Intra-rater reliability of an experienced physiotherapist in locating myofascial trigger points in upper trapezius muscle

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Objectives: Myofascial trigger points (MTrPs) are considered the principal clinical feature of myofascial pain syndrome (MPS). An MTrP consists of spot tenderness within a taut band of muscle fibers and its stimulation can produce both local and referred pain. The clinical diagnosis of MPS depends on correct history taking and a physical examination aimed at identifying the presence of MTrP. The purpose of this study was to investigate the intra-rater reliability of a palpation protocol used for locating an MTrP in the upper trapezius muscle.

Methods: Twenty-four subjects with MTrP in the upper trapezius muscle were examined by an experienced physiotherapist. During each of eight experimental sessions, subjects were examined twice in randomized order using a palpation protocol. An anatomical landmark system was defined and the MTrP location established using X and Y values.

Results: The intraclass correlation coefficient $ICC_{(1,1)}$ values were 0.62 (95% CI: 0.30–0.81) for X and 0.81 (95% CI: 0.61–0.91) for Y. The Bland–Altman plots for X and Y showed a mean of difference of 0.04 and –0.2 mm, respectively. Limits of agreement for X ranged from –26.3 to 26.2 mm and for Y from –27 to 26.4 mm.

Discussion: The $ICC_{(1,1)}$ for the observed values revealed a moderate to high correlation and the Bland–Altman analysis showed means of difference very close to zero with narrow limits of agreement. An experienced physiotherapist can reliably identify MTrP locations in upper trapezius muscle using a palpation protocol.

Keywords: Myofascial pain syndromes, Myofascial trigger points, Intra-rater reliability, Palpation, Upper trapezius muscle

Introduction

Myofascial pain syndrome (MPS) is characterized by sensory, motor and autonomic symptoms, and a myofascial trigger point (MTrP) is considered the principal clinical feature.¹ Over the past few decades, MTrPs has received greater attention in the scientific and clinical literature, and a survey by American pain specialists has revealed a general agreement that MPS is a legitimate medical diagnosis.² Since 2005, the International Association for the Study of Pain has included MPS in the *Core Curriculum for the Professional Education in Pain*.³ Epidemiological studies have reported MTrPs in 9% of patients presenting to general internal medicine clinics⁴ and stated that

MTrPs was the primary source of pain in patients admitted to pain medical centres.^{5,6}

The principal authoritative publication on the MTrP diagnostic criteria has been written by Travell and Simons.^{1,7} MTrPs have been described as discrete areas of muscle tenderness presenting in taut bands of muscle, with a diagnosis dependent on a correct history taking confirmed by a physical examination.^{1,8} Three minimum clinical diagnostic criteria have been proposed: indurated bundle of fibres within a muscle, known as taut band (TB); focal hypersensitive and painful point in the TB, called spot tenderness (SP); and referred pain sensation with mechanical stimulation of the SP, known as referred pain (RP).^{1,8,9} An additional six confirmatory features may be present: local twitch response with snapping palpation of the TB, jump sign, patient recognition of the elicited pain (PR), predicted referred pain patterns, muscle

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weakness or muscle tightness, and pain with stretching or contraction of the affected muscle.^{9–11}

A physical examination is used to confirm an MTrP diagnosis, which consists of a palpation protocol that includes manual palpation and the patient's replies to specific questions about painful symptoms. The palpation technique used correctly provides relevant information including the bony location, tissue temperature, and texture. Frequently, specific palpation techniques are used to elicit pain by pressure on affected anatomical structures. These manoeuvres are important for diagnostic clinical reasoning and manual therapy treatments.¹²

Numerous research studies and two systematic reviews^{13,14} have been conducted to investigate the reproducibility of the MTrPs examination for several muscles.^{15–22}

These studies have focused on the reliability of the MTrPs diagnostic criteria and no attention given to the reliability of palpation protocols in identifying the MTrPs exact location. The best reproducibility of the MTrP diagnostic criteria has been reported in the upper trapezius, which is frequently affected by MTrPs, as observed in patients with neck pain and chronic tension-type headaches.^{23–27}

Considering that MTrP treatment requires the same MTrP be located and treated over repeated sessions, the intra-rater reliability of a palpation protocol could be relevant in supporting a clinical practice. The aim of this study was to investigate the intra-rater reliability of a palpation protocol, performed by an experienced physiotherapist, in locating an MTrP in the upper trapezius muscle.

