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CLINICAL APPROACHES

The effect of manual pressure release on myofascial trigger points in the upper trapezius muscle

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Summary 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 latent MTrPs in the upper trapezius muscle using a novel pressure algometer. 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 the neck and/or head on manual pressure). Subjects were randomly allocated into either treatment (MPR) or control (sham myofascial release) groups. The pressure pain threshold (PPT) was recorded pre- and post-intervention using a digital algometer, consisting of a capacitance sensor 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 ($P < 0.001$), but not following the sham treatment. Pressure was monitored and maintained during the application of MPR, and a reduction in perceived pain and significant increase in tolerance to treatment pressure ($P < 0.001$) appeared to be caused by a change in tissue sensitivity, rather than an unintentional reduction of pressure by the examiner. The results suggest that MPR may be an effective therapy for MTrPs in the upper trapezius.

Introduction

Myofascial trigger points (MTrPs) are claimed to be a common source of musculoskeletal pain in people presenting to manual therapists for treatment. Simons (2002) has contended that MTrPs are often

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inadequately diagnosed and treated due to insufficient training and knowledge of practitioners. MTrPs are claimed to be a source of local and referred pain, and may create additional complaints 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 (Simons et al., 1999).

Simons et al. (1999) have defined MTrPs 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. Active MTrPs are a cause of symptoms (pain, autonomic phenomena, restricted motion), whereas latent MTrPs may not be an immediate source of pain, but produce characteristic referred pain when manual pressure is applied. Latent MTrPs are believed to be prevalent in symptomatic and asymptomatic individuals alike, are claimed to be easily rendered 'active' by minor muscle overload or fatigue (Simons et al., 1999) and there is evidence that they may disturb normal patterns of motor recruitment and movement efficiency (Lucas et al., 2004).

The reliability for the diagnosis of MTrPs, as well as the criteria used to detect their presence, is contentious because there appear to be no definitive clinical tests and some researchers have reported poor reliability in detecting MTrPs (Nice et al., 1992; Tunks et al., 1995). Sciotti et al. (2001) used a three-dimensional camera system to examine the agreement and precision of examiners in locating latent MTrPs in the upper trapezius muscles, and reported that two trained examiners could reliably locate the MTrPs with a precision that approximated the dimensions of the clinician's own fingertips. Gerwin et al. (1997) demonstrated acceptable inter-examiner reliability ($K = 0.66$) for the detection of MTrPs in the trapezius muscle using the criteria of taut band or nodule, spot tenderness and referred pain. Local twitch responses appear to have poor inter-examiner reliability, as reported in a review by Hsieh et al. (2000). Simons et al. (1999) and Gerwin et al. (1997) recommend that the minimum acceptable criteria is the combination of spot tenderness in a palpable taut band of skeletal muscle and characteristic referred pain.

Although the exact incidence of myofascial pain is unknown, Cummings and White (2001) identified three studies that 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 incidence and clinical efficacy of treatment of MTrPs is warranted.

Sustained manual pressure, referred to in this paper as 'manual pressure release' (MPR), and previously referred to as 'ischaemic compression,' 'inhibition', and 'trigger point pressure release,' is one of a number of techniques advocated for the treatment of MTrPs. MPR is performed by applying tolerably painful, persistent manual pressure, usually with the thumb or fingertip, against the tissue barrier of a MTrP (Simons et al., 1999). There is evidence that the palpable MTrP bands and nodules are a result of localized bulging and shortening of the sarcomeres in a muscle fibre to produce 'contraction knots' and 'contraction discs' (Mense et al., 2003; Simons et al., 1999). Manual pressure applied to the MTrP '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 s. Alternatively, the clinician can employ the use of a pain scale, where patients state when the pressure reaches a certain threshold ('moderate but tolerable' pain, such as 7 on a scale of 1–10, where 1 = no pain, 10 = severe pain) and pressure is maintained until the pain reduces to a lesser value (such as 3 or 4). In the experience of the authors, patients often report a reduction of tenderness after approximately 20–30 s of sustained MPR application, and this allows the pressure to be increased to restore the pain to the original value of 7. It is possible that clinicians may unintentionally release the pressure during application, thereby causing the reduction in tenderness, and this warrants further investigation. Other commonly advocated treatments include spray and stretch, post-isometric stretching (muscle energy technique), dry needling and injection (Simons et al., 1999).

