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Evidence – The intraoral palpability of the lateral pterygoid muscle – A prospective study

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ABSTRACT

The intraoral palpability of the inferior caput of the lateral pterygoid muscle has been a matter of ambiguity because of its topography. Thus, none of the recently published studies has provided reliable proof of the possibility of digital intraoral palpation, although palpation of the muscle is part of most of the examination catalogs for clinical functional analysis and functional therapy.

Digital muscle palpation was performed intraorally on five preparations after exposure of the infratemporal fossa and visualization of the lateral pterygoid muscle. Direct digital palpation of the lateral pterygoid muscle was seen in all five cases. The successful palpation was carried out and approved during laterotrusion to the examined side (relaxation). While opening and closing the mouth (contraction) the muscle is palpable. In real-time kinematic measurements (MRI) an impression of the lateral caput of the left lateral pterygoid muscle of a 30-year-old control male person was found up to 6 mm. Electromyographic detection by direct signal conduction with concomitant palpation is possible. The injection electrode tested in situ in the muscle was felt transorally with the palpating finger.

The intraoral palpability of the inferior caput of the lateral pterygoid muscle is verified. The basic requirement for successfully palpating the lateral pterygoid muscle is the exact knowledge of muscle topography and the intraoral palpation pathway. After documented palpation of the muscle belly in cadaverous preparations, MRI and EMG also visualized palpation of the lateral pterygoid muscle in vivo. The palpation technique seems to be essential and basically feasible.

1. Introduction

The intraoral palpability of the inferior caput of the lateral pterygoid muscle is part of most of the examination catalogs for clinical functional analysis and functional therapy (Ahlers, 2011; Bumann and Lotzmann, 2000; Reichert and Stelzenmüller, 2008; Stelzenmüller and Wiesner, 2004, 2010) and the lateral pterygoid muscle is one of the muscles of the jaw that causes the most pain (Ahlers, 2011; Bumann and Lotzmann, 2000; Reichert and Stelzenmüller, 2008; Stelzenmüller and Wiesner, 2004, 2010). To treat this muscle it must be ensured that the digital palpation of the quality of muscular tissue, the assessment of pain, and the following functional massage is possible (Reichert and Stelzenmüller, 2008). However, none of the recently published studies has provided reliable proof of the possibility of digital intraoral palpation.

Discussions about the possibility of intraoral palpability of the inferior pterygoid muscle began in 1966/1971, starting with Krogh-Poulson's study “the movement analysis” (Krogh-Poulsen, 1971; Schumacher, 1997). The intraoral palpability has been questionable because of its topography (Stratmann et al., 2000; Tuerp and Minagi, 2001). It is important to answer this question, because the lateral pterygoid muscle is one of the “key-muscles” (Ahlers, 2011; Bou-Atme et al., 2005; Bumann and Lotzmann, 2000; Murray et al., 2004; Okeson, 1996, 2003; Reichert and Stelzenmüller, 2008; Schindler et al., 2006; Stelzenmüller et al., 2004; Stelzenmüller and Wiesner, 2004, 2010) for the treatment of craniomandibular disorders (McNeill, 1983) (CMD). In the USA and UK, CDN and

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Australia using the term temporomandibular disorders (Okeson, 1995; Posselt, 1971; Thompson, 1964) (TMD) is more useful. TMD/CMD symptoms arise in the head/jaw/face (Ahlers, 2011; Bou-Atme et al., 2005; Bumann and Lotzmann, 2000; Murray et al., 2004; Okeson, 1996, 2003; Reichert and Stelzenmüller, 2008; Schindler et al., 2006; Stelzenmüller et al., 2004; Stelzenmüller and Wiesner, 2004, 2010). Literally, this describes the suboptimal functioning of the cranium (condylar path on the skull) and the mandible (the head[s] of the lower jaw) joint partners (Reichert and Stelzenmüller, 2008). The term temporomandibular joint disorder (TMD) is more commonly used in English. It describes the suboptimal functioning of the head of the mandible (including the articular disk located in the joint) and the temporal bone more precisely and names the bones that contribute anatomically to the temporomandibular joint (TMJ). A TMJ never moves alone and the interaction with the contralateral joint must always be considered. Many of these craniomandibular symptoms present themselves in different types of headache or as ear, tooth, jaw, or face pain. This frequently involves "referred pain" arising from structures such as muscular trigger points (where pain is projected from sections of the muscle into other regions). In addition to the systematic subjective and objective assessments, precise palpation of the muscles and, as much as possible, the articular structures, is of importance.

