient to demonstrate these in the patient's workplace.
- The patient will be asked to demonstrate the work tasks that they are ***currently*** completing and the work tasks that they potentially have difficulty returning to (pre-injury tasks).
- The patient will provide the hand therapist with as much information as they can to identify possible risk factors that may be associated with the progression/exacerbation of LE.
- The "**Worksite Visit Form"** is developed to assist the hand therapist to document what they observe during the worksite visit.

5

STEP 3: Provide and demonstrate specific work recommendations and education to reduce the risk factors

The hand therapist will provide specific work recommendations tailored to the patient's work tasks based on the following aspects:

☑ **Pathology**

- Educate the patient about the pathology of LE in the workplace by demonstrating how the involved structures may be aggravated through different risk factors that are adopted and identified in **STEP 2**.

☑ **Equipment: Adaptive, ergonomics and orthoses**

- Determine if there is any adaptive or alternative equipment that may assist the patient to complete the work tasks but with less force and better positioning.
- Determine the best orthoses for the patient to wear to assist them complete the work task without placing stress on the affected structures.
- If the patient uses vibration tools, explain how they can reduce the risk through use of gel gloves.

☑ **Activity modification**

- Suggest and demonstrate alternative methods of completing the work tasks to reduce the load and stress on the elbow and wrists.
- Ensure that the patient takes appropriate rest breaks during their 4workday.

☑ **Environment**

- Physical environment: Provide recommendations on how this can be changed to place less stress on the affected structures.
- Cultural/organisational environment: Discuss with the patient the level of workplace support from co-workers and supervisors. Communicate your recommendations clearly with the supervisor, treating physician and workplace rehabilitation provider to help ensure the patient is supported regarding any workplace modifications recommended.

STEP 4: Educate and inform the appropriate key parties

- Provide direct feedback to the patient in the workplace at the time of visit.
- Use the information gathered at the workplace visit in future clinic appointments with the patient to reinforce the work recommendations and education provided.
- Write a post-worksite report using the template provided on front desk to update the medical practitioner. You should also Cc in relevant key parties such as the insurer, employer and the patient. The patient should be able to identify clearly from the work recommendations and photos how to complete their work tasks more safely and with less stress placed upon their injured elbow.

STEP 5:

Reinforce to the patient in future clinic appointments, the occupational risk factors identified, and strategies implemented at the workplace visit

- Refer to worksite visit with the patient in future follow-up clinical appointments. Discuss the risk factors identified and evaluate if the effectiveness of the strategies provided to mitigate these risk factors.
- Address any questions regarding the worksite visit and provide further advice regarding activity modification and recommendation as required.

FREQUENTLY ASKED QUESTIONS

Will the employer require me to complete other pre-worksite preparation activities?

Some workplaces may require the hand therapist to complete online training modules about safety prior to attending the workplace. In the event that this is required, the hand therapist may book out time on front desk to complete it.

Will I need to wear special uniform for the worksite visits?

Some workplaces may require you to wear special personal protective equipment (PPE) such as steel capped boots, safety glasses or hearing protection. The research coordinator will ensure that appropriate PPE are available for you prior to you conducting the workplace visit. There will be no cost to hand therapists for any PPE that may be required.

Do I need to have knowledge of Australian health and safety regulations for different workstations/workplaces?

No, this knowledge is not a pre-requisite. You are encouraged to provide work recommendations and education to the patient based on your specialised skills and knowledge as an occupational (hand) therapist in the patient's work environment. Remember, the aim of the project is to complement what vocational rehabilitation providers are already doing. Hand Therapists are not expected to replicate the work of vocational rehabilitation providers.

Will I get reimbursed for my petrol for driving to workplaces?

As per normal Hand Works procedure, on your timesheet please write "MV" and the number of kilometres travelled to and from the worksite. Hand Works will reimburse you. You may also want to keep track of the number of kilometres you drove for tax purposes. Remember that one of the inclusion criteria for this study is that patients must work within the Perth Metropolitan area; therefore you are not likely to be required to travel far.

Who should I contact if I have further questions?

Please contact your researcher/ research coordinator directly for any queries regarding this study:
Email: thuy.tran23@hotmail.com, Phone #: 1300 887 798/ 0431 653 315

Appendix K Billing procedure

LE Study: FD procedure for billing and time allocations

Appointment		Time on FD allocated	Billing Codes
Initial appointment	If patient has LE and is on workers compensation. Check inclusion criteria for screening.	1 hour	6B + consumables as per normal
Follow up appointments	Therapists will rebook patients for weekly reviews and then fortnightly after week 8. Longer appointments for week 6, 8 and 12 as extra assessments required.	30mins/1 hour 1 hour for week 6, 8 and 12	5/6 6
Pre-worksite interview	If patients are allocated in group B, then they will need to come back within the first two weeks for an extra assessment about the tasks they have problems with at work and home.	30 mins	5
Worksite consultation	Staff to put MV and kms on their timesheet	1 hour + travel time	6 + travel fee
Post worksite report	Template is found on FD *"LE worksite report"*	Admin time Approx. 15-20 mins	110 (short report)

