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LITERATURE REVIEW

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Clinical and morphofunctional aspects of pterygoid hamulus: literature review

Aspectos clínicos e morfofuncionais do hamulo pterigóideo: revisão de literatura

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ABSTRACT

The understanding on the pterygoid hamulus (PH) and its anatomical and functional relationship with neighboring structures is of utmost importance to conduct assertive, differential diagnosis and for the prevention of diseases in the region.This study aimed to review the literature on the anatomical and functional PH features, a bone structure sometimes neglected by the dentist. Also, the main pathologies occurring in HP are reported. PH relates with many anatomical elements of the cranium and face involved in a varied physiological processes such as speech and swallowing. The alteration of PH alterations and neighboring structures may cause symptoms similar to other craniofacial disorders hindering the correct diagnosis. PH may be involved in pathologies that should be included in the differential diagnosis from any craniofacial disorders.

KEYWORDS

Pterygoid hamulus; Pterygoid hamulus syndrome; Bursitis pterygoid hamulus; Anatomy.

RESUMO

O entendimento sobre a hâmulo pterigóideo (PH) e suas relações anatômicas e funcionais com estruturas vizinhas é de extrema importância para conduzir um diagnóstico diferencial assertivo e para a prevenção de doenças na região. Esse estudo teve como objetivo revisar a literatura sobre as características anatômicas e funcionais do PH, uma estrutura óssea, por vezes negligenciada pelo dentista. Além disso, as principais patologias que ocorrem no PH são relatados. PH relaciona-se com muitos elementos anatômicos do crânio e da face e está envolvido em uma variada processos fisiológicos como a fala e deglutição. Alterações no PH podem se refletir em de alterações nas estruturas vizinhas promovendo sintomas semelhantes a outros distúrbios craniofaciais dificultando o diagnóstico correto. PH pode estar envolvido em patologias que devem ser incluídas no diagnóstico diferencial de quaisquer desordens craniofaciais.

PALAVRAS-CHAVE

Hâmulo Pterigóideo; Síndrome Hâmulo Pterigóideo; Bursite do Hâmulo Pterigóideo; Anatomia.

INTRODUCTION

The dentist's knowledge on the pterygoid hamulus (PH) and understanding of its anatomical and functional relationship with neighboring structures is of utmost importance to conduct assertive, differential diagnosis and for the prevention of diseases in the oropharyngeal region (Figure 1 and 2).

PH is a process located in the medial plate of the pterygoid process of the sphenoid bone serving mainly of support point of the tensor muscle of the soft palate functioning as a reflection pulley, and of fixing the pterygomandibular ligament [1]. In this ligament, which extends to the retromolar triangle, the buccinator muscle and the superior constrictor muscle of the pharynx are fixed [1]. A portion of palatopharyngeus muscle and also

has its origin in PH [2]. The tensor muscle of the palatine veil tightens the palate and opens the Eustachian tube during speech, swallowing, chewing, breathing, sneezing and yawning [2].

The changes of PH or related structures can cause symptoms common to other diseases, for example pain when chewing or swallowing, edema and erythema in the posterior region of the palate [3,4] as well as ear pain, hearing loss and autophonia [5]. These lesions can be misled with temporomandibular disorders or glossopharyngeal neuralgia [6]. Other symptoms may also include snoring and sleep apnea [7].

Thus, this study aimed to review the literature, reporting the morphology of PH and structures which it relates as well as addresses the function of these elements, emphasizing the changes in which they can be involved. Therefore, the inclusion of such changes in the differential diagnosis of diseases that may affect the PH region are highlighted.

Anatomical and functional aspects of the pterygoid hamulus and related structures

The pterygoid hamulus (PH) is a tapered process located at lower end of the posterior edge of the medial plate of the pterygoid process of the sphenoid bone [1,8,9]. In the posterior edge of that plate, the cartilaginous part of the Eustachian tube is inserted, the pharyngobasilar fascia and the superior constrictor muscle of the pharynx [9].

