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Macroscopy and light microscopy of the discomallear ligament passing through the petrotympanic fissure in human fetuses

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SUMMARY

In light of the controversy reported in previous studies, we conducted this study with the objective of using macroscopy and light microscopy to elucidate the morphology of the discomallear ligament and detail its topographic relationship with other fibrous structures of the temporomandibular joint (TMJ). Two human fetuses with 36 and 37 weeks of intrauterine life were used. Bundles of longitudinal fibers crossed the petrotympanic fissure forming a single ligament. Microscopic analysis of laminae from the discomallear and anterior malleolar ligament region showed that their insertion into the malleus is a region common to both ligaments. Therefore, these findings suggest that the discomallear and anterior malleolar ligaments could be distinct portions (anterior and superior) of the same ligament. Additionally, we propose the inclusion of these ligaments in future editions of the international anatomic nomenclature.

Key words: Temporomandibular joint – Joint capsule – Fetus

INTRODUCTION

The temporomandibular joint (TMJ) is a synovial joint of the ellipsoid type, consisting of the temporal bones and the mandible; it has a joint capsule, an articular disc, a synovial membrane, ligaments, and mastication muscles (Williams et al., 2000; Zarb et al., 2000).

The joint surfaces are covered by a fibrous, avascular connective tissue: the articular disc. This disc divides the joint into two distinct compartments: a superior one, between the temporal bone and the joint disc, and an inferior one, between the joint disc and the mandible (Gardner et al., 1988; Okeson, 1992; Latarjet and Ruiz Liard, 1993).

A fibrous joint capsule is present around the joint, inserted in the joint tubercle, in the squamotympanic fissure, and in the margins of the mandibular fossa, involving the head of the mandible before its inferior insertion in the periosteum of the mandibular condylar process (Mérida-Velasco et al., 1993).

The joint capsule delimits the joint cavity and the articular disc divides the joint cavity into two compartments: the upper and lower chambers. The joint capsule is supported by

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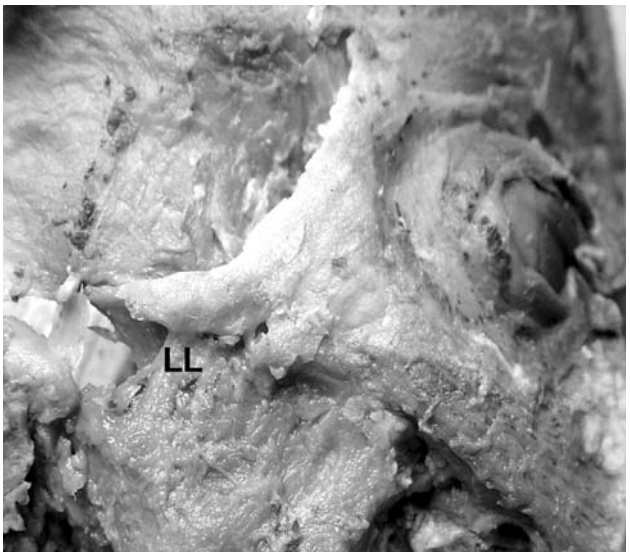

Fig. 1. Macroscopic lateral view of the TMJ of a human fetus of 36 weeks of age. LL: lateral ligament.

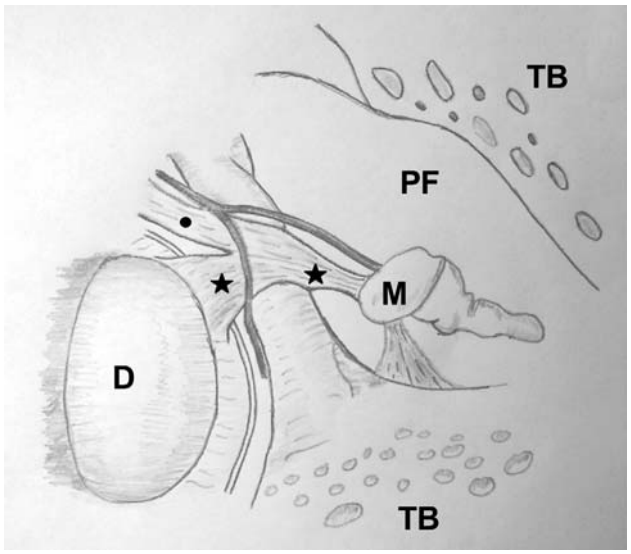

Fig. 2. Diagram with the topographical relations of the ligaments discomallear (★) and sphenomandibular (●). The temporal bone (TB), malleus bone (M), articular disc (D), and petrotympanic fissure (PF) can be observed.

