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Immediate effect of ischaemic compression and trigger point pressure release on neck pain and upper trapezius trigger points: A randomised controlled trial

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Summary

Objective: The purpose of this study was to determine the immediate effect of ischaemic compression, trigger point pressure release and placebo ultrasound on pain, degree of cervical lateral flexion and pressure pain threshold of upper trapezius trigger points in subjects with non-specific neck pain.
Design: Randomised, single-blind, placebo-controlled trial.
Setting: Anglo-European College of Chiropractic (AECC) in Bournemouth, England.
Subjects: Forty-five subjects from the AECC student body between 18 and 55 years of age with non-specific neck pain of at least 30 mm on a visual analogue scale (VAS) for pain, an upper trapezius trigger point and decreased cervical lateral flexion to the opposite side of the active upper trapezius trigger point were entered into the study.
Methods: The subjects were randomly assigned to one of three treatment groups with 15 subjects in each group: trigger point pressure release, ischaemic compression or sham ultrasound (control group). Neck pain level was determined using a visual analogue scale, degree of lateral flexion was determined using a CROM goniometer and pain pressure thresholds were measured with a pain pressure algometer. All subjects attended one treatment session and outcome measures were repeated within five minutes after treatment.
Results: Clinical improvement was considered as a reduction of 20 mm or more on the visual analogue scale. Nine subjects in the ischaemic compression group improved after treatment compared to seven subjects in the trigger point pressure release group and four subjects in the control group. The number needed to treat for one patient to improve with ischaemic compression compared to trigger point pressure release was 7.5 (95% CI −4.53 to 2.05). The number needed to treat for one patient to improve with ischaemic compression compared to sham ultrasound was 2.5 (95% CI 1.39–12.51). The odds ratio for improvement with ischaemic compression compared

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to trigger point pressure release was 1.68 (95% CI 0.41–6.88). The odds ratio for improvement with ischaemic compression compared to sham ultrasound was 5.01 (95% CI 1.19–21.06). A one-way analysis of variance (ANOVA) indicated there was no statistically significant difference beyond chance in pain level, lateral flexion or pain threshold among the groups ($P > 0.05$).

Conclusion: Ischaemic compression is superior to sham ultrasound in immediately reducing pain in patients with non-specific neck pain and upper trapezius trigger points. Further research is needed to determine if there is a difference between ischaemic compression and trigger point pressure release.

Introduction

Mechanical neck pain has a lifetime prevalence of 45–54% in the general population,[1–3] and up to 30% of men and 50% of women experience neck pain in the course of a lifetime.[4] The point prevalence of neck pain has been estimated to be between 13.4 and 22.2%.[5] Further, 14% of patients are at risk of their neck pain becoming chronic which makes neck pain expensive in terms of absenteeism from work and in healthcare costs.[6]

Travell and Simons[7] originally recommended 'ischaemic compression' for trigger points (TrPs) with thumb pressure firm enough to cause the skin to blanch. However, in the second edition of their book[8] they recommended 'ischaemic compression' be replaced with 'trigger point pressure release'. The reason for this change relates to the ATP energy crisis model, which views TrPs as being evoked by abnormal depolarisation of motor end plates and the TrPs themselves as areas of tissue hypoxia. Firm thumb pressure, according to this theory, would produce more ischaemia and not be beneficial.

Prior studies[3,9–13] and systematic reviews[14,15] have compared various treatments for neck pain and trigger points. The Fernandez de las Penas et al. systematic review[15] included two trials of ischaemic compression.[11,12] However, we are unaware of any study that has directly compared the above two methods of trigger point (TrP) therapy to a sham treatment. Therefore, the purpose of this study was to determine the immediate effect of ischaemic compression (IC) and trigger point pressure release (TrPPR) on non-specific neck pain in subjects with upper trapezius TrPs compared to sham ultrasound (SUS).

Methods

This study was a randomised, single-blind, sham-controlled clinical trial. The study was conducted at the AECC in the United Kingdom and approval for the study was obtained from the AECC Research Ethics Sub-Committee. Data collection occurred between November 2005 and January 2006.