Evidence exists that direct needling of MTrPs may be an effective treatment, however, the hypothesis that the therapy is effective beyond placebo remains to be proven (Cummings and White, 2001). Recently, de las Penas et al. (2005), in a review of the treatment of MTrPs with manual therapy, concluded that although a few studies demonstrated reduced pain scores and pressure sensitivity following manual therapy, there was a lack of rigorous evidence that some manual therapies have an effect beyond placebo in the treatment of myofascial pain.

Hanten et al. (2000) examined the effect of a home program of MPR and sustained stretching for 40 volunteers with active MTrPs in their neck or upper back. Inclusion criteria for the presence of MTrPs were a palpable tender spot in the neck or upper back, reproduction of the patient's pain on palpation, and a 'jump sign' characterized by patient vocalization or withdrawal. Subjects in the treatment group performed MPR (with a hand-held tool) and sustained stretching twice a day for 5 days, whereas those in the control group performed active range of neck motion exercises. Subjects in the treatment group were found to have significantly decreased perceived pain and pressure pain threshold (PPT, where pressure first changes to pain or discomfort) in comparison to those in the control group.

Hou et al. (2002) investigated the immediate effects of MPR on pain reduction, MTrP sensitivity and improvements in cervical range of motion in 48 women with upper trapezius MTrPs. The researchers used two treatment pressure loadings, PPT and a higher loading (an average of the PPT and pain tolerance), and three MPR treatment durations (30, 60 and 90 s). Hou et al. (2002) found that the higher pressure MPR applied for 90 s produced the most significant change, however, significant change was also evident in the groups using the low pressure for 90 s, and the high pressure for 30 and 60 s.

The validity and reproducibility of pressure algometry to measure pressure sensitivity and PPTs in the evaluation of MTrPs has been well established by many researchers (Reeves et al., 1986; Fischer, 1987; Brennum et al., 1989; Hogeweg et al., 1992; Vanderweeen et al., 1996). Traditional pressure algometers are ideal for measuring PPTs of superficial muscles and 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 that 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.

The upper trapezius is probably the muscle most often beset by MTrPs (Sciotti et al., 2001; Wade, 2001). Fischer (1987) measured the PPT of eight different muscles with a pressure algometer and determined that the upper trapezius was most sensitive to the 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 (Simons et al., 1999).

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 capacitance sensor algometer. Additionally, the study aimed to examine whether pressure sensitivity changed during the application of sustained, pressure-controlled MPR, or whether the decrease in reported pain was due to an unintentional release of the pressure by the clinician.

Method

Subjects

Volunteers ($N = 37$) were recruited from the student population at Victoria University, Melbourne. Subjects ranged in age from 20 to 33 years (mean 23.1, SD = 3.2, $M = 12$, $F = 23$). Participants signed a consent form and were excluded if they had generalized primary fibromyalgia syndrome (Sciotti et al., 2001), had taken analgesic medication in the past 24 h (Brennum et al., 1989), or had no identifiable myofascial MTrPs in the upper trapezius muscle.

Measures

Digital algometer

The digital algometer device was modelled on the "Palpometer" (Atkins et al., 1992; Bendtsen et al., 1994), and consisted of a circular 0.86 cm^2 pliance® (novel, Munich) capacitance pressure sensor

Fig. 1 Digital algometer (pliance® capacitance sensor) attached to the thumb.