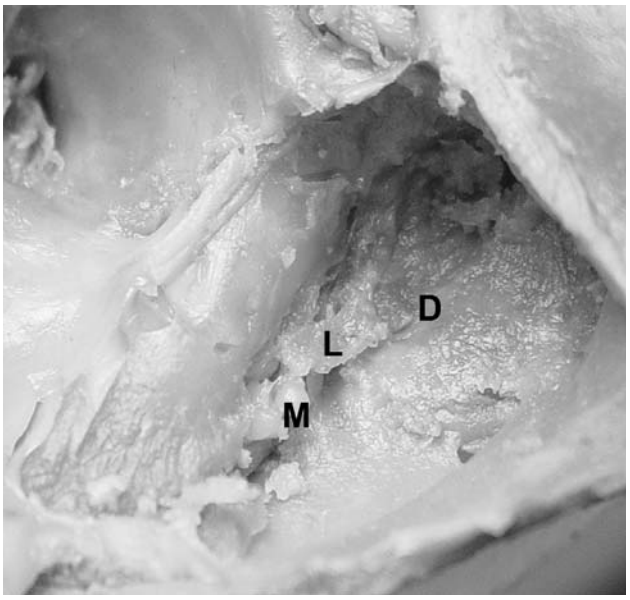

Fig. 3. Macroscopic superior view of the discomallear ligament of the TMJ of a human fetus of 36 weeks of age showing the malleus bone (M), discomallear ligament (L) and articular disc (D).

ligaments; these are inelastic collagen structures that restrict and limit joint movements (Mérida-Velasco et al., 1993).

There is controversy in literature regarding the TMJ ligaments and the location of their proximal and distal fixation points (Pinto, 1962; Toledo Filho et al., 1985; Loughner et al., 1989; Ogutcen-Toller, 1995; Rodríguez-Vazquez et al., 1998; Kim et al., 2004).

The most widely described functional ligament associated with the TMJ is the lateral ligament (temporomandibular) (Figure 1), whose shape resembles a trapezium. This ligament is located in the lateral wall of the joint capsule and projects itself posteroinferiorly, until it connects with the lateral aspect of the articular tubercle of the temporal bone and then all the way to the posterior aspect of the mandibular neck (Amor et al., 1998; Savalle, 1998; Zarb et al., 2000).

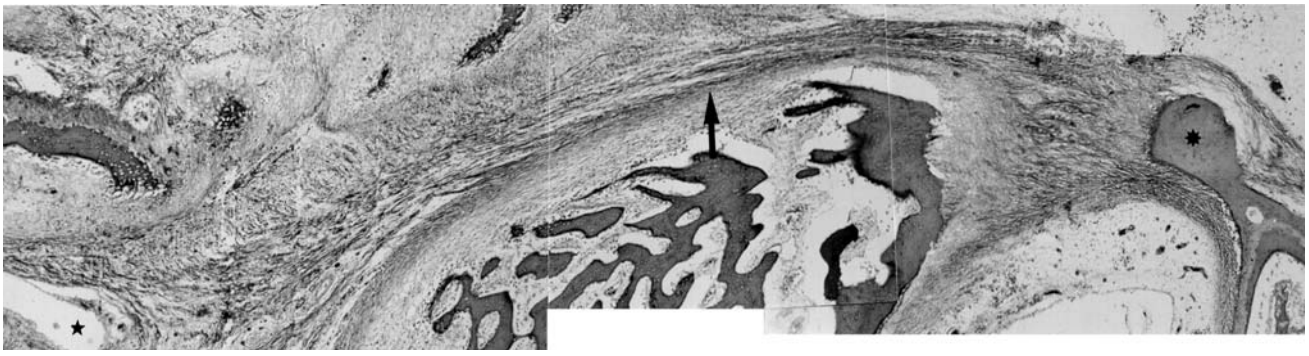

Fig. 4. Photomicrograph of the TMJ of the human fetus, with 37 weeks of age, stained with Trichrome of NMC (Castro and Camargo, 1951). The malleus bone in the tympanic cavity (✱), supradiscal articular space of the posterior region of the TMJ (★), and the discomallear ligament (→) can be observed. x 130.

The stylomandibular ligament, a specialized bundle of the deep cervical fascia, passes superiorly from the styloid process to the posterior edge of the mandible at the angle. This ligament may be considered exclusively accessory for the joint and its function is still uncertain (Williams et al., 2000).

For Rodriguez-Vasquez et al. (1998), the sphenomandibular ligament (Fig. 2) penetrates the middle ear through the petrotympanic fissure, passing above and behind it in two portions: one portion beside the temporomandibular joint and the other inside the middle ear, where it inserts itself in the neck and in the anterior process of the malleus and continues until the tympanic portion.

Another ligament described in literature involved with the temporomandibular joint is the discomallear ligament (anterior malleolar ligament, discomalleolar or tiny ligament) (Fig. 2). Pinto (1962) reported finding a ligament within the neck of the malleus, immediately below the anterior process of the malleus, inserting itself in the middle posterosuperior part of the joint capsule and articular disc of this joint.

