THE EFFECT OF MANUAL PRESSURE RELEASE ON MYOFASCIAL TRIGGER POINTS IN THE UPPER TRAPEZIUS MUSCLE

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ABSTRACT

Sustained manual pressure has been advocated as effective treatment for myofascial trigger points (MTrPs). This study aimed to investigate the effect of manual pressure release (MPR) on the pressure sensitivity of MTrPs in the upper trapezius muscle using a novel pressure algometer. Asymptomatic subjects (N=37, mean age 23.1 ± 3.2, M=12, F=23) were screened for the presence of latent MTrPs in the upper trapezius muscle (tender band that produced referred pain to neck and/or head on manual pressure). Subjects were randomly allocated into either the treatment (MPR) or control (sham myofascial release) groups. The pressure pain threshold (PPT) was recorded pre and post treatment intervention using a digital algometer, consisting of a capacitance sensor was attached to the tip of the palpating thumb. There was a significant increase in the mean PPT of MTrPs in the upper trapezius following MPR ($p<0.001$). There was no significant change in the PPT following the sham treatment in the control group ($p> 0.8$). Perceived tenderness and tolerance to pressure significantly decreased during the application of MPR ($p<0.001$). The pressure sensitivity of MTrPs was immediately reduced following application of MPR, and the reduction in tenderness during application of MPR was due to a change in tissue sensitivity, rather than an unintentional reduction of pressure by the examiner. MPR appeared to be an effective therapy for MTrPs in the upper trapezius muscle.

Keywords: myofascial trigger points, pain, algometry, trapezius

INTRODUCTION

Myofascial Trigger Points (MTrPs) are claimed to be a common source of pain in people presenting to manual therapists for treatment. Simons (2002) has contended that MTrPs are often poorly diagnosed and treated due to insufficient training and poor knowledge of practitioners. MTrPs are believed to be a source of local and referred pain, and may create additional complaint by reducing joint range of motion and producing autonomic disturbance. Patients with MTrPs can present with complex clinical findings and the underlying cause of MTrPs has been the subject of much speculation (Travell & Simons, 1983).

Myofascial trigger points have been defined as discrete foci, often palpable as a nodule, within taut bands of skeletal muscle that are tender on palpation and produce characteristic referred pain and autonomic phenomena (Travell & Simons, 1983). A latent trigger point will only produce referred pain when manual pressure is applied, whereas an active trigger point produces referred pain without palpation. Common characteristics of MTrPs include a taut band, nodule, spot tenderness, consistent referred pain pattern, local twitch response (LTR), restricted range of stretch motion and associated autonomic phenomena. Criteria for the reliable diagnosis and detection of MTrPs is contentious, because there are no definitive clinical tests. As such, manual palpation skills combined with patient feedback, have been the primary way in which MTrPs are diagnosed and treated (Sciotti et al., 2001). Gerwin et al. (1997) demonstrated acceptable inter-examiner reliability (K=0.66) for the detection of MTrPs in trapezius using the criteria of taut band, nodule, spot tenderness and referred pain, in the diagnosis of MTrPs. Local twitch response (LTR) was not used as a

criteria for diagnosis in the current study, due to poor interexaminer reliability as demonstrated in a review by Hseih et al. (2000).

Whereas the exact incidence of myofascial pain is unknown, Cummings and White (2001) identified 3 studies which reported MTrPs as a significant primary source of pain. Trigger points were claimed to be the primary cause of pain in 74% of 96 patients with musculoskeletal pain presenting to a community medical centre and in 85% of 283 patients admitted to a pain centre. In another study, 55% of patients referred to a dental clinic were reported to have MTrPs as the cause of their pain. Further research into the pathogenesis of MTrPs and clinical efficacy of treatment is warranted.

The aetiology of MTrPs is speculative, however there is growing evidence of motor end plate dysfunction. Simons (2004) proposed an integrated hypothesis of the aetiology of MTrPs, where acute or chronic muscle overload results in trauma to the motor end plate and subsequent release of acetylcholine (ACh). Excessive amounts of ACh result in the formation of contraction knots (areas of localised sarcomere shortening), which are in a state of continued contraction and result in local ischaemia and hypoxia. The combination of increased energy demand in the face of loss of energy supply causes the release of sensitising noxious substances, which are proposed to be responsible for the pain associated with MTrPs. Autonomic effects can modulate the increased ACh release and contribute to the positive feedback cycle (Simons, 2004). Simons (2002) proposed that in order to treat MTrPs, the sarcomeres need to be lengthened, which reduces the energy consumption and in turn will cease the release of noxious substances.