Subjects

Participants were AECC students. Subjects were admitted into the study if they met the following criteria:

- 18–55 years of age
- had mechanical neck pain for less than 3 months
- had an active upper trapezius TrP (an active upper trapezius TrP was defined as a tender nodule in a taut band that referred pain in a pattern specific for upper trapezius TrP_1 or TrP_2)[7]
- pain of at least 30 mm on a visual analogue scale (VAS)
- decreased cervical lateral flexion to the opposite side of the active upper trapezius TrP

We excluded those who were taking anticoagulants or who were using long-term corticosteroid therapy, and those with specific causes for their neck pain.

Each subject read a Study Information Sheet and signed an Informed Consent Form before enrolment in the study. The randomisation scheme was generated by using the web site Randomization.com <http://www.randomization.com>. To ensure equal numbers in the groups, subjects were randomised in blocks of three. Sealed opaque envelopes were prepared containing the assigned treatment and numbered consecutively. Subjects were allocated to the next available envelope number.

Interventions

Ischaemic compression

This consisted of sustained deep pressure with the thumb to the upper trapezius TrP for 30 s–1 min. Pressure was released when there was decreased

tension in the TrP or when the TrP was no longer tender or one minute had elapsed, whichever occurred first.[7,8] The procedure was similar to the method as described by Dr. Raymond Nimmo.[16]

Trigger point pressure release

The clinician applied non-painful slowly increasing pressure with the thumb over the TrP until a tissue resistance barrier was felt. This level of pressure was maintained until release of the tissue barrier was felt, at which time pressure was increased until a new barrier was reached.[8] This process was repeated until there was no TrP tension/tenderness or 90 s had elapsed, whichever occurred first.

Sham ultrasound

A detuned Medi-Link Systems ultrasound machine from Electro-Medical Supplies (Greenham) Ltd. was used. The subject was informed that pulsed ultrasound was going to be used; that they should not feel any sensation of heat or pain and that, if this was felt, to let the clinician know and the machine would be turned down. Since this was a sham procedure, such adjustment made no actual difference. Ultrasound lotion was applied over the TrP and the ultrasound head was moved slowly over the upper trapezius muscle in the region of the TrP for 2 min. The machine's integrated timer was used to alert the clinician when 2 min had elapsed.

Outcome measures

A pressure algometer (PA) was used to measure pain threshold of the involved upper trapezius TrP. It consisted of a gauge that was attached to a hard rubber tip of 1 cm in diameter. The dial gauge was calibrated in kg/cm^2 and ranged from 1 to 10 kg/cm^2. The force recorded was the amount of pressure that caused pain in the subject; this is called the pressure pain threshold (PPT). Inter-examiner reliability of the PA is good to excellent (interclass correlation (ICC) = 0.75–0.89).[17,18] Also, reliability may be enhanced when one examiner takes all measurements.[18]

The CROM goniometer was used to measure lateral cervical flexion. Inter-examiner reliability of the CROM device for measuring lateral cervical flexion is good to excellent (ICC = 0.73–0.89).[19,20]

A visual analogue scale was used for subjects to grade their current level of neck pain. The VAS for pain is a 10 cm horizontal line with polar descriptors of "no pain" and "worst pain possible". Subjects indicated their pain by placing a vertical line through the VAS line at the point that represented their current level of neck pain. The VAS for pain is considered to have good validity.[21–23]

Procedure

The subject entered the treatment room and filled out the pain scale. If the pain level was at least 30 mm, the examiner then took the other baseline measurements. The TrP located in the area of TrP_1 or TrP_2, on the same side as the neck pain, was marked with a cross using a skin-pencil. If both trigger points were involved, the most tender TrP was used. If the subject had bilateral neck pain, the upper trapezius with the most tender TrP was used.

To determine cervical lateral flexion, the CROM device was attached to the subject's head with straps and the subject was asked to sit up straight and first laterally flex the head to the right (degrees of lateral flexion was recorded) and then laterally flex the head to the left (degrees of lateral flexion was recorded). For entry into the study, the subject had to have decreased lateral flexion to the side opposite the active upper trapezius TrP. It was this measurement that was used in the statistical analysis.

To measure PPT, the rubber tip of the PA was placed over the cross signifying the TrP location and the patient was instructed to indicate when the sensation changed from pressure to pain. The pressure was steadily increased at a rate of 1 $kg/cm^2/s$.

The examiner then left the room and the treating clinician entered. The clinician opened the next consecutively numbered envelope and delivered the assigned treatment. To mask the examiner to treatment assignment, the clinician set the timer on the ultrasound machine for each subject, placed ultrasound lotion over the trigger point and then wiped it off for each subject, and kept each subject in the treatment room for 3 min. The clinician advised each subject not to discuss anything about the treatment with the examiner. The clinician then left the room and the examiner entered and conducted the post-tests within 5 min of treatment.