The objective of this study was to elucidate the morphology of the discomallear ligament using macroscopy and light microscopy and detail its topographic relationship with the other fibrous structures of the temporomandibular joint.

Material and Methods

The material consisted of two human fetuses obtained from the collection of the Federal University of São Paulo - Paulista School of Medicine. The ages of the fetuses were determined by measuring the distance between the skull vertex to the midpoint between the apices of the buttocks – the Crown-rump length (CRL) – and were found to correspond to gestational ages of 36 and 37 weeks (340 and 350 mm respectively, given by the chart associating CRL and fetal age, according to Sadler, 2005). The fetuses were fixed in a 10% formalin solution.

The fetus with a gestational age of 36 weeks was used for the macroscopic study. The temporomandibular joint (TMJ) regions were dissected with the aid of the surgical microscope D.F. Vasconcellos M900™. The skin and subcutaneous tissue were removed exposing the masseter fascia, masseter muscle, lateral ligament, joint capsule, temporal fascia and temporal muscle. The dura mater was removed through the middle cranial fossa. The squamous portion of the temporal bone and the greater wing of the sphenoid bone were then removed, exposing the temporal fascia and muscle, lateral pterygoid muscle and periosteum of the upper surface of the mandibular fossa. The piece was then dissected to analyze the discomallear ligament. The TMJ was sectioned and examined under a surgical microscope.

The fetus with a gestational age of 37 weeks was used for the light microscopy study. The previously fixed sample was rinsed with distilled water, dehydrated in ethanol at 75% and absolute, discolored in xylol and embedded in paraffin. Slices with a width of 4 µm were obtained with a Leica, model RM2035™ microtome. Once mounted on glass slides, the slices were stained with HE and Trichrome of NMC (Castro and Camargo, 1951) and covered with a coverslip.

The research was approved by the Research Ethics Committee from the Federal University of São Paulo School of Medicine, protocol number 329/01.

Results

In our study, we were able to observe the petrotympanic fissure, the TMJ and the middle ear cavity with the malleus in development (Fig. 1). Macroscopy and light microscopy revealed longitudinal fiber bundles crossing the petrotympanic fissure between the articular disc and the malleus, forming the discomallear ligament (Figs. 3 and 4). Some of the fibers that originated in the malleus extended frontward, attaching themselves to the temporal bone; the ones extending to the TMJ presented partial insertions on the margins of the petrotympanic fissure after a short course and ended in the posterior region of the articular disc.

Discussion

In this study, the samples used made it possible to observe the morphology of the discomallear ligament during its embryonic development and its topographic relationship with adjacent structures using light microscopy.

This fibrous structure originates in Meckel's cartilage but its function is still under dis-

cussion. Given its insertions along the petrotympanic fissure observed in this study, this ligament would not be capable of pulling the malleus during articular disc movements of the TMJ (Rodriguez-Vázquez et al., 1993; Ögutcen-Toller et al., 1995).

The literature reports studies that describe the so-called Costen's syndrome, with the occurrence of symptoms associated with the TMJ and the middle ear. In his study, Pinto (1962), who pioneered the description of a structure he named "tiny ligament," reported the occurrence of symptoms in the regions mentioned and their possible relationship with the movement made by this ligament. The "tiny ligament" was found connecting the neck and the anterior process of the malleus to the middle posterosuperior part of the joint capsule of the TMJ, the articular disc, and the sphenomandibular ligament.

Rodriguez-Vazquez et al. (1993) and Kim et al. (2004) observed the movement of the malleus in response to the traction of the anterior malleolar ligament in five samples. In light of the results found in these studies, the authors proposed that middle ear symptoms (like buzzing and pressure) may be caused by the stretching of the anterior malleolar ligament during mandibular movements. However, given the fact that the movements of this ligament occur more freely when the adjacent bone structures are removed in dissection, it would not be appropriate to conclude that malleus movement is promoted by this ligament based exclusively on anatomical observations.

Analysis of the slices by light microscopy allows us to conclude that the discomallear and anterior malleolar ligaments constitute a single ligament. This ligament would consist of two portions, an anterior portion, projecting from the superolateral portion of the malleus head to the temporal bone, and a superior portion, projecting from the superolateral portion of the malleus head, passing through the petrotympanic fissure and inserting itself in the posterosuperior portion of the articular disc of the TMJ.

The slices obtained revealed the presence of a region common to both portions of the discomallear and anterior malleolar ligaments. This region lies anterior to the malleus and microscopic analysis suggests that these ligaments would have a common insertion point and, possibly, a common function.

For Rodriguez-Vazquez et al. (1993), the discomallear ligament could be considered an intrinsic ligament of the TMJ given its origin, morphology and anatomical arrangement. Therefore, it can be distinguished from the tympanic portion of the sphenomandibular or anterior malleolar ligaments, constituting a single ligament.