Despite the variable morphology, PH usually has a spherical end, denominated head, attached to the rest of the process by a narrow neck. A shallow groove can be seen on the PH lateral side extending from the base toward the cervix. In adult skulls, the average length of 7.2 mm, the average width of 1.4 mm in the sagittal plane and 2.3 mm in the transverse plane were found. The distance between the hamulus ranged from 26 to 36.9 mm. In children, the PH features have the same morphology, although smaller [8].

Krmpotic-Nemanic et al. [7] studying PH morphology found an average length of 6. 9 mm, results similar to those of Putz and Kroyer [8]. The authors noted that in children PH is smaller (3.6 mm), as well as in the elderly, although less significantly, but in these patients, the mean length of PH was 5 mm, concluding that PH morphology changes with age. Orhan et al. [6] evaluating the PH morphology through CBCT scans and their results showed that the average length of PH was 5.48 mm on the right and 5.40 mm on the left side.

Figure 1 - Lower view of the skull showing the pterygoid hamulus (arrow).

Figure 2 - Lateral view of the pterygoid hamulus and its proximity to the posterior region of maxilla.

PH serves as fixation for pterygomandibular ligament and for several muscles, such as the tensor muscle of the palatine veil that in addition to using PH as reflection pulley, also comes from this process and the superior constrictor muscle of the pharynx, among others [8].

PH has primarily served as support point of the palatine veil of the tensor muscle functioning as a reflection pulley. The tensor muscle of the palatine veil comes from the scaphoid fossa extending to the soft palate. During its path, it bypasses the pterygoid hamulus, narrowing at that point (Figure 3). To bypass it changes its direction, initially vertical, to become a horizontal tendon plate that meets the opposite side constituting the palatine aponeurosis [1].

Certain anatomical features of the tensor muscle of the palatine veil are not yet defined and have been investigated [10]. In relation to its origin, the authors cite the scaphoid fossa [1,10], the spine of the sphenoid [7,10] and the Eustachian tube [5,7,10,11]. Some authors observed a fixation of the tensor muscle of the palatine veil in PH [8,12]. This fixation has not been found in other studies that claim to be the PH an exclusively reflection pulley [10,11].

The Eustachian tube communicates the nasopharynx to the tympanic cavity. Its function is to equalize the air pressure of the external environment and the air contained within the tympanic cavity. The two anterior-medial thirds are cartilaginous and the posterolateral third is bone. The cartilaginous portion is located in a groove between the petrous part of the temporal bone and the greater wing of the sphenoid. The Eustachian tube is laterally related to the tensor muscle of the palatine veil, mandibular nerve and the middle meningeal artery. Laterally, is related to the elevator muscle of the palatine veil and the pharyngeal recess. The cartilaginous portion opens during swallowing and yawning, preventing a pressure increase in the middle ear. The opening mechanism of the tube, if either passive or muscular, is not yet fully understood. It is believed that if the mechanism is muscular, the muscle activity is the tensor muscle of the palatine veil [9].

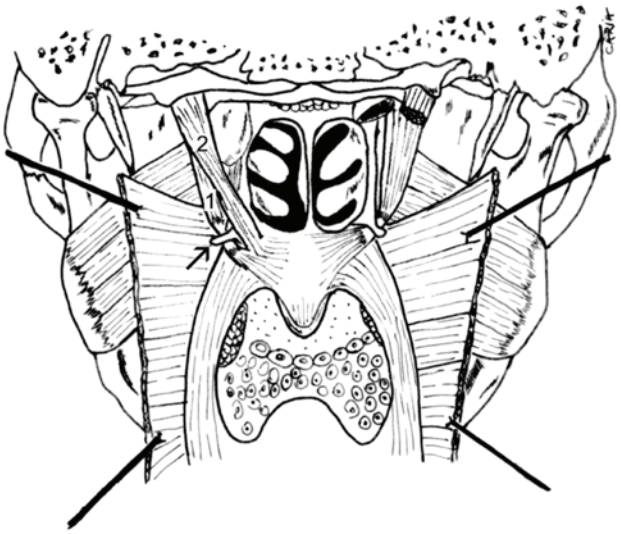

Figure 3 - Posterior view of the tensor (1) and elevator (2) muscles of the palatine veil and its relationship with PH (arrow).