Current evidence suggests that the upper trapezius is probably the muscle most often beset by myofascial trigger points (Sciotti & Mittak, 2001;Wade, 2001). Fischer (1987) measured the PPTs (pressure pain threshold) of 8 different muscles with a pressure algometer and determined the upper trapezius to be the most sensitive to pressure of the muscles tested. The two trigger point locations in the upper trapezius commonly refer pain along the posterolateral aspect of the neck, behind the ear to the temple (Travell & Simons, 1983).

MPR, previously referred to as "ischaemic compression," is one of a number of techniques employed to treat MTrPs. MPR is performed by applying persistent manual pressure, usually with the thumb or fingertip against the tissue barrier of a MTrP (Simons, 2002). The pressure on the contraction knot has been proposed to reduce the height of the sarcomeres and cause concomitant lengthening of the sarcomeres in the involved muscle fibres (Simons, 2002). The pressure is sustained until the clinician feels a release of the underlying tissues, usually within 60 seconds. Alternatively, the clinician can employ the use of a pain scale, where patients state when the pressure reaches a certain threshold (such as 7 on a scale of 1-10, 1= no pain, 10=severe pain) and pressure is maintained until the pain reduces to a lesser value (such as 3-4). Other commonly used treatments include stretch and spray, passive and active rhythmic releases, dry needling and injection (Travell & Simons, 1983). Some of these techniques are invasive and may produce post treatment soreness.

Evidence exists that direct needling of MTrPs is effective, however the hypothesis that the therapy is effective beyond placebo remains to be proven (Cummings & White, 2001). MPR was shown to be an effective treatment for MTrPs in a study by Hou et al (2002) and requires no specialist equipment and can be taught as a self-management technique for patients. Hou et al (2002) investigated 48 women across 6 groups with upper trapezius MTrPs. The study examined the immediate effects of MPR on pain reduction, MTrP sensitivity and improvements in cervical range of motion. Two treatment pressure loadings were used, PPT (where pressure first changes to pain or discomfort) and an average of the PPT and pain tolerance, and three MPR treatment durations (30, 60 and 90 seconds) were also employed. The study found that both the pressure and time duration factors were significant. MPR for 90 seconds of averaged pressure produced the most significant change, however, significant change was also evident in the groups using PPT for 90 seconds and the averaged pressure for 30 and 60 seconds.

Pressure algometers are useful tools to quantify tenderness in muscles. The validity and reproducibility of pressure algometry in the evaluation of MTrPs has been well established by many researchers (Reeves et al., 1986; Fischer, 1987; Brennum et al., 1989; Ohrbach & Gale, 1989; Hogeweg et al., 1992; Vanderweeen et al., 1996). Reeves et al. (1986) demonstrated a high reliability when using a pressure algometer to measure pressure pain threshold (PPT) on trigger points. Brennum et al. (1989) concluded that pressure algometer reading did not demonstrate an order or learning effect.

Traditional pressure algometers are ideal for measuring PPTs of superficial bony landmarks, but may be of limited value for measuring deeper muscles. Recently, Fryer et al (2004) examined the PPT of deep, medial paraspinal muscles and found a conventional mechanical algometer could not be reliably relocated to deep discrete sites of altered tissue texture. Fryer et al (2004)found that a digital algometer modelled on the "Palpometer" (Atkins et al., 1992; Bendtsen et al., 1994), which used a round force capacitance sensor mounted on the palpating fingertip was ideal for this purpose, because it measured the pressure applied during palpation. Fryer et al (2004) found the capacitance sensor produced highly repeatable results. The reliability of the capacitance sensor is yet unknown however, the results from Fryer et al (2004) are promising.

The aim of the present study was to investigate the immediate effect of MPR applied to latent upper trapezius MTrPs on PPT measured with a digital algometer. Additionally, the study aimed to examine whether pressure sensitivity changed during the application of sustained, pressure controlled MPR.

METHOD

Subjects

Volunteer subjects (N=37) were recruited from the student Osteopathic population at Victoria University, Melbourne. Subjects ranged in age from 20-33 (mean 23.1, ± 3.2, M=12, F=23). Participants signed a consent form and were excluded if they had generalised primary Fibromyalgia syndrome (Sciotti & Mittak, 2001), taken analgesic medication in the past 24 hours (Brennum et al., 1989) or had no identifiable myofascial MTrPs in the upper trapezius muscle.

Measures

Digital Algometer

The digital algometer device has been described previously (Fryer et al., 2004) and was modelled on the "Palpometer." A circular 0.86cm^2 pliance® (novel, Munich) pressure sensor was attached to the fingertip of the palpating finger. The sensor was connected to pliance® (novel, Munich) data collection hardware and displayed on a computer monitor that was not in view of the examiner. The pressure sensor was calibrated according to the manufacturer's specifications before data collection commenced.