Statistical analysis

Statistical analysis was conducted using INSTAT™ for Windows. Our primary outcome was clinical improvement, which was defined as a reduction of 20 mm on the VAS for pain. Clinically significant effect size was determined using an odds ratio (OR) and number needed to treat (NNT) with

Table 1 Baseline data for the groups

Variable	Ischaemic compression	Trigger point pressure release	Sham ultrasound	*P*-value
Median age (S.D.)	24 (3.3)	24 (4.6)	23 (1.5)	0.4386
Mean VAS (S.D.)	41.3 (7.8)	43.6 (8.8)	38.1 (8.8)	0.2143
Mean PPT (S.D.)	3.39 (1.16)	2.8 (1.2)	2.6 (0.83)	0.1060
Mean LCF (S.D.)	50.7 (7.2)	44.1 (7.9)	47.3 (7.3)	0.0642

Age in years; VAS in millimetres; pressure pain threshold (PPT) in kg/cm^2; lateral cervical flexion (LCF) in degrees. Median used for age as S.D.s among groups were significant. Kruskal–Wallis test used for age; ANOVA used for other outcome measures.

95% confidence intervals. The difference in post-test VAS, cervical lateral flexion and pain threshold scores between the groups was determined using one-way analysis of variance with alpha set at 0.05.

Results

Between November 2005 and January 2006, 55 students were considered for enrolment. Nine students were excluded for failure to achieve a baseline VAS score of at least 30 mm and one student was excluded for failure to achieve a baseline VAS score of at least 30 mm and for taking anticoagulants. Forty-five subjects were randomly assigned, 15 to the IC group, 15 to the TrPPR group and 15 to the SUS group. Baseline data for the groups are shown in Table 1. There was no baseline difference between the groups in age ($P = 0.4386$), level of pain ($P = 0.2143$), pressure pain threshold ($P = 0.1060$) or in lateral cervical flexion ($P = 0.0642$).

Using a reduction of pain of at least 20 mm on the VAS to signify clinical improvement nine subjects in the IC group improved, seven in the TrPPR group improved and four in the SUS group improved (Table 2). The number needed to treat for one patient to improve with IC compared to TrPPR was 7.5; however, this result was not significant (95% CI −4.53 to 2.05). The number needed to treat for one patient to improve with IC compared to SUS was 2.5 (95% CI 1.39–12.51). The odds ratio for a patient improving with IC compared to TrPPR was 1.68; however, this result was not significant (95% CI 0.41–6.88). The odds ratio for a patient improving with IC was 5.01 (95% CI 1.19–21.06) compared to a patient receiving SUS.

The difference in post-treatment VAS means was not significant between the groups ($P = 0.5721$) (Table 3). With pressure pain threshold there was no significant difference between the groups ($P = 0.2171$) (Table 3). On the outcome of cervical lateral flexion there was no significant difference between the groups ($P = 0.8805$) (Table 3).

Discussion

There was no statistically significant difference between the groups in any of the secondary outcome measures. However, there was a clinically significant difference between IC and SUS. Three patients need to be treated with IC for one to improve compared to SUS. A patient treated with IC has a five times greater chance of improving compared to a patient treated with SUS. Although clinically significant results were found for IC as compared to SUS, future research into the long-term effects of this treatment is warranted. Also further comparisons between IC and TrPPR need to be considered using larger sample sizes and with a longer follow-up period.

Our primary outcome was clinical significance instead of statistical significance as statistical significance does not necessarily equate to clinical importance and non-significance does not necessarily mean no effect. Small studies may report non-

Table 2 Number of subjects improved with treatment

	Sham ultrasound	Ischaemic compression	Trigger point pressure release
Number improved	4	9	7
Group size	15	15	15
% Improved	26.7	60.0	46.7

Table 3 Post-treatment VAS, pressure pain threshold and lateral cervical flexion means

Group	VAS (S.D.)	PPT (S.D.)	LCF (S.D.)	Passed normality test	Difference between groups
Sham ultrasound	22.67 (8.21)	3.37 (1.62)	49.1 (8.3)	Yes	$P = 0.5721$ (NS)
Ischaemic compression	22.93 (12.76)	4.45 (1.69)	50.5 (8.6)	Yes	$P = 0.2171$ (NS)
TrP pressure release	27.13 (16.40)	3.77 (1.76)	49.1 (10.4)	Yes	$P = 0.8805$ (NS)