So the complacency of the Eustachian tube depends on the tensor muscle of the palatine veil, whose peculiarity is its fixation as a "spider's web" in the skull base, between the pterygoid process and the spine of the sphenoid, having PH as one of its support points [13].

Between PH and the tensor muscle of the palatine veil, sometimes a synovial bursa can be found [8]. This synovial bursa, located inside the PH groove, allows the sliding of the tendon of the tensor muscle of the palatine veil [7]. Such synovial bursa can be observed in human embryos at eight weeks [10]. However, Abe et al. [11] reported not finding any saccular structure covered by epithelium or a space compatible with the bursa around the tensor muscle of the palatine veil. The same results were found by Barsoumian et al. [12] which found no evidence of the presence of the bursa in their study. Putz and Kroyer [8] observed the bursa occasionally. Kronman et al. [14] observed the presence of a bursa during the surgical treatment of a patient with osteophyte in PH. Initially Gray [15] described a synovial membrane surrounding the tendon of the tensor muscle of the palatine veil which was later associated with a bursa [12].

The pterygomandibular ligament, also called oropharyngeal raphe, extends laterally and downward from PH to the temporal crest, behind the third molar. It represents a tendon insertion separating the buccinator muscle from the superior constrictor muscle of the pharynx [16]. The pterygomandibular ligament is of fundamental importance for the movement of the pharynx. It is believed that this ligament fixation associated with the impact of mechanical stresses due to chewing and swallowing has been related to the increase in PH length in adults. The opposite was observed in infants and the elderly, whose PHs feature is short and massive, especially in edentulous elderly in whom the reduction of the chewing effort promotes a PH shortening [7].

The medial plate of the pterygoid process, the PH, the pterygomandibular ligament and the insertion of the ligament in the mandible form a network for insertion of the muscles that perform the constriction and elevation of the pharynx. Only after PH reaches the proper length and the pterygomandibular ligament is firmly adhered to it and to the mandible, the superior constrictor muscle of the pharynx may act accordingly.

The position, length and inclination of PH exerts an important influence on the function of several muscles as the tensor muscle of the palatine veil, the palate-pharyngeal and the top of the superior constrictor muscle of the pharynx (pterygoid-pharynx fascia). These muscles are responsible for separation of the nasal cavity and the mouth during sucking and swallowing. This separation is performed by raising the soft palate through the constriction of the elevator muscle of the palatine veil, the tubal part of the tensor muscle of the palatine veil, the contraction of the pterygoid-pharynx fascia of the superior constrictor muscle of the pharynx and by increasing the palatine aponeurosis by the tensor muscle of the palatine veil [7].

The superior constrictor muscle of the pharynx originates in PH, and fix in the pterygomandibular raphe, posterior ending of the milo-hyoid line and the lateral side of the tongue [9,17,18].

According to Putz and Kroyer [8] the buccinator muscle and the medial pterygoid muscle also use PH for fixing their fibers.

Clinical Considerations

The PH is reference in the differential diagnosis of palatine injuries. Professionals should include it in clinical cases with pain in the palate region without conclusive diagnosis [19]. The most common symptom associated with changes in PH is local pain [4,14,20], when chewing or swallowing, associated with digital pressure or when the tongue is applied in this area. Clinically, the presence of edema and erythema occurs at the site [4]. According to Ramirez et al. [2] PH palpation is done manually and orally or through a blunt instrument, by palpating carefully until reaching the posterior and medial part of the maxillary tuberosity.