Methods

Experimental sessions were conducted between November and December 2011 in the laboratory of movement analysis at Vita-Salute San Raffaele University, Milan, Italy.

Before the study, the researchers completed training in an MTrP palpation protocol and established a consensus on MTrP diagnostic criteria. *The Trigger Point Manual*¹ was used as the main reference for the MTrP diagnostic criteria. The study was approved by the Internal Ethical Committee. The methodology proposed for this study was developed according to the Quality Appraisal of Reliability Studies Checklist proposed by Lucas et al.²⁸

Subjects

Volunteer subjects ($N=24$, 23 female and 1 male; age: 24 ± 3 years) who suffered from neck/shoulder pain were recruited among students and employees of the San Raffaele Scientific Institute. During the enrollment phase, information regarding the study was provided. All subjects signed a written informed consent form before screening and enrollment. The inclusion criteria

included at least one painful active movement of the cervical spine and at least one painful neck/shoulder event in the last 4 weeks. The exclusion criteria included the following: (1) history of neurological or rheumatic disorders; (2) whiplash in the previous 6 months; (3) the presence of scars or moles in the area of the upper trapezius muscles; (4) pregnancy; (5) clinical depression; and (6) a body mass index of 30 or higher.

In order to ensure unbiased enrolment, a screening procedure was carried out by two blinded physiotherapists 1 day before the collection of data. The purpose of the screening procedure was to verify the presence of at least one clinically relevant MTrP in either the left or right upper trapezius. As proposed by Myburgh et al.¹⁴ a clinically relevant MTrP was defined as a TB of muscle fibers, which when palpated elicited either one or a combination of SP, PR, or RP. Subject enrolment was confirmed when there was agreement between the two physiotherapists.

Procedure

Two physiotherapists performed the screening phase and the experimental procedures. A third physiotherapist (the examiner) with 10 years of clinical experience and with a specialism in the diagnosis and management of MPS, performed the palpation protocol to locate the MTrPs. The examiner attended postgraduate courses on MTrP diagnosis and treatment.

The study consisted of eight experimental sessions, with three subjects in each. Four sessions included subjects with MTrPs in the left and four in the right upper trapezius. Sessions were arranged in two separate rooms in order to avoid the subject's voice recognition by the examiner. Indeed, in the first room, one physiotherapist explained the experimental protocol and drew an anatomical landmark system (ALS) on the subject's shoulder using a surgical pen (Fig. 1). The ALS consisted of a line between the acromial angle (AA) and the spinous process of the seventh cervical vertebra (C7). The distance between AA and C7 (ALS_d) was recorded for all the subjects. In the second room, subjects were seated in front of the examiner who was blindfolded and not allowed to speak. A sheet with pre-set answers was given to each subject and used to reply to the examiner's questions. Each subject was examined twice and the MTrP detected during the first palpatory examination was called MTrP_1, while the second MTrP detected during the second session was called MTrP_2. The subjects were allowed to rest for 10 minutes between the two consecutive examinations and their order was randomized.

Before starting the palpation protocol, the same physiotherapist who had drawn the ALS on the subject's shoulder, placed the examiner's hand on the midpoint of the drawn ALS. After the examiner

Figure 1 A graphical representation of the anatomical landmark system and the two variables, X and Y , used to define the MTrP location on the upper trapezius. AA indicates the acromial angle of the scapula and C7 the spinal process of the seventh cervical vertebra. ALS_d is the distance between C7 and AA. MTrP, myofascial trigger point; AA, acromial angle; C7, spinous process of the seventh vertebrae; ALS_d, distance between AA and C7.

detected the MTrP location, the physiotherapist marked the overlying skin with a single point using the surgical pen. Finally, two values were recorded: (1) the distance between the spinal process of C7 and the intersection point of a perpendicular line from the MTrP to ALS (X value); and (2) the distance between the MTrP and the ALS (Y value).

Both the examiner and subjects were blinded to these measurements.

MTrP palpation protocol

Before each session, the examiner marked a point on the skin of the pad of his middle finger using a surgical pen. The MTrPs were identified through a flat palpation technique using the index, the middle, and the ring finger of the right hand. The SP identified on the TB was used to define the location of the MTrPs on the upper trapezius muscle. Once the examiner confirmed the MTrP location under the middle finger pad, the operator rolled the examiner's middle finger and marked on the skin the contact between the point on the pad and the skin.