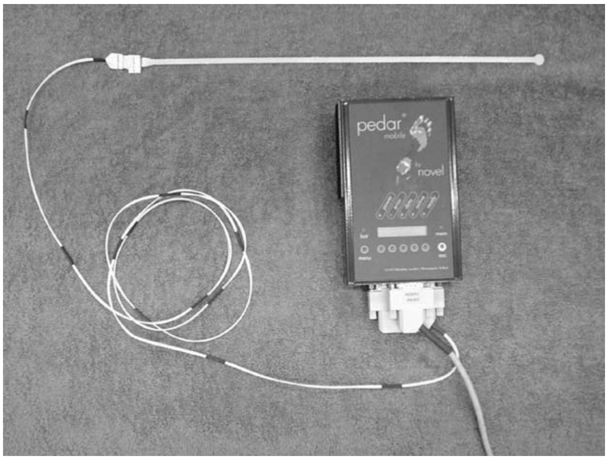

Fig. 2 Digital algometer (pliance® sensor) and pliance® (novel, Munich) data collection hardware.

attached to the tip of the palpating thumb (Fig. 1), and connected to pliance® (novel, Munich) data collection hardware (Fig. 2). PPT measurements using this algometer have been found to be highly repeatable (intraclass correlation coefficient (ICC) $=0.952$) (Fryer et al., 2004). The pressure reading was displayed on a computer monitor that was not in view of the blinded palpating examiner or the subject. The pressure sensor was calibrated according to the manufacturer's specifications before data collection commenced.

Pressure pain threshold (PPT)

When manual pressure over a muscle 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 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 have been demonstrated in numerous studies (Fischer, 1987; Brennum et al., 1989; Reeves et al., 1986).

Two examiners were present during the collection of data. Examiner 1 performed the PPT measurement and treatment technique and was blinded to the PPT readings, while examiner 2 recorded the pressure values from the computer monitor. 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 application of pressure ceased at this moment and examiner 2 recorded the pressure value (N/cm^2). The PPT was recorded three times for each MTrP and the mean calculated and used for analysis. The first examiner and subject were blinded to the pressure displayed on the computer.

In addition to the PPT, the amount of pressure during the application of MPR was also monitored. The examiner's thumb remained in contact with the skin overlying the MTrP for the entire procedure to ensure accurate re-location of pressure for MPR and post-treatment PPT measurement.

Procedure

All procedures were explained to the subjects prior to any screening or measurements. All subjects signed a consent form and the procedures of this study were approved by the Victoria University Human Research Ethics Committee. Subjects were requested to undress to expose their shoulder and trapezius region and lie supine on a treatment table.

Subjects underwent a screening process to establish the presence of MTrPs in the trapezius muscle. With the subject supine and the examiner seated at the head of the table, the examiner used his right thumb to palpate (using flat palpation) the upper trapezius muscles from medial to lateral to establish if any MTrPs were present. Patient feedback was elicited with regard to local and referred pain during the examination. The inclusion criteria for a diagnosis of a MTrP was a taut band with spot tenderness and subject recognition of referred pain to ipsilateral neck and/or head.

Subjects were randomly allocated via lottery draw to either a MPR treatment or sham (control) group. Examiner 1 measured the PPT of the MTrP in subjects from both groups pre-treatment and immediately following intervention, as previously described.

Manual pressure release (MPR)

Subjects ($n=20$) were encouraged to relax as much as possible before pressure was applied. Examiner 1 applied slow pressure to the MTrP until the subject reported a 'moderate but easily tolerable' pain value of 7 out of 10 (where $0=$ no pain and $10=$ severe pain) and examiner 2 recorded the pressure value. This pain value was deemed to lie somewhere between pain tolerance and the lesser PPT, as recommended by Hou et al. (2002). The MPR pressure was sustained for 60 s while examiner 2 monitored the pressure reading and prompted examiner 1 to maintain constant pressure (Fig. 3). If the subject reported that the pain decreased to a value of 3 or 4, examiner 1 slowly increased the pressure to restore the perceived pain to the original value of 7. Examiner 2 recorded the pressure applied at the end of the 60-s treatment period.

