Anatomical Basis of the Myofascial Trigger Points of the Trapezius Muscle

Bases Anatómicas de los Puntos de Gatillo Miofasciales del Músculo Trapecio

Flávia Emi Akamatsu; Samir Saleh; Henrique Trombini Pinesi; Katarina Reichmann Rodrigues; Cintia Benedicto Zandoná; Mauro Andrade & Alfredo Luiz Jacomo

INTRODUCTION

Myofascial pain syndrome (MPS) is the most frequent cause of chronic musculoskeletal pain (Chen et al., 2008; Ge et al., 2008; Hong, 2000; Huguenin, 2004; Simons et al., 2005; White & Harth, 2001) with estimates of world-wide prevalence ranging from 0.5% to 5.0% (Harden et al., 2000; Gran, 2003; White & Harth). MPS is defined as a focal hyperirritability in muscle tissue (Ferández-de-las-Peñas et al., 2010). This syndrome presents clinically as referred pain (Ge et al., 2009), a limited range of motion in joints (Harden et al.) and a local twitch response following mechanical stimulation of certain muscular and fascial areas, known as myofascial trigger points (MTP) (Simons et al., 2005), and is associated with motor endplates (Chu, 1995). The chronic pain diagnostic taxonomy published by the International Association for the Study of Pain provides no specific criteria for the diagnosis of MPS; rather, it offers a note that the "diagnosis depends upon the demonstration of a trigger point (tender point) and reproduction of pain by maneuvers which place stress upon proximal structures or nerve roots (Merskey & Bogduk, 1994). The lack of a formal, widely accepted, criterion-based diagnostic scheme has proved to be a serious impediment to proper diagnosis, clinical communication and research related to this topic (Simons et al., 1999).

Four different MTP related to motor innervation have been clinically described for the trapezius muscle (Simons et al., 1999), but data showing anatomical correlations are still lacking (Fumal & Schoenen, 2008; Sciotti et al., 2001). The complex physiopathology of MTPs is not yet fully understood, but it is theoretically based on the presence and activity of MTP (Hong; Huguenin).

MTP are clinically identified by palpation of a knot or a taut band of muscle or fascia that elicits local tenderness and referred pain (Hong; Lavelle et al., 2007;
Simons et al., 2002; Simons et al., 2005). Electrophysiological analyses have been published suggesting that an MTP occurs when a nociceptor and a muscular motor endplate coincide (Chu; Karakurum et al., 2001; Simons, 2001; Simons et al., 2002; Tollison et al., 2002). Nevertheless, the lack of anatomical information about these structures constitutes a major obstacle to obtaining a complete understanding of the physiopathology and widespread clinical treatment of MTP.

MATERIAL AND METHOD

Twelve human adult cadavers (6 male and 6 female) were dissected to expose the accessory nerve, with its spinal fibers, which innervate the trapezius muscle. The cadavers were previously prepared using a 4% phenolic acid and 0.5% formaldehyde solution. The cadavers were obtained from a body donation program undertaken by the Discipline of Human Structural Topography of the Department of Surgery of the University of São Paulo Medical School, and this study was approved by the Ethics Committee on Research of the University of São Paulo Medical School under protocol 130/11. Specimens without signs of previous surgery or other severe abnormalities in regions of interest were accepted. The specimens were positioned in ventral decubitus on the dissection table, and a long incision down the spine was made starting from the external occipital protuberance and continuing to the T12 level. Next, flaps of skin and subcutaneous tissue were pulled away laterally to expose the trapezius muscles from both sides. We cut through the attachment of the trapezius to the spines of the vertebrae and then folded the muscle laterally, without damaging the underlying neurovasculature. The spinal accessory nerve arises in the neck through the jugular foramen, descends along the cervical region under the sternocleidomastoid muscle and reflects to the posterior triangle of the neck in the distal third of that muscle, reaching the shoulder where it extends its first branch to the trapezius muscle, which we designated MTP1. This denomination is also employed in clinical settings and corresponds to the anatomical location described in the specimens dissected in this study. Photographic documentation was obtained from these nervous structures. Dissections to identify the exact point where fibers from the spinal accessory nerve enter the trapezius muscle were extremely difficult because of the intricate relationship among the nerve fibers, fascia and fat (Fig. 1). The dissections usually required 3 to 4 periods of 4 hours of careful work under magnifying lenses to thoroughly study the specimens.

