Changes in cervical movement impairment and pain following orofacial treatment in patients with chronic arthralgic temporomandibular disorder with pain: A prospective case series

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ABSTRACT

The purpose of this study was to investigate the influence of isolated temporomandibular joint (TMJ) manual therapy on pain and range of motion (ROM) of the TMJ and cervical spine including flexion-rotation test (FRT) in people suffering chronic pain arising from chronic arthralgic temporomandibular disorder (TMD). An experienced clinician managed a case-series of 12 patients with TMD (mean duration 28.6 months +/- 26.9). The intervention comprised 4 weekly sessions of transverse medial accessory TMJ mobilisation and advice. Patients were examined prior to, and one-week following the intervention period. Outcome measures included jaw disability (JFLS-20), jaw pain measured by Visual Analogue Scale (VAS), maximal mouth opening ROM, cervical ROM including FRT, and pain during cervical movement. A paired t-test revealed significant improvement following the intervention in disability ($p<0.001$), VAS pain score at rest ($p<0.001$) and at maximum mouth opening ($p<0.001$), jaw opening ROM ($p<0.001$), FRT ROM to the left ($p=0.024$) and right ($p=0.001$). In contrast, no significant change was identified for total cervical ROM ($p=0.905$). After the intervention, five patients (41.66%) had no pain at rest or at maximal mouth opening, and all had a negative FRT. The effect sizes indicate a moderate to strong, clinically significant effect for all variables apart from total cervical ROM. While a case-series cannot identify a cause and effect relationship, these results provide preliminary evidence for the influence of TMJ manual therapy on measures of TMD including pain, as well as upper but not whole cervical movement and associated pain in patients with a diagnosis of TMJ arthralgia.

INTRODUCTION

Temporomandibular disorder (TMD) is a multifactorial problem affecting the masticatory musculature, the temporomandibular joints (TMJ) or both. Symptoms of TMD may include pain in the head, neck or face, as well as impairment of mandibular movement and joint sounds (i.e. clicks, crackles and/or tinnitus) with or without pain (Martins et al, 2015).

The prevalence of TMD in women is 6.3% and 2.8% in men (Isong, Gansky and Ples, 2008) and constitutes a significant cost burden to society. For example, Stowell et al. (Stowell, Gatche and Wildenstein, 2007) estimated the annual medical cost to be $4 billion for TMD treatment in the United States alone. An update to the diagnostic criteria for TMD (DC/TMD) has recently been published in an effort to improve diagnostic accuracy and thereby treatment efficacy (Schiffman et al. 2014).

A number of recent systematic reviews and meta-analyses recommend non-invasive methods in the management of TMD including manual therapy and exercise (Calixtre et al, 2015; Martins et al, 2015; Randhawa et al, 2015). The aim of physical therapy in TMD is to restore normal mandibular function while relieving pain, and promoting healing in damaged tissues (Rashid, Matthews and Cowgill, 2012).

One recent systematic review of manual therapy for TMD reported varied effects for pain and maximal mouth opening (Calixtre et al, 2015). This might be explained by the many different forms of manual therapy for TMD (Maitland, 1993; von Piekartz, 2007; Vicenzino, Hing, Hall and Rivett, 2011; González-Iglesias et al., 2013; Shaffer, Brismée, Sizer and Courtney 2014) with no study investigating the relative merits of one form of treatment over another (Martins et al, 2015; Calixtre et al, 2015). Maitland (1993) suggested that patient's who experience pain associated with TMD respond best to oscillatory transverse medial accessory mobilization of the mandibular condyle with respect to the mandibular fossa. von Piekartz (2007) also suggested transverse accessory mobilization as a treatment for patients with disc displacement without reduction. The exact mechanism of action for this technique is not clear, but it may facilitate improvement by inhibition of pain, improvement of ROM, and inhibition of muscle spasm (Shaffer, Brismée, Sizer and Courtney, 2014).