In addition to local pain, signs and symptoms include pain in the palate and jaw, ear and throat pain and difficulty in swallowing [21]. Still, earache, autophonia, sore throat, taste changes, jaw pain, toothache, retro-orbital pain, headache and sensitivity changes such as burning, paresthesia and hypoesthesia have been cited [2]. Kronman et al. [14] reported a case in which the patient had an osteophyte in the PH region and pain in the mandible, maxilla, and neck, headache, autophonia feeling, pressure in the eyes and TMJ disorders, among others. The authors do not disagree on the symptoms, since all remain linked.

Among the diseases that can involve PH, the bursitis of the pterygoid hamulus is highlighted. The bursa located on the PH groove, responsible for the sliding of the tensor muscle of the palatine veil [7], can be affected by an inflammatory process so-called bursitis of the pterygoid hamulus [21] or bursitis of the tensor muscle of the palatine veil [14]. It is a pathological condition that is often mistaken

by temporomandibular disorders (TMD), impacted tooth, trigeminal or glossopharyngeal neuralgia, calcification of stylohyoid ligament, inflammation of the stylomandibular ligament, tumors, cysts, herpes simplex infections and otitis [22]. For differential diagnosis, the clinician must carefully examine the palate and pharyngeal region and consider the diagnosis of hamular bursitis aiming to provide the patients with the appropriate treatment [23].

The etiology of this disease is diverse and is not fully understood, which can be caused by trauma in the region [2,21], ill-fitting dentures, undergoing intubation, swallowing of large masses [21], bulimic patients, those who suffered sex abuse [2,21] and related to the presence of osteophytes in PH [14]. Elongated PH may predispose to this condition [2,20,24].

The PH stretching can interfere with the contraction function of the tensor muscle of the palatine veil causing bursitis or fibrosis due to excessive pressure in the palatal aponeurosis. This condition may stimulate greater and lesser palatine nerves, glossopharyngeal and facial, resulting in painful sensation on the palate, pharynx and areas of the face, head and neck [20]. Sasaki et al. [20] reported a case in which the patient had pain in the oropharynx and burning sensation in the soft and hard palate, as well as bilateral swellings of the soft palate in the posterior region of the maxillary tuberosity. In computed tomography, PH was elongated. No other changes in tissue were noted. After anesthesia and resection of HP, the pain ceased, confirming the diagnosis of the syndrome of elongated PH.

Hertz [25] reported the case of an edentulous patient with elongated PH and painful condition, ulceration, edema and erythema at the distal surface of the tuberosity of the maxilla. The adopted treatment was surgical resection and osteotomy of 4 mm from PH.

In addition to the elongated PH, other anatomical features may be related to the pathogenesis of PH injuries such as: a) medial plate of the pterygoid process, consequently PH, may have a lower location than expected in relation to palate b) the mucosa of the soft palate can be located closer to PH than normal; c) even the mucosa of the soft palate can be thinner than normal [4].

The average PH length is 7.2 mm [8]. Among the cases of elongated PH reported in the literature, Orhan et al. [6] cite a PH of 10.9 mm in length, while Sasaki et al. [20] reported a case which PH measured 13 mm.

The treatment of this condition may be conservative or surgical [2,14,20,21]. In the conservative treatment, the trauma source must be removed associated with a soft diet and local anti-inflammatory infiltration with prior anesthesia. The post-infiltration anti-inflammatory systemic medication should be prescribed. After two weeks the local infiltration can be repeated if the pain persists, however, according to the authors, this situation is not frequent.

When conservative treatment is not effective, surgery may be used to remove bone spurs or fibrosis in the bursa. If no such changes occur, careful partial resection of PH should be carried out, since the tensor muscle of the palatine veil is the structure involved. [20].