RESULTS

We observed in all of the cadavers that the nerve fibers reached the muscle and tendon in areas coincident with the clinical locations of MTPs described by Simons (Chu; Simons; Simons et al., 2002; Simons et al., 2005).

All four MTPs located in the muscle belly in all cadavers and both insertional MTPs were identified as entry points of the spinal accessory nerve into the trapezius muscle and tendon. The locations of the entry points coincided with the clinical area of MTPs. Variation was observed in two MTPs; point 3 presented two nervous entry points, designated MTP 3 and MTP 3.1, and point 5 presented three different patterns, designated MTP5, MTP5.1 and MTP5.2. MTP1 was situated in the intermediate part of the anterior margin of the upper part of the muscle, as described previously (Figs. 1 and 2). MTP2 was located distal and slightly lateral to the previous MTP (Figs. 1 and 2). MTP3 corresponded to entry points on the margin of medial fibers near the inferior margin of the muscle, and two nerve branches were found in this region in all specimens (Figs. 1 and 2).

Table I. Anatomical location of the MTPs in 12 cadavers (insertional MTPs were not listed).

<table>
<thead>
<tr>
<th>Trigger Point</th>
<th>Specimens 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12/Left and Right Side</th>
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<tbody>
<tr>
<td>MTP1</td>
<td>Intermediate part of the anterior margin of the upper part of the muscle near the vertical fibers of the muscle attached to clavicle.</td>
</tr>
<tr>
<td>MTP2</td>
<td>Distal and slightly lateral to the MTP1.</td>
</tr>
<tr>
<td>MTP3</td>
<td>Medial to the scapula and on the margin of medial fibers near the inferior margin of the muscle.</td>
</tr>
<tr>
<td>MTP3.1</td>
<td>Medial fibers near the inferior margin of the muscle, medial to MTP3; nervous branch always smaller than MTP3 branch.</td>
</tr>
<tr>
<td>MTP5</td>
<td>Medial to the scapula in the intermediate part of the muscle belly.</td>
</tr>
<tr>
<td>MTP5.1</td>
<td>Medial to the scapula in the intermediate part of the muscle belly inferior to MT5.</td>
</tr>
<tr>
<td>MTP5.2</td>
<td>Medial to the scapula in the intermediate part of the muscle belly inferior to MTP5.1.</td>
</tr>
</tbody>
</table>

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Similarly, MTP5, located in the intermediate part of the muscle belly, presented three different nerve entries (Figs. 1 and 2). The insertional MTP 4 and 6 corresponded to the muscle insertions in the spine of the scapula and acromion (Fig. 2). This was a constant pattern observed in our dissection for all cadavers (Table 1).
DISCUSSION

Myofascial trigger points are considered to represent a pathogenic model of pain from diverse etiologies (Hong & Hsueh, 1996). MTPs, or muscle knots, are a type of electrically active, hyperirritable areas of muscle associated with contractile nodules and dysfunctional motor endplates, known as MTPcentral (MTPC) (Simons et al., 2005). Theoretically, a sensitive spot may be found anywhere in the skeletal muscle but is usually found near the motor endplates (Basmajian & De Luca, 1985; Hong & Hsueh; Lavelle et al.; Simons et al., 2002; Simons et al., 2005). MTP can be either active, causing painful disorders, or latent, causing pain only when stimulated (Ge et al., 2008, 2009; Simons et al., 2005). Clinical identification is the most commonly used technique to locate MTP, and both needle and surface electromyography have been described for research purposes (Huguenin; Lavelle et al.; Sciotti et al.). Knowledge of the anatomical location of these structures is essential not only to provide a correct diagnosis but also because many therapeutic modalities include a direct approach of the affected area (Chen et al.; Fernández-de-las-Peñas et al.; Hong; Hsueh et al., 1997; Lavelle et al.; Merskey & Bogduk; Olavi et al., 1989; Simons et al., 2005; Strandling, 2008). Some painful cervical and thoracic disorders are related to trigger points in the trapezius muscle, and misdiagnosis of these conditions is common when the putative responsible MTP are not adequately evaluated (White & Harth).