In addition to physical treatment directed at the temporomandibular area there is also growing evidence for the use of intervention applied to the cervical spine either in isolation (La Touche et al, 2009) or in combination with treatment to the TMJ (González-Iglesias et al, 2013). One reason why treatment is directed to the cervical spine in TMD is that there is a close anatomical and biomechanical relationship between the cervical spine and temporomandibular region. Indeed, studies have reported dysfunction of the cervical spine in patients with TMD (Bevilaqua-Grossi, Chaves and de Oliveira, 2007; Weber et al, 2012; Grondin, Hall, Laurentjoye and Ella, 2015).

Evidence for the relationship between impairment of the cervical spine and TMD is shown in the significant correlation between jaw disability and neck disability (r = 0.82) (Armijo Olivo et al, 2010) and finding of significantly greater pain on neck movement in subjects with TMD when compared to asymptomatic people (Bevilaqua-Grossi, Chaves and de Oliveira, 2007; Weber et al, 2012). Furthermore, we recently reported the presence of impaired upper cervical spine mobility determined by the flexion-rotation test (FRT) in people with TMD (Grondin, Hall, Ella, and Laurentjoye, 2015). These findings could be explained by the convergence of nociceptive afferents from the first 3 cervical nerve roots with trigeminal afferents in the trigeminocervical nucleus complex (Bartsch and Goadsby, 2003; Hu, Sun, Vernon and Sessle, 2005). Sensitization of this nucleus may lead to altered cervical muscle activity (Hellström et al, 2002) and consequent changes in cervical spine range of motion (ROM) in patients with features of TMD (von Piekartz and Hall, 2013; Grondin, Hall, Laurentjoye and Ella, 2015).

One of the signs often associated with TMD is a reduction in mouth-opening capacity (Schiffman et al, 2014). During normal mouth opening, extension occurs at the cervical-cranial junction, and it has been suggested that restriction in the upper cervical spine may decrease a patient's mouth-opening capacity (Eriksson, Haggman-Henrikson, Nordh and Zafar 2000; Mansilla-Ferragut et al, 2009; Oliveira-Campelo et al, 2010). It has been proposed that cervical impairments should be considered as a perpetuating factor for TMD (Bevilaqua-Grossi, Chaves and de Oliveira, 2007) and may limit the patient's rehabilitation potential (Shaffer, Brismée, Sizer and Courtney 2014). Consequently, some authors have proposed that cervical impairment should be assessed and treated if necessary when managing patients with TMD (Bevilaqua-Grossi, Chaves and de Oliveira, 2007; von Piekart, 2007; La Touche et al, 2009; González-Iglesias et al, 2013; Shaffer, Brismée, Sizer and Courtney 2014).

However, evidence supportive of this notion is limited. Two studies found that upper cervical spine manual therapy led to an immediate small but significant increase in maximum active mouth opening and pressure pain thresholds over masticatory muscles (Oliveira-Campelo et al, 2010; Mansilla-Ferragut et al, 2009). One other study has shown that mobilization of the lower cervical spine, together with cervical spine exercise led to decreased pain and increased pain-free mouth opening in a series of patients with myogenous TMD (La Touche et al, 2009). Although, as suggested, there is evidence that patients with TMD have upper cervical spine movement impairment (Grondin, Hall, Ella, and Laurentjoye, 2015), and there are studies that demonstrate the influence of treatment of the upper cervical spine on temporomandibular impairments in myofascial TMD (Mansilla-Ferragut et al, 2009; Oliveira-Campelo et al, 2010; La Touche et al, 2009), this does not imply a cause and effect relationship between the cervical spine and TMD, especially not in arthralgic TMD. To the best of our knowledge, few studies have examined the effects of cervical spine mobilisation techniques alone on arthralgic TMD-pain or the reverse, the effects of TMJ mobilisation on cervical movement. Despite this lack of clinical evidence, there is basic science evidence. For example, experimentally provoked pain induced by noxious injection into the TMJ induced a nociceptive response in the upper cervical cord neurons (Lam, Sessle and Hu, 2009) as well as activation of static fusimotor neurons in dorsal neck muscles (Hellström et al, 2002). Furthermore, in a recent randomized controlled trial, von Piekartz and Hall (2013) found that manual therapy treatment of TMD signs in addition to usual cervical care showed significantly greater reduction in all aspects of upper cervical impairment after the treatment period compared to usual cervical care alone. Hence, identifying the interaction between the cervical spine and TMJ in people with TMD-pain requires further investigation. The purpose of this study was to investigate the influence of a single, isolated manual therapy technique applied to the TMJ on a number of variables including pain and cervical ROM including ROM of the upper cervical spine. It was hypothesized that improvements would be observed for each of the outcome variables, including a reduction in pain and increase in cervical ROM.