For any questions please contact research coordinator: Thuy ("Twee") Tran at thuy.tran23@hotmail.com / 0431653315

Appendix L Worksite visit form

Worksite Visit Form

Worker's name:	**Date of site visit:**
Assessor name:	**Date of first clinic appointment:**
Affected upper limb:	

Work Details

Job title:	**Alternative job title (Fill this section as well if currently performing alternative duties):**	**Supervisor name and contact details:**
Position description:	**Position description:**	
Normal work hours:	**Current work hours:**	
Key work tasks:	**Key work tasks:**	

*Print multiple copies for different work tasks identified from the PSFS Assessment

Worksite Assessment and Recommendations

Work task #_____ from PSFS_____ **PSFS Score: _____**

	Risk Factors for LE	Estimate frequency of work demands				Description of the work demands	Recommendations and education to reduce risk factors
		0 Absent	1 Low	2 Moderate	3 High	Low= 1-33% of work shift, Moderate= 34-66% of work shift, High= 67-100% of work shift	
1	**FORCE** Forceful gripping, holding or squeezing Tools used						
2	**REPETITION** Repetitive arm movements						
3	**POSTURE** Awkward postures (i.e. elbow, forearm and wrist positions) Lifting arms in front, above and below body						
4	**VIBRATION** Exposure to vibration tools						
5	**WORK EQUIPMENT** Weight of work equipment Type of work equipment						
6	**OTHER:** Social Environment Physical Environment						

Perception of injured worker

The workers believes he or she is capable of performing the work (select all that apply):

- ☐ As described in the first section of this form (pre-injury duties)
- ☐ If the worker can work at his or her own pace
- ☐ If the worker can stop as needed
- ☐ With the changes indicated in the recommendations listed below
- ☐ If the work hours are reduced
- ☐ The worker does not believe he or she is capable of performing this work

Summary of work recommendations

1.

2.

3.

4.

5.

(Adapted from Tools for Modified Work, 2004)

Hand Works Occupational Therapy

Curtin University

Appendix M Employer consent form

Hand Works Occupational Therapy

Curtin University

EMPLOYER INFORMATION AND CONSENT LETTER

TREATING TENNIS ELBOW AT WORK

Dear *XXX:*

We are writing to you with regards to a research project that is being conducted by Hand Works Occupational Therapy and Curtin University concerning the condition lateral epicondylalgia (LE) or tennis elbow. Your employee, *XXX*, has been referred to Hand Works for hand therapy to treat this condition and has consented to being a part of this study.

What is tennis elbow and what is this study about?

Tennis elbow is a very common condition that causes pain and discomfort when using the wrist and elbow. It is frequently a work-related injury and is associated with work absences and the inability to complete necessary job tasks. Research shows that workplace-based rehabilitation can be beneficial in the return-to-work process for various musculoskeletal conditions; however, no evidence currently exists for seeing how effective worksite rehabilitation is in the management of work-related LE by a hand therapist.

The aim of our study is to determine if workplace-based treatment in combination with clinic-based treatment is more effective in improving pain, grip strength and functional disability of workers diagnosed with LE compared to clinic-based treatment alone.

Participants are eligible for this study if they have a confirmed diagnosis of LE and an approved workers' compensation claim relating to this condition. Participants are randomly allocated to either Group A or Group B. Participants in Group A will receive usual clinic-based care for LE at Hand Works. Participants in Group B will receive the same clinic-based care in combination with a one-time worksite consultation to provide them with education and specific work recommendations relevant to their usual job tasks.

XXX has been randomly allocated into Group B. As such they require a worksite visit from a Hand Works therapist on one occasion for up to one hour.

Will there be additional costs associated with this?

There will be no additional costs associated with this worksite visit. Potential benefits of workplace-based rehabilitation include maintaining the employee's "worker role" in their usual environment and maintaining contact with co-workers who provide ongoing social support. The purpose of this research is to determine the best way for workers with LE to return to their usual jobs tasks as efficiently and effectively as possible and, as suggested by other existing research, we hypothesise that this may be achieved through workplace rehabilitation.

If you consent to the above please sign below and a Hand Works clinician will be in touch to organise a time suitable for both you and your employee to conduct this worksite visit.

If you have any questions please contact Associate Professor Marina Ciccarelli on +618 9266 3692 or email M.Ciccarelli@curtin.edu.au.

_____

Name

_____

Signature **Date**

Appendix N Participant information sheet (Study 5)

PARTICIPANT INFORMATION FORM

HREC project number:	HR46/2016
Project title	A novel approach to managing lateral elbow tendinopathy: Hand therapists' experiences in conducting workplace-based education
Chief investigator and contact details	Thuy Tran Email: thuy.tran@student.curtin.edu.au
Version number	1
Version date	4th February 2020

About the study

This study follows the recent pilot randomised controlled trial titled *"The impact of a workplace-based education approach in the management of Lateral Elbow Tendinopathy*" that was conducted from April 2016 to March 2019 at Hand Works Occupational Therapy. This study aims to:

1) To explore the experiences of hand therapists who provided a workplace-based education intervention to manage injured workers with LET.
2) To explore the hand therapists' attitudes towards providing this type of intervention.
3) To identify the nature of the education provided in the workplace.
4) To determine hand therapists' perceived benefits and challenges of conducting this type of intervention.