Control group

The control group ($n = 17$) underwent a sham 'myofascial release' procedure. Extremely light pressure of no greater than 2 N/cm^2 (monitored by examiner 2) was applied to the MTrP. Subjects were informed that they were being treated with an indirect osteopathic myofascial release technique, that the technique involved subtle movement of the skin and underlying tissues, and that they should feel no pain. The light pressure was held for 60 s. Examiner 1 made no attempt to palpate or engage any perceived tissue barriers in order to make the sham treatment inert.

Results

To assess the reliability of the PPT measurement, an ICC was calculated for the three sets of pre- and post-intervention 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 and high repeatability for the three measurements.

Within-group change was analysed using a dependant t-test (Table 1). The mean PPT was significantly increased following application of MPR ($t = -5.15$, $P<0.001$), but the control group showed no significant change ($t = 0.021$, $P = 0.835$). The mean changes in both experimental and control groups were compared using an independent t-test, and were found to be significantly different ($t = 3.82$, $P<0.001$).

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 and Aron, 1999). The within-group effect size 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.

In the treatment group, MPR pressure was increased during the process of treatment while maintaining a perceived pain value of no more than 7 out of 10. A dependent t-test was used to compare the initial treatment pressure to the final pressure application and showed that the pressure was significantly increased ($t = -5.73$, $P<0.001$), and the within-group effect size was large ($d = 1.35$) (Table 2).

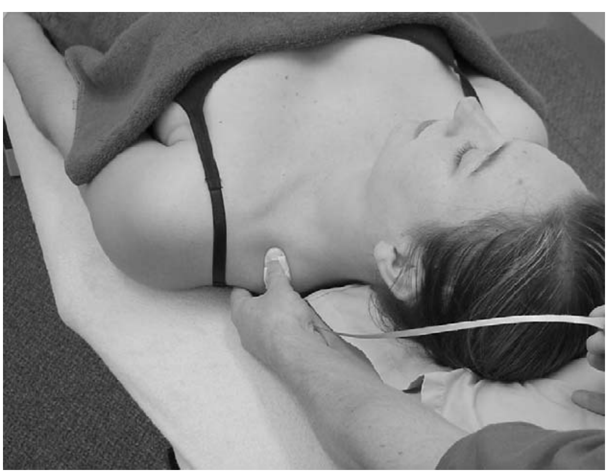

Fig. 3 Manual pressure release.

Discussion

Treatment of latent upper trapezius MTrPs with 60 s of MPR produced significant immediate decreases in sensitivity of MTrPs to manual pressure. It was possible that sustained manual pressure on the tender MTrPs would actually produce irritation and make them more sensitive to post-treatment PPT measurement, but this proved not to be the case.

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 (N/cm^2)	Standard deviation	t value	P	Effect size (d)
MPR	−2.05	1.70	−5.15	0.000*	1.21
Control (MR)	0.083	1.70	0.21	0.835	0.05

* Significant at $P<0.05$.

Table 2 Dependent t-test and effect sizes for initial–final treatment pressure application.

	Mean change (N/cm^2)	Standard deviation	t value	P	Effect size
Treatment pressure	−2.08	1.54	−5.73	0.00	1.35

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, whereas the effect size of the sham control group was small. The results suggest that MPR is an effective therapy for MTrPs in the upper trapezius. These findings are consistent with reports from other authors including Hanten et al. (2000) and Hou et al. (2002) who found that MPR decreased the sensitivity of MTrPs.

Pain evoked from the MTrP 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 ('moderate but easily tolerable'), and examiner 2 monitored the pressure to ensure it did not change. By about 30–40 s most subjects reported that the pain had reduced to at least 3–4 and then examiner 1 increased the pressure until the pain rating was restored to 7. The increase in treatment pressure, while maintaining perceived tenderness at no greater than the initial value, was found to be significant. Anecdotal evidence suggested that reduction in tenderness frequently occurs during MPR, but it was possible that this occurs due to an unintentional release of pressure by the practitioner. The osteopath in this study had a tendency to reduce the pressure during MPR (and had to be prompted to maintain it), but it was also possible that slight reductions in pressure were caused by the release of tissues in response to treatment. Regardless of the cause, this study demonstrated that the pressure sensitivity of MTrPs did reduce during the application of pressure-controlled MPR.