PROCEDURES AND MESUREMENTS

Design

A case-series study design was used to investigate the effects of TMJ manual therapy on pain and ROM of the TMJ and cervical spine including FRT in women suffering from arthralgic TMD-pain. The investigation was carried out according to the Declaration of Helsinki and approved by the local Ethical Committee. All patients provided informed consent following an explanation of the study. The trial team consisted of one receptionist who recruited subjects, and one physiotherapist (FG), who had specialized for 2 years in manual therapy management of TMD.

Subjects

Consecutive patients with arthralgic TMD-pain attending an out-patient physiotherapy clinic in Bordeaux, France, were recruited between September and December 2012. A dentist or a medical practitioner, who specialised in maxillofacial surgery, referred all patients. In order to be included, patients were required to have the following inclusion criteria. All patients had a primary complaint of side-dominant TMD of at least 3-months duration, with a pain score of 30mm on a 100mm visual analogue scale (VAS) at rest or during mouth opening. At the time of the patient evaluation, the diagnosis of TMD with "any joint pain" (Arthralgia or Arthritis) was based on the Revised Research Diagnostic Criteria for TMD (RDC/TMD) which is a widely used system for the diagnosis and classification of TMD with excellent reliability and validity (Schiffman et al 2010). The diagnostic criteria comprises of a history of pain in the face, jaw, temple, or ear region together with familiar pain provoked by TMJ palpation or jaw movements (Schiffman et al 2010). In comparison to the Revised RDC/TMD, the updated Diagnostic Criteria for TMD's (DC/TMD) (Schiffman et al 2014) includes a new history criteria for the category of TMJ Arthralgia: "pain modified with jaw movement, function and parafunction". In our study, all patients reported TMJ pain during mouth opening, which allows us to categorize the patients to "TMJ Arthralgia" on the updated DC/TMD (Schiffman et al 2014). Due to the association between upper cervical ROM determined by the FRT and headache (Hall, Briffa, Hopper and Robinson, 2010a), subjects were excluded if they had headache at least once per week in the previous 3 months. Out of a total of 53 individuals referred to the physiotherapy department with TMD, 12 were found suitable for inclusion. Demographic details including age, sex, medical history, and duration of symptoms were collected. Of these 12 subjects, all were female (mean age 34.4 years SD 8.0) with 8 having left-side dominant and 4 right-side dominant pain. Mean duration of symptoms was 28.6 months (SD 26.9) (Table 1).

Insert the table 1 about here

Measurements

Subjects were examined prior to, and one-week following the four-week intervention period. The same physiotherapist provided the intervention and also assessed disability, jaw pain, ROM and cervical pain during active cervical movement.

Disability was determined by the Jaw Functional Limitation Scale (JFLS-20), which is a reliable and valid instrument for assessing functional limitations of the jaw (Ohrbach, Larsson and List, 2008). The reliability of this instrument for the measurement of TMD related functional limitation is excellent with an internal reliability coefficient of 0.82 (Ohrbach, Larsson and List, 2008). Jaw pain was evaluated at rest and during maximal active mouth opening using a 10cm VAS, anchored with a '0' at one end representing 'no pain' and '10' at the other end representing 'the worst pain imaginable'. The VAS is reliable (Bijur, Silveer and Gallagher, 2001), with a minimal clinically important difference (MCID) of between 9 and 11 mm (Bird and Dickson, 2001; Gallagher, Liebman and Bijur, 2001).