The palpation protocol was conducted according to the following steps:

1. palpation over the upper trapezius region to identify one or more TBs and their extension along the muscle fibers;
2. gentle compression of contiguous spots along the detected TB in order to elicit pain and locate accurately the SP. A positive reply from the subject to the question (Is this spot unusually painful?) was used to confirm the presence of SP. In case of more than one painful spot, the question (I will compress two spots, a first one and second one. Please tell me which is the most painful.) was asked;
3. perpendicular progressive and gentle compression on SP to elicit pain and verify the presence of PR. A positive reply to the question (Do you recognize

this pain as a familiar complaint?) was requested to confirm the presence of PR;

4. sustained painful compression (approximately 6 seconds)¹¹ on SP was performed to elicit pain and verify the presence of RP. A positive reply to the question (Does the pain occurs anywhere from the spot that I am compressing? If yes, indicate where according to the anatomical regions reported on the sheet) was requested to confirm the presence of RP.

To answer the examiner's questions, the subjects were asked to point to the sheet with the pre-set answers. The operator communicated the answers to the examiner. A TB with at least one of the following, SP, PR, or RP, was requested to confirm the MTrP presence.

If more than one SP was detected, only that which elicited a familiar pain was considered (PR). If a patient was not able to distinguish between two MTrPs in relation to his familiar pain, the examiner asked to indicate which was the most painful. To avoid adverse effects due to tissue irritation, SP was progressively compressed until the minimal force necessary to elicit pain in the subject.

Analysis

The statistical analysis considered X and Y values in the two examinations performed on the same subject. Intra-rater reliability was examined using intraclass correlation coefficient (ICC)²⁹ and Bland-Altman plots^{30,31} as they have been advocated to be the statistical methods of choice in reliability studies.³² Since reliability of one examiner was analyzed, a single-measure ICC_(1,1) model was applied.³² For the considered variables, the 95% confidence interval of the ICC values was computed.

The criteria used for the interpretation of the ICCs were as follows: 0.00–0.25 indicated little or no correlation; 0.26–0.49 indicated low correlation; 0.50–0.69 indicated moderate correlation; 0.70–0.89 indicated high correlation; and 0.90–1.00 indicated very high correlation.³³ ICC values were not considered clinically useful if under 0.6.²⁹

Bland-Altman plots were provided to give a visual representation of size and range differences between X and Y values. Finally, the distance between MTrP_1 and MTrP_2 was estimated (MTrPs_d). Additionally, a t -test was used to compare the MTrP_d, and the X and Y values in left and right upper trapezius muscles. Statistical analyses were performed using SPSS Version 12.0 (SPSS Inc, Chicago, IL, USA).

Results

All study participants completed the palpation procedures and the locations of MTrP_1 and MTrP_2 were recorded (Table 1). The TB, SP and PR were identified in all subjects while the RP was recorded in nine subjects. The ICC_(1,1) values were 0.62 (95% CI: 0.30–0.81) for X and 0.81 (95% CI: 0.61–0.91) for Y . The

Figure 2 Bland Altman plots showing the intra-rater reliability of the palpation protocol in locating MTrPs in the upper trapezius muscle. *X* and *Y* are variable used to define the MTrP location according to the ALS. The difference of values is plotted against the mean values of for each subject. The middle dotted line shows the mean of difference. The two lines above and below the mean of difference represent the 95% upper and lower limits (two standard deviations). *X1*, *X* value measured during the first palpatory examination; *X2*, *X* value measured during the second palpatory examination; *Y1*, *Y* value measured during the first palpatory examination; *Y2*, *Y* value measured during the second palpatory examination.

Bland–Altman plots are shown in Fig. 2. The values for mean difference were 0.04 mm for *X* and −0.2 mm for *Y*. The standard deviation (SD) of the *X* value's differences was 13.4 mm and the 95% limits of agreement were −26.2–26.3 mm. The SD of *Y* value's differences was 13.6 mm and the 95% limits of agreement were −27–26.4 mm. The mean MTrPs_d was 15 ± 11 mm, and in 19 out of 24 cases, it was less than 20 mm. No statistically significant difference was found between the values of MTrP_d ($P=0.52$) and

between the *X* values ($P=0.25$) of the left and right upper trapezius. However, a statistically significant difference was found for the *Y* values between the left and right upper trapezius ($P<0.001$).