VAS in millimetres; pressure pain threshold (PPT) in kg/cm^2; lateral cervical flexion (LCF) in degrees; NS, not significant. Normality test determined by the method of Kolmogorov and Smirnov.

significance even when there are real clinically important effects. Using confidence intervals instead of *P*-values gives a range within which the true treatment effect is likely found, and allows the reader to extrapolate the findings from the study to their individual patient.[24,25]

In the current study, pressure pain threshold values were obtained unilaterally from the right or left upper trapezius. Measurements from opposite sides of the body are reproducible and it is generally considered unnecessary to measure soft tissue PPT bilaterally.[26] In cases of suspected unilateral pathology, pressure pain thresholds can be used to compare differences from side to side.[27] Pain pressure threshold was measured by the use of a manual PPA. Nussbaum and Downes[18] studied the reliability of clinical algometric measurements and suggested that an electronic PPA provides more reliable measurements than a manual non-electronic PPA. However, they also stated that algometric measurements, regardless of the type of PPA used, showed good intra- and inter-examiner reliability when measurements were performed by a skilled examiner once or repeatedly on a single day.

McNair et al.[28] determined that the greatest improvements in cervical range of motion (ROM) after one treatment with joint mobilisation were in flexion and extension. Lateral flexion was the movement that showed the least detectable degree of improvement. It is difficult to determine if these results relate to our study because lateral flexion was the only movement which was measured. *However, it may mean that differences in lateral flexion* are generally smaller and not as easily detected as changes in flexion and extension movements.

Hou et al.[11] investigated various combinations of physical therapeutic modalities for active upper trapezius trigger points and found IC with quantified pressure and duration provided immediate pain relief and reduction of trigger point sensitivity. However, no placebo comparison group was used, and unlike our study, subjects with non-specific neck pain were not included, and there was no comparison to TrPPR. Further, clinical significance was not investigated and it is difficult to extrapolate the results to patients seen in practice.

Hanten et al.[12] investigated the home use of IC with a 'Theracan' self-treatment tool followed by sustained stretching for trigger points located in the neck or upper back. Active range of motion was used as the control and IC was found to be superior in reducing pain and increasing PPT. There was no placebo comparison group or TrPPR comparison group, but the home programme was followed over a 5-day period. It is difficult to make direct comparisons to our study, which was limited to those with non-specific neck pain and active upper trapezius trigger points. Also, clinical significance was not investigated.

Fryer and Hodgson[13] did use a sham comparison group in their study of 37 asymptomatic subjects with latent upper trapezius trigger points. They found TrPPR to be superior to sham IC. As there was no IC group and asymptomatic subjects without active upper trapezius trigger points were used, it is difficult to compare their results to our study. Again, clinical significance was not investigated.

Limitations

A factor such as small sample size[29] limits the conclusions regarding non-specific neck pain and upper trapezius TrPs in patients treated with IC. The wide confidence intervals are also probably due to the small sample size. Further, we only examined the short-term effects of IC and TrPPR and post-treatment soreness possibly may have masked any positive effects of treatment. However, we included a *sham control group which also received hands-on* intervention. This strengthens the evidence of clinical effectiveness because the placebo effect, which should not be underestimated,[30] was accounted for. In our study, all measurements were made by a 4th year chiropractic student trained by a chiropractor with 28 years of clinical practice. Insufficient time for practising examination procedures may act as another source of error. The examiner only had three practice sessions before the experiment. It has been established that the reliability of diagnosing TrPs by the use of palpation is acceptable when performed by appropriately trained and experienced clinicians.[31–33]

Conclusions

In patients with non-specific neck pain, a single treatment with IC to an active upper trapezius TrP is superior to SUS. For one patient to improve with a single treatment of IC three patients would have to be treated compared to SUS. A patient treated with IC is five times more likely to improve compared to a patient treated with SUS. Further research is needed to determine if IC is superior to TrPPR.

Competing interests

The authors state they have no competing interests.

Contributions

H.G. and P.M. developed the concept for this research. H.G., P.M. and H.N. designed the study. H.G. and H.N. analysed the data. H.G. wrote the first draft of the manuscript and all authors approved the final version.

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