Active range of pain-free mouth opening was determined by measuring the distance between the incisal edge of the maxillary central incisor that was most vertically oriented, measured vertically to the labioincisal edge of the opposing mandibular incisor (Beltran-alacreu et al, 2014). Intra-tester reliability of this procedure is high (ICC= 0.94−0.96) (Walker, Bonhannon and Cameron, 2000; Beltran-alacreu et al, 2014). The mean of three repeated measures was calculated for analysis. The minimal detectable change (MDC) for this measure is reported to be between 6 and 9 mm (Kropmans et al, 1999).

Cervical spine ROM was assessed separately for the whole cervical spine and upper cervical spine. Active whole cervical spine flexion and extension ROM was evaluated with an inclinometer (MIE Medical Research Ltd, Leeds, UK) placed on the top of the subject's head, aligned in the sagittal plane and zeroed. The examiner also recorded the presence of pain, being present or not during each movement. The mean of three repeated measures was calculated for analysis. Previous reports have indicated good validity (Bush, Collins, Portman and Tillett, 2000) and good reliability for this measurement method, with ICC ranging upwards from 0.74 and standard error of measurement of 4.7˚ for flexion and 5.6˚ for extension in patients with mechanical neck pain (Cleland, Childs, Fritz and Whitman, 2006 ; Piva, Erhard, Childs and Browder, 2006). The smallest detectable change (SDC) for cervical ROM is reported to be 10° for flexion (Fletcher and Bandy, 2008). The FRT was evaluated according to a previously reported method (Hall and Robinson, 2004). With the subject supine, the cervical spine was passively maximally flexed, whereupon the examiner passively rotated the head to the left and right. Range was determined either by the subject reporting the onset of pain or firm resistance encountered by the therapist whichever came first. At this point the examiner was required to state whether the FRT was positive or negative, and which side was positive. A positive state was based on an eyeballed, estimated limitation of more than 10° from the anticipated normal range of 44° (Ogince, Hall and Robinson, 2007). Following this, the examiner measured ROM using a modified cervical ROM (CROM) device attached to the apex of the head by Velcro straps as described Hall and Robinson (2004). Examiner interpretation and range recorded during the FRT has excellent reliability with an ICC for intra-tester reliability of more than 0.95, and with a MDC at most 7 degrees (Hall, Briffa, Hopper and Robinson, 2010b).

Intervention

Each patient underwent an individualized treatment protocol based on the examiners routine clinical examination of the orofacial region. The orofacial manual therapy treatment protocol comprised 4 sessions, with an interval of 1 treatment per week for 4 weeks. Each treatment session included education as well as TMJ mobilization. Sessions were performed by the primary author and lasted approximately 20 minutes.

Prior to manual therapy intervention, all patients were given general information including the suspected aetiology of the condition, TMJ anatomy and biomechanics, and the role of psychological factors in TMD. Patients were reassured and encouraged to keep their jaw muscles relaxed by keeping their teeth apart to aid muscle relaxation (Michelotti et al., 2004; Romero-Reyes and Uyanik 2014).

During each session, the physiotherapist reinforced the patient's education with further information and checked if the patient was able to keep the jaw muscles relaxed. Manual therapy comprised oscillatory transverse medial accessory movements of the mandibular condyle (Maitland, 1993) on the side of TMJ pain. This technique was applied with the patient laying supine, with the TMJ and cervical spine in neutral position. Three sets of grade III oscillatory mobilisations were carried out for 40 seconds with a 3-minute rest between sets (Maitland, 1993; Carmeli, Sheklow and Bloomenfeld, 2001). After the first set, the practitioner evaluated the efficacy of the intervention by measuring TMJ pain, TMJ movement and range of pain-free mouth opening in order to adjust the strength of TMJ mobilization. If no improvement was noted the practitioner applied a stronger or weaker mobilization (Carmeli, Sheklow and Bloomenfeld, 2001; Shaffer, Brismée, Sizer and Courtney, 2014)

Insert the figure 1 about here

The physiotherapist did not re-test the FRT or cervical spine ROM during the intervention period. Furthermore, no additional techniques were directed at the cervical spine during the intervention period, and no other treatments were provided for TMD. All patients completed all intervention sessions, and there were no reports of exacerbation of pain.