Participant's role

You have been asked to take part in this study because you were one of the treating hand therapists that implemented the novel workplace-based intervention *"Working Hands- Ed".* We would like to interview you so that we can understand your experiences and perceptions about this type of work-place based education intervention for your patients with LET. The interview will take approximately 30-40 minutes in a location and time most convenient for you. A Coles/Myer gift card valued at $30 will be offered to renumerate you for your time and contribution to this research.

Benefits of the study

There may be no direct benefits to you as a result of your participation in this study. By participating in this project will contribute to the knowledgebase about this novel approach to management work-related LET. Such an intervention may benefit future injured workers in terms of clinical and work-related outcomes and hand therapists in their management of this common condition.

Risks of the study

There are no foreseeable risks to your health and well-being from participating in this research project.

Confidentiality and privacy

The interview with you will be audio-recorded and transcribed to analyse the data. All data collected will be de-identified, securely stored, remain confidential, and only used for the purpose of completing the study aims. The results of this study may be presented at conferences or published in professional journals. You will not be identified in any results.

Your rights as a participant

Taking part in this research project is entirely voluntary and you can withdraw from the project without providing a reason. There will be no repercussions for withdrawal. If you decide to take part in this research, we will ask you to sign the consent form. By signing this, you are telling us that you understand what you have read and what has been discussed.

If you have any questions, please contact Thuy ("Twee") Tran (primary researcher) on 0431653315 or via email thuy.tran@student.curtin.edu.au.

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number /). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au

Appendix O Participant consent form (Study 5)

Curtin University

CONSENT FORM

A novel approach to managing lateral elbow tendinopathy: Hand therapists' experiences in conducting workplace-based education

HREC project number:	HR46/2016
Project title	A novel approach to managing lateral elbow tendinopathy: Hand therapists' experiences in conducting workplace-based education
Chief investigator and contact details	Thuy Tran Email: thuy.tran@student.curtin.edu.au
Version number	1
Version date	4th February 2020

I _____ _____

First Name **Surname**

Date of birth: _____Years of experience working in hand therapy:_____

- have read, the information statement listed above, and I understand its contents;
- believe I understand the purpose, extent, and possible risks of my involvement in this project;
- voluntarily consent to take part in this research project;
- have had an opportunity to ask questions and I am satisfied with the answers I have received;
- understand that this project has been approved by Curtin University Human Research Ethics Committee and will be carried out in line with the National Statement on Ethical Conduct in Human Research (2007) – updated March 2014.
- understand I will receive a copy of this Information Statement and Consent Form.

_____ _____

Participant signature **Date**

Declaration by researcher: I have supplied an Information Letter and Consent Form to the participant who has signed above, and believe that they understand the purpose, extent and possible risks of their involvement in this project.

_____ _____ _____

Researcher name **Research Signature** **Date**

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number HR46/2016). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au

Appendix P Interview guide (Study 5)

Interview Questions

The following open-ended questions will be used to guide the semi-structured interviews:

1.0 Practicality of conducting a workplace-based intervention

1.1 What previous experience do you have in conducting any type of workplace-based intervention?

1.2 What type of training was provided to prepare you to conduct the ***hand therapy*** workplace-based intervention as part of the pilot study?

1.3 Describe your experience of at least one of your ***hand therapy*** workplace-based interventions.

1.4 Explain your experience of the logistics of providing education to the injured worker at the workplace vs. in the clinic setting.

2.0 Feelings and attitudes towards this type of intervention

2.1 How confident did you feel before conducting your first workplace-based intervention? How confident did you feel afterwards? What contributed to this level of confidence?

2.2 What are your feelings towards hand therapists delivering specific education to patients at their workplace?

3.0 Education principles provided

3.1 What types of information or education did you provide to your patient in the workplace?

3.2 Explain any differences you observed when providing education to your patient in the clinic vs. their workplace. Did you observe your patient translating this into practice?

4.0 *Benefits and challenges of conducting this type of intervention*

4.1 What benefits, if any, did you personally experience as a hand therapist from delivering the workplace-based education?

4.2 What benefits, if any, did you observe for your patients from receiving education at their workplace?

4.3 What are some challenges you faced in planning or delivering this type of intervention?

5.0 Other

Appendix Q Copyright declaration: Cross-sectional survey

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Yours sincerely

Carry Koolbergen (Mrs.)
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Not in the office on Wednesdays

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Appendix R Copyright declaration: RCT

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RE: The impact of a hand therapy workplace-based educational approach on the management of lateral elbow tendinopathy: A randomized controlled study, Journal of Hand Therapy, 2021, Tran et al

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