Pressure Pain Threshold (PPT)

When manual pressure is increased, the sensation of pressure will at some level change to a sensation of discomfort or pain. This pressure is recorded to indicate the pressure pain threshold (PPT). The International Association for the Study of Pain (1986) defines the PPT as the least stimulus intensity at which a subject perceives pain. The high reliability, reproducibility and validity of the PPT has been demonstrated in numerous studies (Fischer, 1987; Ohrbach & Gale, 1986; Brennum et al., 1989; Reeves et al., 1986).

Two examiners were present during the data collection. One examiner, who performed the treatment techniques was blinded to the PPT readings and the second examiner read the values from the monitor and recorded them. The first examiner, using the pressure algometer on the palpating thumb, applied steady, gradually increasing pressure to the identified MTrP. Subjects were instructed to say "now"

when they first began to feel the pressure change to discomfort or pain. The second examiner read and recorded the values at this stage. The application of pressure ceased at this moment and the pressure value was recorded (N/cm^2). The PPT was recorded three times and the mean calculated and used for analysis. The examiner and subject were blinded to the pressure displayed on the computer.

Procedure

All procedures were explained to subjects prior to any screening or measurements. Subjects were required to undress to expose their shoulder and trapezius region and lay supine on a treatment table. Subjects underwent a screening process to establish the presence of MTrPs in trapezius muscle.

Screening Process

With the subject supine and the examiner seated at the head of the subject, the examiner used his right thumb to palpate (using flat palpation) the upper trapezius muscles from medial to lateral to establish if a MTrP was present (Sciotti & Mittak, 2001). Patient feedback was elicited with regard to local and referred pain during the examination. The inclusion criteria for MTrP diagnosis was both a taut band or nodule and characteristic referred pain (to ipsilateral neck and/or head).

Treatment

Subjects were randomly allocated via lottery draw to either a treatment or sham (control) group.

Manual Pressure Release (MPR)

The participants in the MPR group were investigated for 2 factors. Firstly, the PPT was examined pre and post treatment and the values were recorded by a second examiner. In addition to the PPT, the amount of pressure during the application of MPR was also monitored.. The pressure was monitored during MPR application using the following method. Subjects (n=20) were encouraged to relax as much as possible before pressure was applied. The examiner applied slow pressure to the MTrP to a subjective value of 7 on a pain scale (0-10, where 0 = no pain and 10 = severe pain) and this pressure value was recorded by a second examiner and was used in data analysis. The pressure was sustained for 60 seconds and a second examiner monitored the pressure on a computer display and prompted examiner 1 to maintain constant pressure. If the subject reported that the pain decreased to a value of 3-4, the examiner slowly increased the pressure to restore the perceived pain to the original value of 7. At the end of the 60 second period, the pressure value that corresponded to a final pain rating of 7 was recorded and used for analysis.

Control Group

The control group (n=17) underwent a sham myofascial release procedure. This involved extremely light palpation of no greater than 2 N/cm^2 as monitored by a second examiner, of force on the MTrP. Subjects were informed that they were bring treated with an indirect Osteopathic myofascial release and that they should feel no pain. The light pressure was held for 60 seconds.

The PPT was then re-measured, using the same method as before.

RESULTS

To assess the reliability of the PPT measurement, an intraclass correlation coefficient (ICC) was calculated for the 3 pre and post-interventions PPT readings in each subject. The average measure ICC was 0.98 ($F_{69, 138} = 42.55$, $p<0.01$) which indicated a strong correlation for the 3 measurements, and suggested that the procedure was highly repeatable .

Within-group change was analysed using a dependant t-test (Table 1). The mean PPT was significantly increased following application of MPR ($p<0.01$), but the control group showed no significant change ($p>0.8$). Effect sizes were calculated using Cohen's d, and can be interpreted as being large (d=0.8), medium (d=0.5) and small (d=0.2) (Aron & Aron, 1999). The within-group effect size (Cohen's d) for the treatment group was found to be large (d=1.21), whereas the effect size was small (d = 0.05) for the control group.

Table 1: Dependent t-test and effect sizes (Cohen's d) for pre-post treatment PPT values and change in treatment pressure application

	Mean Change	Standard Deviation	T Value	p	Effect Size
MPR	-2.05	1.70	-5.15	0.00	1.21
Control (MR)	0.083	1.70	0.21	0.84	0.05

The treatment group showed that pressure was able to be increased post MPR whilst using a pain scale to a rating of 7 out of 10. The dependent t-test showed that the

pressure was significantly increased ($p<0.01$) during the application of MPR while maintaining a pain rating that did not exceed the original value (7 out of 10) (Table 2).