Statistical analysis

Mean baseline demographic values were calculated for continuous variables. Frequencies were calculated for categorical variables. Preliminary analysis (Kolmogorov-Smirnov test) revealed that all data was normally distributed ($p>0.05$). Hence, comparisons of the pain, disability, and ROM outcome measures across the assessment points were analysed using separate paired t-tests. To determine the magnitude of any treatment effect, Cohens d (Cohen, 1988) effect sizes with 95% confidence intervals (CI) were also calculated for all pairwise comparisons. Effect sizes were rated as small if they were less than 0.40, moderate if between 0.41 and 0.69, or strong if greater than 0.70 (Cohen, 1988). All statistical tests were performed using SPSS version 19.0 (IBM Corporation, New York, USA). Significance level was set at <0.05.

RESULTS

Mean disability was 50.8/200 (SD=19.7) on the JFLS-20 scale. Mean intensity of pain at rest was 44.7/100 (SD=20.6) and pain-free range of mouth opening was 35.3mm (SD=4.7). Further patient demographics are shown in Table 1. Prior to the intervention all subjects were positive on the FRT (100%). Comparing the final assessment to baseline, significant changes were identified in disability ($p<0.001$), VAS pain score at rest ($p<0.001$), VAS pain score at maximum mouth opening ($p<0.001$), jaw opening ROM ($p<0.001$), FRT ROM to the left ($p=0.024$), and FRT ROM to the right ($p=0.001$). In contrast over the same assessment points, no significant difference was found for total sagittal cervical ROM (p=0.905). The effect sizes and 95% CI for each variable and means ±SD and change scores with 95% CI for each variable are presented in Table 2. When considering effect sizes for variables showing a significant improvement after the intervention (all variables apart from total sagittal cervical ROM) there was a strong effect for all variables apart from ROM recorded during the FRT to the left, where there was a moderate effect.

Insert the table 2 about here

Following the intervention the proportion of subjects who were positive on the FRT changed from 100% to 50%, at which point all pain-free subjects at rest (n=5/12) also had a negative FRT. Further information regarding frequency of pain at rest, and during neck and mouth movements are shown in Table 3.

Insert the table 3 about here

DISCUSSION

To our knowledge, this is the first report of changes to cervical spine mobility including upper cervical ROM determined by the FRT following isolated TMJ manual therapy and advice. Following the intervention, there were significant changes in disability (p<0.001), VAS pain score at rest (p<0.001), VAS pain score at maximum mouth opening (p<0.001), jaw opening ROM (p<0.001), FRT ROM to the left (p=0.024), and FRT ROM to the right (p=0.001). In contrast, no significant changes were identified for total sagittal cervical ROM (p=0.905). The effect sizes indicate a moderate to strong, clinically significant effect for all variables.

In this sample, 41% of patients reported no pain at rest or at maximum mouth opening following 4 sessions of manual therapy to the TMJ together with advice. While these results provide preliminary evidence for the efficacy of manual therapy in TMD, caution is required as a cause and effect relationship cannot be determined from a case-series as change may occur with natural resolution. However, natural resolution is unlikely considering the long duration of TMD symptoms in this sample (mean 28.6 months).