Discussion

During the eight experimental sessions, 24 subjects with MTrPs were examined, 12 MTrPs were located in the left upper trapezius and 12 in the right upper trapezius. Subjects were examined twice in the same

Table 1 MTrP location (MTrP_1 and MTrP_2), with respect to the ALS, in the two examinations for each subject. Mean and standard deviation of distance between MTrP_1 and MTrP_2 are reported in the last column (MTrPs_d). ALS_d indicates the distance between C7 and the acromial angle

Subjects	MTrP side	Session	ALS_d (mm)	MTrP_1		MTrP_2		MTrPs_d (mm)
				<i>X</i> (mm)	<i>Y</i> (mm)	<i>X</i> (mm)	<i>Y</i> (mm)	
1	R	1	214	64	75	51	62	18
2	R		210	69	70	70	70	1
3	R		216	89	32	86	34	4
4	L	2	210	90	8	78	22	18
5	L		192	62	74	67	90	17
6	L		195	75	7	80	9	5
7	R	3	185	95	32	76	32	19
8	R		205	75	35	81	40	8
9	R		195	60	56	76	25	35
10	R	4	220	115	35	80	68	48
11	R		215	78	57	75	65	9
12	R		215	96	39	94	40	2
13	L	5	197	76	22	80	15	8
14	L		203	66	39	77	42	11
15	L		195	91	10	85	11	6
16	L	6	220	98	31	122	12	31
17	L		218	57	5	64	5	7
18	L		193	64	24	65	12	12
19	L	7	205	77	31	88	17	18
20	L		217	70	25	91	26	21
21	L		195	102	13	92	15	10
22	R	8	187	103	56	105	45	11
23	R		200	87	31	94	56	26
24	R		208	86	35	67	36	11
Mean (SD)		...	205 (11)	81 (16)	35 (21)	81 (15)	35 (23)	15 (11)

Note: MTrP, myofascial trigger point; ALS_d, distance between acromial angle and the spinous process of the seventh vertebrae; MTrP_1, myofascial trigger point detected during the first palpatory examination; MTrP_2, myofascial trigger point detected during the second palpatory examination; MTrPs_d, distance between MTrP_1 and MTrP_2.

Figure 3 Locations of MTrP_1 and MTrP_2 for each subject according to the ALS. *X* and *Y* values are normalized with respect to ALS_d. Coloured circles are used to distinguish subjects in left and right ALS. The dotted line joining MTrP_1 and MTrP_2 represent the normalized MTrP_d. MTrPs are located in well-defined area medially to the ALS midpoint and right MTrPs are located in more caudal area ($P<0.001$). ALS, anatomical landmark system; MTrP_1, myofascial trigger point detected during the first palpatory examination; MTrP_2, myofascial trigger point detected during the second palpatory examination; AA, acromioclavicular angle; C7, spinous process of the seventh vertebrae.

session, and the MTrPs locations were defined by an operator measuring *X* and *Y* according to ALS. No statistically significant difference was observed for the MTrP_d ($P=0.52$) in the left or right upper trapezius indicating that the particular side (left or right) does not affect the reliability of the palpation protocol.

The study cohort showed that the MTrPs located medially with respect to the ALS midpoint (Fig. 3), resulted in no statistically significant differences between the *X* values of the left and right upper trapeziuses ($P=0.25$). Interestingly, the *Y* values of the MTrPs showed a statistically significant difference between the left and right sides ($P<0.001$). The MTrPs in the right upper trapezius were clearly located, as shown by the ALS in the more caudal areas (Fig. 3). It is possible to speculate that this finding could be related to different muscular activities between the left and right upper limbs as all the study subjects, except one were right-handed. However, caution should be used in discussing the observed location asymmetry among the MTrPs, as morphological differences between left and right hemibody are frequently observed, and this can affect the comparability of the left and right ALS. Our results showed a well-defined

area for the MTrP location in the upper trapezius region similar to that described by Travell and Simons¹ in their maps.