Most authors state that the anterior discomallear ligament is continuous with the sphenomandibular ligament (Toledo Filho et al., 1985; Rodriguez-Vazquez et al., 1993; Ogütcen-Toller, 1995).

Ogutcen-Toller (1995) reported that, in adults, the posterior fixation of the articular disc of the TMJ, known as the bilaminar zone and corresponding to the discomallear band during the fetal period, connects the tendon of the lateral pterygoid muscle to the malleus through the squamotympanic fissure.

In our study, microscopic analysis of the slices in the discomallear and anterior malleolar ligament region revealed a region common to these two ligaments at their insertion in the malleus. A loose connective tissue region was also observed, corresponding to the bilaminar zone in the adult, where the discomallear ligament or the superior portion of a single ligament would insert.

The results obtained in this study are in agreement with those of others, pointing toward the need for new studies to elucidate the morphology of these ligaments and determine a more adequate nomenclature, since these ligaments are not listed in the current Anatomical Terminology elaborated by the Federative Committee on Anatomical Terminology (FCAT).

In a future edition of the FCAT, we suggest that the term "mallear ligament" as being formed by two portions: anterior and superior.

Conclusions

Microscopic analysis of the slices allows suggests that the discomallear and anterior malleolar ligaments constitute a single ligament formed by a superior and an anterior portion, respectively.

Functionally, there seems to be a common action of the two ligaments, since they share a common insertion in the malleus. The action of this ligament on the malleus is debatable since this was an anatomical study and did not consider functional aspects.

Studies designed to assess both the morphology and physiology of this ligament are necessary in order to elucidate the existing divergences.

References

Amor FB, Carpentier P, Foucart JM and Menier (1998). Anatomic and mechanical properties of the lateral disc attachment of the temporomandibular joint. *J Oral Maxillofacial Surg*, 56: 1164-1167.

Castro NM and Camargo JS (1951). *Coloração policrômica de cortes histológicos*. *An Fac Farm Odontol Univ São Paulo*, 9: 211-215.

Gardner E, Gray D and O'Rrahilly R (1988). *Anatomia - Estudo Regional do Corpo Humano.* Guanabara Koogan, Rio de Janeiro.

Kim HJ, Jung HS, Kwak HH, Shim KS, HU KS, Park HW, Park HD and Chung IH (2004). The discomallear ligament and the anterior ligament of malleus: An anatomic study in human adults and fetuses. *Surg Radiol Anat*, 26: 39-45.

Latarjet M and Ruiz-Liard A (1993). *Anatomia Humana*. Panamericana, São Paulo.

Loughner BA, Larkin LH and Mahan PE (1989). Discomallear and anterior malleolar ligaments: possible causes of middle ear damage during temporomandibular joint surgery. *Oral Surg Oral Pathol*, 68: 14-22.

Mérida-Velasco JF, Rodríguez-Vázquez FR and Jiménez-Collado J (1993). The relationships between the temporomandibular joint disc and related masticatory muscles in humans. *J Oral Maxillofac Surg*, 51: 390-395.

Ögutcen-Toller M (1995). The morphogenesis of the human discomallear and sphenomandibular ligaments. *J Craniomaxillo-Facial Surgery*, 23: 42-46.

Okeson JP (1992). *Fundamentos de Oclusão e Desordens Temporomandibulares.* Artes Médicas, São Paulo.

Pinto OF (1962). A new structure related to the temporomandibular joint and middle ear. *J Pros Den*, 12: 95-103.

Rodríquez-Vázquez JF, Mérida-Velasco JR and Jiménez-Collado J (1993). Relationships between the temporomandibular joint and the middle ear in human fetuses. *J Dent Res*, 72: 62-66.

Rodríguez-Vázquez JF, Mérida-Velasco JR, Mérida-Velasco JA and Jiménez-Collado J (1998). Anatomical considerations on the discomallear ligament. *J Anat*, 192: 617-621.

Sadler TW (2005). *Langman: Embriologia Médica.* Guanabara Koogan, Rio de Janeiro, pp 63.

Savalle WPM (1998). Some aspects of the morphology of the human temporomandibular joint capsule. *Acta Anat*, 131: 292-296.

Toledo Filho JP, Zorzetto NL and Navarro JAC (1985). Structures and relationships of the anterior malleus ligament. *Anat Anz*, 158: 13-22.

Williams PL, Warwick R, Dyson M and Bannister LH (2000). *Gray Anatomia*. Guanabara Koogan, Rio de Janeiro.

Zarb G, Carlsson G, Sessle BJ and Mohl ND (2000). *Disfunções da articulação temporomandibular e dos músculos da mastigação.* Livraria Editora Santos, São Paulo, pp 48.