Comparisons with previous studies are difficult as most previous studies combine treatment to the TMJ with other body regions (Carmeli, Sheklow and Bloomenfeld, 2001; Nicolakis, Erdogmus and Kollmitzer, 2001; Furto, Cleland, Whitman and Olson, 2006; Tuncer, Ergun, Tuncer and Karahan, 2013). Our results are consistent with previous studies using combined treatment including orofacial manual therapy in patients with arthralgic TMD (Carmeli, Sheklow and Bloomenfeld, 2001), myofascial pain and/or anterior disc displacement (Tuncer et al, 2013), and TMJ osteoarthrosis (Nicolakis et al, 2001). Tuncer et al (2013) investigated the effect of home exercise and manual therapy in 40 patients with TMD with myofascial pain and/or anterior disc displacement with mean duration of 13 months (±11.8). Treatment comprised a combination of manual techniques (TMJ and cervical mobilization, deep friction massage and myofascial release techniques) together with a home exercises program including patient education, self-massage and stretching for masticatory and neck muscles, active jaw movement exercises and coordination exercises for the TMJ. After the 4-week treatment period, VAS pain scores at rest and during teeth clenching were significantly reduced. In the present study, 4 sessions of manual therapy to the TMJ together with advice gave similar results to that multimodal treatment programme. Nicolakis et al (2001) reported a case series of 20 patients (eighteen female) with TMJ osteoarthrosis with 2.7 years of mean of duration. Treatment was based on TMJ mobilization, muscles stretching and strengthening, massage, posture correction, and relaxation techniques. After an average of 11 treatment sessions over 47 days, VAS pain scores at rest and at maximal mouth opening were significantly improved. Carmeli et al (2001) used a similar TMJ manual therapy protocol to that used in our study. In their study, 36 patients with chronic arthrogenous TMD (mean 2.5 years) were randomly allocated to receive either splint therapy or manual therapy and jaw exercise. Pain levels were measured according to the pain-physiopathology instrument scale, ranging from 0 to 5. After 15 sessions spread over five weeks, there was a significant improvement in pain and maximal mouth opening ROM in the manual therapy and exercise group compared to splint therapy group. Improvements seen after the 4 treatment sessions in the present study were similar to these previous reports but which had more intervention, over a greater number of sessions and a longer treatment period (Nicolakis et al 2001; Carmeli et al, 2001),

Considerable evidence exists that supports the use of joint mobilization for improving pain and movement in other body areas (Michlovitz, Harris and Watkins, 2004; Bronfort et al., 2010). In support of this evidence, two recent systematic reviews have concluded that there is evidence that manual therapy improves pain and maximal mouth opening in subject's with TMD (Calixtre et al, 2015; Martins et al, 2015). However, it is not possible to discern whether a combination program is more effective than providing the separate elements of the intervention as individual treatment techniques (Martins et al, 2015). The results from the current study support the notion that multimodal interventions may not be more effective than treatment provided to a single body-region such as the TMJ. Previous results investigating treatment for patients with TMD corroborate our study's findings in regard to improvement on maximal mouth opening ROM and pain reduction. Future studies are required to determine the most effective techniques to improve TMD-pain (Martins et al, 2015) in each TMD sub-group described by the updated DC/TMD (Schiffman et al 2014) in subjects selected to ensure homogeneity (Calixtre et al, 2015).

In the current study, range recorded during the FRT before the intervention was consistent with previously reported values in people with TMD (Grondin, Hall, Ella, and Laurentjoye, 2015) and in people with cervicogenic headache (Hall et al, 2008). Similarly, range of cervical spine sagittal mobility was similar to values found in asymptomatic people (Woodhouse and Vasseljen, 2008; Kauther et al, 2012; Peolsson et al, 2014) and in people with TMD (Grondin, Hall, Ella, and Laurentjoye, 2015). The lack of change in sagittal cervical mobility following the intervention is not surprising given the near normal ROM prior to intervention. Some authors suggested that cervical movement impairment could be considered as a perpetuating factor for TMD (Bevilaqua-Grossi, Chaves and de Oliveira, 2007). Others suggest that TMD may influence cervical impairment (von Piekartz and Hall, 2013). In this sample, prior to the intervention all subjects were positive on the FRT (100%), but this proportion dropped to 50% at the end of the intervention. Furthermore, following the intervention, five patients had complete pain relief at rest and at maximal mouth opening and had a negative FRT. In addition, cervical pain on neck movement was present in 58.33% of patients at baseline but in only 16.67% of patients at follow-up. Taken together, these data suggest the potential for a possible relationship between upper cervical movement impairment and TMD.

In our previous study, we showed that patients with TMD had significant upper cervical movement impairment (Grondin, Hall, Laurentjoye and Ella, 2015). However, in that study it was not possible to identify whether there was a causal relationship between TMD and upper cervical spine dysfunction. The present study together with previous reports provides evidence for the influence of treatment directed to TMD on cervical impairment (von Piekartz and Hall, 2013). von Piekartz and Hall (2013) found that a group of patients with headache of likely cervical origin and who received orofacial treatment in addition to usual cervical spine treatment showed significant reduction in all aspects of upper cervical impairment after the treatment period, while improvement in upper cervical impairment were not observed in the usual care group at any point. One reason for these results may be that the cause of upper cervical impairment may be intricately linked with TMD.