The ICC for the *X* and *Y* values did not fall under 0.6 suggesting a potential clinical application for the palpation protocol.²⁹ The reliability analysis showed a high correlation for *Y* [$ICC_{(1,1)}=0.81$] and a moderate correlation for *X* [$ICC_{(1,1)}=0.62$].³³

Considering the potential use of the palpation protocol in a clinical setting, further discussion is required concerning the difference that was found in the *X* and *Y* correlations. The *Y* values, according to the ALS, describe the vertical position of the MTrP, and are the first to be identified in accordance with the palpation protocol. The *Y* value can be used to detect the TB in the upper trapezius muscle. The TB is considered the only specific feature of MTrP, and it is an objective sign. With regard to the muscle fibres direction, the indurated muscle bundles are palpated by snapping the bundles vertically. In the upper trapezius muscle, this procedure can be applied in optimal conditions as the muscle fibers run approximately horizontal and parallel to the skin's surface.³⁴ A recent study³⁵ using an innovative ultrasound

imaging technique, described the TB in upper trapezius as an elliptical shape with a size of $0.16 \pm 0.11 \text{ cm}^2$; thus, it can be reasonably palpated using fingers. A recent systematic review on the reliability of a physical examination for MTrP diagnosis reported kappa scores for TB ranging from -0.08 to 0.75 .¹³ This inconsistent reliability was attributed to the anatomy of the different muscles and the lack of appropriate training for the examiners.

The ICC scores for the X values, which indicate the horizontal location of the MTrPs, were considerably lower. The X values were defined by detecting the SP along the TB, and they should be considered as a subjective sign as related to the pain provocation of the palpation procedure. The SP of an MTrP is described as a highly localized hyperalgesia on TB, but no information is available on how pressure pain threshold is distributed around the MTrP. In addition, it was located by eliciting pain using the middle finger which had a fingerprint on skin of approximately 1.5 cm^2 . However, this potential error is limited by the palpation protocol that explicitly requires the examiner to elicit pain only by increasing pressure on the TBs. Finally, the greater range of the X axis compared with that of the Y could potentially result in a lower reliability. These factors could explain the difference in the reliability between the X and Y values.

The Bland–Altman plots support the reliability of the MTrP palpation protocol by showing that the mean of the difference was close to zero for both X and Y . The limits of agreement were from 26 to -23.2 mm for X (Fig. 2A) and from 26.2 to -29.6 mm for Y (Fig. 2B). They indicated both an acceptable error range and error size for the 24 MTrP palpation procedures, especially if we consider the area explored by the examiner, an area that extended horizontally for $205 \pm 11 \text{ mm}$.

In the examples where the results of Y are high, the Bland–Altman plot shows a lower reliability (Fig. 2B). This suggests that palpation reliability in the upper trapezius region decreases as compared with the inferiorly located MTrPs, though this remains speculative due to the small number of cases in this study. The clinical relevance of the observed error is limited, and it should not influence standard treatment techniques, such as ischemic compression, ultrasound, or dry needling.^{24,36–38}

The present study is the first to look at the intra-rater reliability of a palpation protocol for locating an active MTrP in the upper trapezius region, and the only known one to follow the Quality Appraisal of Reliability Studies Checklist²⁸ guidelines. This was ensured by the examiner being blinded to the clinical information and to any additional cues that could have influenced the outcomes. Similar results have been reported in a study focusing on the clinical

precision among four clinicians in detecting a latent MTrP in the trapezius muscle.³⁹ The precision in that study was around 5 mm in the mediolateral, superior-inferior, and anteroposterior directions. It is important to consider that the reliability of the investigated palpation protocol could be improved if applied in a clinical setting, where the examiner can benefit with visual contact and be in direct verbal communication with the patient. In order to prevent bias, this was not the case in our study.

Limitations

This study presents a few limitations that need to be acknowledged. First, we are aware that we did not check the pressure applied by the examiner on the spots of the TB that elicited the pain. Thus, it was not possible to confirm that the subjects' responses to the painful stimuli were due to the pressure on the SP, rather than overpressure on a TB point. Also, we cannot exclude that the first palpatory examination of the MTrP may have influenced the sensitivity of the MTrP during the second examination.

Second, the possibility of a selection bias cannot be completely ruled out due to the procedure used for enrolling and screening the study subjects. Subjects were selected among volunteers with neck/shoulder complaints, and both operators had to agree on the presence of an MTrP before a patient could be enrolled. This procedure could have selected subjects with MTrPs showing a lower pain threshold; thus, it is not possible to compare our results with subjects having MTrPs with a higher pain threshold, such as that found with latent MTrPs. We noticed that, in a few occasions, subjects reported a difficulty in comparing pain elicited by pressure applied to contiguous spots on TB. Finally, our results cannot be generalized to inexperienced physiotherapists.

Conclusion

The findings of this study suggest that an experienced physiotherapist using the MTrP palpation protocol can reliably locate a MTrP in the upper trapezius muscle. Further research is required to investigate the inter-rater reliability, and to associate our results both to different muscles and to physiotherapists with less experience.

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