Disorders of the temporomandibular joints are characterized as temporomandibular dysfunction (TMD) (Okeson, 1995; Posselt, 1971; Thompson, 1964), craniomandibular dysfunction (CMD) (McNeill, 1983) or as orofacial pain (Okeson, 1995, 1996). According to Mayer et al., 2007, the hyperactive, pressure-sensitive masticatory, head, and maxillofacial muscular systems are significant correlates of neuromuscular incoordination or craniomandibular dysfunction, not the occlusal problems.

The significance of digital palpability is that the muscle structure and pain sensation can be determined by digital palpation in manual functional diagnosis and subsequently treated by functional massage (opening and closing the mouth during digital palpation) (Reichert and Stelzenmüller, 2008; Stelzenmueller, 2013; Stelzenmüller et al., 2004; Stelzenmüller and Wiesner, 2004, 2010).

The biomechanics of the TMJ enable movement in all three spatial axes (vertical, transverse, sagittal). Mandibular movements are never purely translational and also never purely rotational (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006).

The main movements in the mandible are:

- Elevation and depression (opening and closing the mouth).
- Protrusion and retrusion (translation movement of the mandible anteriorly and posteriorly).
- Lateral and medial deviation (movement of the mandible to the side away from or toward the median plane) (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006).

The rotational–translational movement pattern at the TMJ is flowing, but is described in three phases hereinafter to make the complex biomechanics easier to understand (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006). Mouth opening: Presented simply, mouth opening involves rotation initiated by the pull of the lateral pterygoid and the suprahyoid muscles and controlled by the mouth closure muscles that decelerate movement (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006).

In phase 1 (first phase of rotation), the condyles in the inferior compartment rotate slightly. This movement is initiated by the pull of the lateral pterygoid and the suprahyoid muscles and acts to overcome the occlusion of the teeth. This causes the head of the mandible to briefly rotate anteriorly. Following the mobile joint socket "principle," the articular disk ideally moves in an anterior direction along the condylar path similar to the operation of a pasta machine. Its movement is decelerated by the superior stratum of the bilaminar zone, the posterior fibers of the temporalis muscle, and the lateral ligament (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006).

The inferior stratum, secured onto the condyle, relaxes. The first phase flows into phase 2, in which more gliding occurs at the head of the mandible. The lateral pterygoid muscle pulls the disk, acting as a mobile joint socket, in an inferoanteromedial direction beneath the articular tubercle. This is also defined as protrusion. This movement is produced by the pull of the lateral pterygoid, assisted and controlled by the muscles mentioned above, and is essentially decelerated by the superior stratum of the bilaminar zone, the posterior fibers of temporalis, and the lateral ligament (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006).

To open the mouth as widely as possible, the condyles must rotate once again at the end of the condylar path in phase 3 (second phase of rotation). The disk has been pulled underneath the articular tubercle in the second phase and is now "pulled along" anteriorly, as the head of the mandible rotates, and is pulled up onto the articular tubercle with the assistance of the lateral pterygoid muscle and the above-mentioned muscles (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006). Only then, can the mouth open up fully by further rotating. The movement of the disk is decelerated again by the superior stratum of the bilaminar zone. The inferior stratum, secured onto the condyle, is now placed under tension (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006).

The superior head of the lateral pterygoid muscle originates on the infratemporal crest of the sphenoid bone. The inferior head comes from the lateral plate of the pterygoid process. The superior head is attached to the articular disk, pulls the disk anteriorly, and initiates mouth opening. The inferior head inserts into the condylar process of the mandible (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006). When acting alone, it displaces the lower jaw to the contralateral side (medial deviation). When the two inferior heads act together, they move the lower jaw anteriorly (protrusion) (Benninghoff, 2004; Reichert and Stelzenmüller, 2008; Schumacher, 1997; Schünke et al., 2006). The kinematics initiated by the lateral pterygoid muscle continue with the suprahyoid muscles. Recent studies (Schindler et al., 2006) have shown that the lateral pterygoid muscle is involved in almost all movements of the TMJ in one way or another. The lateral pterygoid muscle is one of the muscles of the jaw that causes the most pain (Stelzenmüller and Wiesner, 2004, 2010). The function is protrusion and abduction (bilateral activity) and mediotrusion (unilateral activity).

The aim of this study is to show "reliable proof" of the intraoral palpability of the inferior caput of the lateral pterygoid muscle by palpation of the muscle belly in cadaverous preparations, magnetic resonance imaging (MRI) and electromyography (EMG).

The research questions of this study are:

- Is it possible to visualize, document and objectively evaluate the intraoral palpability of the lateral pterygoid muscle?
- Can the effects of intraoral palpability of the lateral pterygoid muscle be evaluated by anatomical preparations?
- Can the effects of intraoral palpability of the lateral pterygoid muscle be evaluated by magnetic resonance imaging (MRI)?
- Can the effects of intraoral palpability of the lateral pterygoid muscle be evaluated by electromyography (EMG)?

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