Table 2: Dependent t-test and effect sizes for pre-post treatment pressure pain scale values

	Mean Change	Standard Deviation	T Value	p	Effect Size
Treatment Pressure	-2.08	1.54	-5.73	0.00	1.35

The mean change of the experimental and control groups were analysed for significant differences using an independent t-test. The differences between the gains in the two groups were found to be significant ($T=3.82$, $p<0.001$).

DISCUSSION

Treatment of latent upper trapezius MTrPs with 60 seconds of MPR produced significant immediate decreases in sensitivity of MTrPs to manual pressure. It was possible that the sustained pressure on the tender MTrP would actually produce irritation and make them more sensitive to post-treatment PPT measurement, but this proved not to be the case. The use of a sham technique produced no significant change and the mean changes in both groups were significantly different from each other. Furthermore, the effect size in the treatment group was large, suggesting a strong clinical effect. The results suggest that MPR may be an effective therapy for MTrPs in the upper trapezius.

These findings are consistent with reports from other authors including Fischer (1987) and Hou et al (2002) who both found that MPR decreased the sensitivity of MTrPs. The pressure values reported in the present study were lower than those reported by Hou et al. (2002) and Fischer (1987). Hou et al. (2002) found the average pre-treatment PPT value in the upper trapezius to be 3.16 kg/cm^2 and Fischer (1987) reported them as 3.7 kg/cm^2 in females and 5.4 kg/cm^2 in males. The values found in the current study were 0.77 kg/cm^2 pre MPR and 0.98 kg/cm^2 post MPR.

A possible explanation for the difference in measurements between the current study and Fischer (1987) and Hou et al. (2002) is that both studies used a different algometer to the one used in the present study. These researchers used a force gauge fitted by a metal rod with a rubber disc tip with a surface of 1cm^2, as opposed to the digital algometer used in this study, which was a force sensing polymer attached to the tip of the index finger.

Pain sensitivity in response to the steady application of pressure was shown to change during the process of treatment. Manual pressure was applied to the MTrP until the subject rated it 7 out of 10, and the pressure was monitored to ensure it did not change. By about 30-40 seconds, most subjects reported that the pain had reduced to about 3-4 and the experimenter then increased the pressure until it produced a pain rating of 7 out of 10 again. This increase in pressure was found to be significant ($p<0.001$). Anecdotal evidence suggested that reduction in tenderness frequently occurs during MPR, but it was possible that it occurred due to an unintentional release of pressure by the practitioner. Although the Osteopath in this study had a tendency to reduce the pressure during MPR (and had to be prompted to maintain it), this study

demonstrated that the pressure sensitivity of MTrPs did reduce during the application of pressure.

There are a number of possible mechanisms behind the effectiveness of MPR. Simons (2002) has proposed that MPR may equalise the length of sarcomeres in the involved MTrP and consequently decrease the palpable knot and pain. Hou et al (2002) suggested that pain reduction in MTrPs following MPR may result from reactive hyperaemia in the local area, due to counter-irritant effect or a spinal reflex mechanism that may produce reflex relaxation of the involved muscle. These proposals are speculative and further research is required to establish the therapeutic mechanisms. It has been argued that in order to prevent an ongoing cycle of MTrP treatment and relapse, contributing or perpetuating factors, such as posture, should be addressed (Hanten et al., 2000; Travell & Simons, 1983).

There are some limitations to the current study. Firstly, the inconsistency of pain perception within a subject may affect the PPT measurement. However, the subjects and examiners were blinded to the PPT values and the PPT appeared highly repeatable, demonstrated by the high ICC value. The control group underwent a believable sham treatment and demonstrated no effect.

There was no follow up period in this study and the duration of treatment effect remains unknown. The participants in this study were asymptomatic and may not be typical of the population presenting to manual therapists for treatment. However, all participants were determined to have latent MTrPs, which are commonly described

and believed to be clinically relevant (Travell & Simons, 1983). The effect size may have been greater if symptomatic subjects were included in this study.

The current study could be expanded to include symptomatic subjects with a longer treatment period (such as 4 weeks), which would enable the duration of treatment effect to be investigated. The effect of cumulative treatment could be investigated with regular MPR application and PPT measurement to examine if pain tolerance is increased following regular treatment. Other concurrent measures of pain and disability could be taken (eg. Visual analogue scale (VAS), McGill pain questionnaire and the NDI (neck disability index) in addition to PPT. A comparison of different techniques for MTrP treatment such as stretch and spray, muscle energy technique (MET) and dry needling could be introduced. It could also be noted whether referred pain diminishes from treatment or whether it only has local effects on pain sensitivity.

CONCLUSION

MPR appeared to be an effective therapy for MTrPs in the upper trapezius. Significant increases in PPT were observed following MPR applied to the predetermined MTrP, but no significant change was demonstrated in the PPTs of the control group.

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