The pathophysiology of MTrPs is still the subject of debate, but there is growing research that implicates a disturbance of the neuromuscular motor endplate. Several researchers have used needle electromyographic techniques to record the presence of spontaneous electrical activity in minute areas (the 'nidus') of the MTrP within resting muscle, which appears similar to 'endplate noise' (Couppe et al., 2001; Hong, 1998; Hubbard and Berkoff, 1993). Simons (2004) proposed an integrated hypothesis of the aetiology of MTrPs, where acute or chronic muscle overload results in trauma to the motor endplate and subsequent release of acetylcholine. Excessive amounts of acetylcholine result in the formation of contraction knots (areas of localized 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 sensitizing noxious substances, which are proposed to be responsible for the pain associated with MTrPs. Autonomic effects can modulate the increased acetylcholine release and contribute to the positive feedback cycle (Simons 2004).

Mense et al. (2003) have provided experimental evidence to support the proposal that an increase in acetylcholine may cause the formation of contraction knots. These researchers injected small amounts of acetylcholinesterase inhibitor (to increase local acetylcholine) into rat gastrocnemius muscles and studied the rats after either electrical stimulation of the muscle to induce muscle twitches or normal activity without electrical stimulation. Mense et al. (2003) found significantly more abnormally contracted fibres (including 'contraction discs' that consisted of a sudden bulging of the muscle fibre with a protruding centre) in the injected region of the muscle compared to the distal control region of the same muscle. Abnormalities also appeared to occur more commonly in the muscles that had been electrically stimulated, compared to those that were not.

Simons (2002) proposed that appropriate treatment of MTrPs involves lengthening the sarcomeres (as might occur with stretching or sustained manual pressure), which reduces the energy consumption and in turn will cease the release of noxious substances. There are a number of possible mechanisms behind the effectiveness of MPR. Simons (2002) has proposed that MPR may equalize 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.

The current study has several limitations. This study only examined the immediate effect of MPR, and, because there was no follow-up assessment, the duration of treatment effect remains unknown. Also, the participants in this study were asymptomatic and may not be typical of the population presenting to manual therapists for treatment. However, many participants had experienced neck and shoulder pain in the recent past and all were determined to have latent MTrPs, which are commonly described and believed to be clinically relevant (Simons et al., 1999). The changes in PPT may have been even greater if the effect of MPR was examined on symptomatic subjects. The present study only examined the effect of MPR on PPT; however, PPT only reflects local pain sensitivity. It would be interesting to establish if MPR also produces a reduction in referred pain from the treated MTrP using a similar pre-treatment pressure application.

It is recommended that future studies include symptomatic subjects with a longer treatment and assessment period (at least 4 weeks), which would enable the duration of treatment effect to be investigated. When treating patients with active MTrPs, however, care would be needed to ensure that the treatment pressure was less than that used in the present study (slightly below pain tolerance) to avoid inducing pain enhancing plastic changes in the central nervous system (central sensitization) in these susceptible, symptomatic individuals. Other concurrent measures of pain and disability could also be used as outcome measures (visual analogue pain scale, McGill pain questionnaire, Neck Disability Index) in addition to the PPT. Future studies could compare the effectiveness of different techniques for MTrP treatment, such as spray and stretch, muscle energy technique and dry needling.

Conclusion

Significant increases in PPT were observed following MPR applied to the pre-determined MTrP, but no significant change was demonstrated in the sham control group. During application of sustained manual pressure, the local MTrP tenderness decreased and this appeared to be due to a change in tissue sensitivity rather than an unintentional release of pressure by the practitioner. MPR appeared to be an effective therapy for MTrPs in the upper trapezius.

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