Orhan et al. [6] reported the case of a patient with pain, swelling and burning sensation in the soft palate and pharynx, related to a traumatic extraction of right maxillary third molar. After the confirmation of elongated PH by cone beam computed tomography, anesthetic infiltration was performed and by the ending of the symptoms, the final diagnosis was hamular pain.

Kronman et al. [14] reported the case of a patient with history of aggression in the face and head for twenty years and a recent fall trauma. Clinical examination revealed a mass in the PH region, which, when pressed caused burning sensation in the hard palate and tingling on the cheek beneath the eye on the same side.

The surgical removal of the fibrous tissue and osteophytes from PH was performed.

The authors agree regarding to the technique used for the diagnosis, based on the anesthetic infiltration on the PH site. The disappearance of symptoms confirms the diagnosis of hamular bursitis [2,14,20,21].

DuPont and Brown [3] evaluated the comorbidity of temporomandibular joint disorders (TMD) and painful conditions in the PH area, once these conditions have common symptoms. The tactile and visual inspection of PH area can be useful for diagnostic conclusion.

Snoring and sleep apnea are symptoms that may also be associated with PH changes. The distance between the ending of PH, the slope of these processes and the hard palate width difference are responsible for the degree of the palatine aponeurosis tension. If the PH remains short, as in the newborns, the superior constrictor muscle of the pharynx will not have adequate support and the contraction leads to a narrowing of the upper part of the pharynx, causing the snoring and sleep apnea [7].

During surgical interventions in third molars, the movement with distal pressure can cause the PH fracture, resulting in looseness of the soft palate on the side of fracture and consequent dysphonia and dysphagia due to the path of the tensor muscle of the soft palate that surrounds the PH [1] (Figure 1).

Snah and Bridgman [26] failure of the opening of the Eustachian tube, was reported to be a sequel after the maxillary tuberosity fracture with consequent disruption of PH and tensor muscle of the palatine veil, and trismus by injury of the pterygoid muscles and ligaments.

The study of the effects of craniomaxillofacial surgeries in the auditory tube shows that chronic disorders of the middle ear of patients with cleft depend on the integrity of PH and tensor muscle of the palatine veil after the surgical repair of the cleft. Thus, the PH and the tensor muscle of the palatine veil must be preserved during veloplasty [13].

In individuals with cleft palate, the tensor muscle of the palatine veil may present variations in the insertion sites, usually fixing on the points lateral to the cleft, such as the maxillary tuberosity and the lower portion of the pterygoid process, including PH. The hamulotomy is a surgical procedure used to obtain enough tissue to close the cleft palate. Therefore, in these patients the tensor muscle of the palatine veil tendon can become loose. Thus, one seeks to preserve the maxilla insertions so that the function of expander the Eustachian tube is maintained [11].

During the palate repair surgery for in patients with cleft lip and palate, some surgeons perform the fracture of PH and move the tensor muscle the palatine veil aiming at decreasing the stress on the region avoiding the occurrence of dehiscence. However, the PH fracture as surgical maneuver in palatoplasty is not recommended by Kane et al. [27], since none advantage was demonstrated, although no deleterious effect was observed. However, Chaudhuri and Bowen-Jones [28] demonstrated that the palatoplasty with PH fracture did not influence on the deafness of children, but improved the quality of speech, since it reduces nasal air escape with the best palatine sealing.

The knowledge of PH morphology as well as its functional importance and possible pathologies involved is of fundamental relevance to the dentist and other health professionals such as otorhinolaryngologists. In order to relieve the painful symptoms of the patient, the clinician must include the PH changes among the diagnostic hypotheses of craniofacial disorders.

CONCLUSIONS

Based on the literature it can be concluded that PH is anatomically and functionally related to the relevant structures of the stomatognathic system and participates in various processes

such as speech, swallowing and opening of the Eustachian tube. The PH and associated structures may be involved in inflammatory or traumatic changes predominantly, and the knowledge of the morphology is essential for the correct diagnosis of these pathologies.

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