The trapezius muscle covers the posterior aspect of the neck and the superior part of the thorax and attaches the upper limb to the skull and vertebrae. Its fibers are divided according to their orientation into superior, intermediate, and inferior fibers, each of which exhibits a different action. The superior fibers have their origin in the superior nuchal line and external occipital protuberance and reach the lateral portion of the clavicle. The intermediate fibers retract the scapula and originate from the spinous processes of the 7th cervical to the 3rd thoracic vertebra and insert on the acromion. These fibers represent the strongest portion of the muscle. The last portion, represented by the inferior fibers, depresses the scapula and lowers the shoulder. Its fibers have their origin in most thoracic spinous processes and insert along the spine of the scapula (Moore & Dalley, 2010; Strandling). MTP are related to the trapezius muscle (Strandling). Four points are located in the muscle belly of the trapezius: (1) the mid-portion of the superior margin, extending into the vertical fibers that reach the clavicle; (2) caudal and lateral to the first point, in the transverse fibers of the muscle; (3) the medial fibers near the inferior margin of the muscle; and (4) the central part of the muscle belly between the C7-T3 levels. Two additional MTP are found on the tendinous insertion: (1) over the medial part of the spine on the scapula; and (2) on the acromial insertion of the trapezius muscle. There is another MTP superficially located on the posterior aspect of the middle part of the clavicle.

According to Simons et al. (2005), and we found the same, MTP1 of the trapezius muscle is found over the medial anterior margin of the muscle in its superior portion and concerns the most vertical fibers attached to the clavicle. MTP2 is caudal and slightly lateral to MTP1. MTP3 and 5 were easier to identify in our cadavers; MTP3 was located near the inferior margin of the muscle in its inferior fibers of the muscle, showing two insertion points (Figs. 1 and 2); and MTP5, as expected from its clinical pattern, was found in several different areas, but with three insertion points (Figs. 1 and 2) rather than only one insertion point as observed clinically, all belonging to the intermediate portion of the muscle. Despite the variations observed in points 3 and 5, it is possible that the clinical localization of the MTP to a single area is due to the anatomical proximity of these different nervous entry points, thus resulting in somewhat overlapping electromyographic identification. Therefore, if there is one MTP3 and one MTP5 that are clinically relevant, we can state that these MTP correspond to two and three motor plates, respectively. Our hypothesis was that MTP could be related to muscle innervation; therefore, this anatomical study was based on the dissection of adult cadavers to observe where branches of the spinal accessory nerve entered the muscle belly and whether there was a positive correlation with MTP. As for the trapezius muscle, two additional MTP corresponding to its tendinous insertion can also be responsible for painful disorders, although there is no relation to the end motor plates. MTP 4 and 6 were also observed in our studies, and no anatomical variation was detected. MTP4 was found on the medial aspect of the spine of the scapula and MTP6 on the acromion, both of which are sites of tendinous insertion of the trapezius muscle (Fig. 1).

We believe that knowledge of the anatomical basis of MTP is a cornerstone that will help provide a precise map for clinical applications related to certain painful disorders and that further investigation of trigger points in other muscles is needed.
RESUMEN: El objetivo de este estudio fue correlacionar los sitios de entrada de los ramos del nervio accesorio en el músculo trapecio con placas motoras y los puntos de gatillo miofasciales. A pesar de las correlaciones anatómofuncionales que se constituyen en la principal característica de los puntos de gatillo, no hay informes en la literatura describiendo sobre la distribución de los ramos del nervio accesorio y su relación anatómica con los puntos de gatillo. Ambos músculos trapecio de doce cadáveres adultos fueron descritos por los autores (profesores de anatomía y estudiantes de postgrado en Medicina) para observar el punto exacto donde los ramos del nervio accesorio espinal penetraban en el vientre muscular. La disección se llevó a cabo respetando las capas estratigráficas para preservar la correlación anatomoclínica entre la rama del nervio accesorio y los puntos de gatillo miofasciales. A pesar de las correlaciones anatomoclínicas se constituyen como la rama del nervio accesorio y los puntos de gatillo miofasciales, y eran comunes a todos los cadáveres. Esta correlación anatomoclínica entre la rama neuronal y el punto de gatillo puede proporcionar una base para un abordaje diagnóstico y terapéutico racional para estos trastornos.

PALABRAS CLAVE: Puntos gatillo; Músculo trapecio; Anatomía; Nervio; Miofascial.

REFERENCES


Simons, D. G.; Travell, J. G. & Simons, L. S. Myofascial Pain and...


Correspondence to:
Flávia Emi Akamatsu
Rua Alexandre Dumas 1410, ap. 154
Chácara Santo Antonio
Santo Amaro
CEP:04717003
São Paulo
BRAZIL

Phone: 55 11 30618277

Email: flaea@usp.br

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