One explanation for the inter-action between the cervical spine and TMD may be the convergence of afferent input from the trigeminal system and the upper three cervical nerve roots. Studies have demonstrated that afferent input from the TMJ can induce sensitization of second-order upper cervical spine neurons. Many studies have demonstrated the convergence of masticatory nociceptive inputs onto upper cervical spinal neurons. Evidence for this is seen in animal studies (Hellström et al, 2002; Vernon et al, 2005; Takeda et al, 2005; Hu et al, 2005; Lam, Sessle and Hu, 2009) and in humans (Wang, Sessle, Svensson and Arendt-Nielsen, 2004; Svensson, Wang, Sessle and Arendt-Nielsen, 2004). In rats, upper cervical spinal cord (C1/C2) nociceptive neurons receiving noxious inputs from the orofacial region are somatotopically organized in these regions (Hu et al, 2005; Takeda et al, 2005). It was also found that many C1 and C2 dorsal horn nociceptive neurons received mechanosensitive convergent afferent inputs from cervical and craniofacial deep tissues including the TMJ (Hu et al, 2005). Injection of noxious substances into the TMJ induced a nociceptive response in the trigeminal subnucleus caudalis neurons and upper cervical cord neurons in a model rat (Lam, Sessle and Hu, 2009) as well as activation of static fusimotor neurons in cat dorsal neck muscles (Hellström et al, 2002). Hence, it has been suggested that the trigeminocervical nucleus works as one functional unit to process nociceptive input from craniofacial and cervical tissues, including that from the TMJ (Hu et al, 2005). In humans, it was found that pain provoked by noxious injections into the masseter muscle elicited neck pain that lasted for up to 7 min, as well as causing increased neck EMG activity (Svensson, Wang, Sessle and Arendt-Nielsen, 2004) and an increased stretch reflex amplitude in both masseter and sternocleidomastoid muscles. It was suggested that the stretch reflex facilitation in the presence of pain corresponds to increased muscle stiffness, which might be interpreted as a protective reflex to reduce mobility (Wang, Sessle, Svensson and Arendt-Nielsen, 2004). Hence, Gonçalves et al, (2011) suggested that nociceptive inputs from masticatory muscle or the TMJ leads to sensitization of the trigeminocervical nucleus, with consequent changes in cervical muscle activity

(Hellström et al., 2002; Svensson, Wang, Sessle and Arendt-Nielsen, 2004) reducing mobility (Wang, Sessle, Svensson and Arendt-Nielsen, 2004) in the upper cervical spine (von Piekartz and Hall, 2013; Grondin, Hall, Laurentjoye and Ella, 2015). Consequently, upper cervical impairments may be secondary to TMD in some people, which is improved following orofacial treatment techniques (von Piekartz and Hall, 2013). While the present study does not confirm or refute that impairment of upper cervical mobility in patients with TMD is primary or secondary in nature, it suggest that further studies are required. Future research must determine whether upper cervical impairment needs to be resolved by specific intervention to deliver long-term improvement in TMD or whether these impairments can be successfully managed by treatment to the orofacial region alone.

Caution is required when interpreting the results of this study. Subjects were all diagnosed with TMJ arthalgia, hence these findings may not apply to other forms of TMD. In addition, despite the improvements seen in signs and symptoms following the brief intervention period, it is not possible to say whether these changes were a result of the intervention or natural resolution and regression to the mean. Furthermore, long-term follow-up was not conducted. Further studies are required to evaluate the long-term effects of cervical manual therapy on TMD in comparison to a control intervention, with randomization of the sample and blinding of the assessor and the patient.

CONCLUSIONS

This study provides preliminary evidence for the influence of arthralgic TMD-pain on upper cervical movement impairment and cervical pain. In this case-series of patients with TMJ arthralgia based on the DC/TMD, TMD disability and pain as well as range recorded during the FRT increased and pain decreased significantly following a 4-week intervention period of manual therapy directed to the TMJ together with advice.

Declaration of interest : the authors reported no potential conflicts of interest

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