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Artigo Original

Anatomical study of the pterygoalar bridge and the foramen crotaphitico-buccinatorius in dry skulls

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ABSTRACT

The pterygoalar ligament is an intrinsic ligament of the sphenoid bone located at the base of the skull that establishes syntopy with several structures. The ossification of this ligament results in the formation of the pterygoalar bridge and the crotaphytic-bucinatory foramen, it constitutes an important inconstant structure of the infratemporal fossa for clinical purposes. The present work aims to the topographic and morphometric description of the complete formation of the pterygoalar bridge and its prevalence, addressing the clinical implications of this formation. Twenty dry skulls of adult individuals from both sexes were analyzed, identifying the formation of the complete pterygoalar bridge on the right side in 10% of the samples with variation in the diameters of the bucinatory crotaphytic foramen. These findings disagree with the predominant data in the literature regarding the frequency, side and age of formation and may contribute to the understanding of the pathological processes associated with this region, since the formation of these bridges is directly related to neuralgias of compressive origin, with motor repercussions and sensory. These results point to the need for further studies on these bone formations and their clinical importance.

Keywords: Pterygoalar ligament; Infratemporal fossa; Skull base; Anatomy.

INTRODUCTION

The pterygoalar ligament is a dense band of connective tissue that constitutes one of the intrinsic ligaments of the sphenoid bone and it extends from the base of the lateral lamina of the pterygoid process to the inferior surface of the greater wing of the sphenoid bone [1].

The ligament may exhibit progressive ossification that results in the formation of a complete or incomplete bone bridge. When ossification is complete, it originates a bone bridge called the pterygoalar bridge, which delimits a foramen, the crotaphytic-bucinatory foramen or Hyrtl's foramen [2, 3].

This bone bridge commonly interposes on the median plane of the foramen ovale or laterally to it, separating the branches of the mandibular nerve and potentially promoting its compression. The buccal nerve, the masseteric nerve and the nerve to the lateral pterygoid muscle cross the crotaphytic-bucinatorium foramen and laterally pass the pterygoalar bridge in the plane of the maxillary artery, while the inferior alveolar nerve and the lingual nerve pass medially [2].

The etiology of ossification of these ligaments is still little known, however the literature points to the phenotypic manifestation after generations of absence, due to the non-expression of certain genes involved with this variation [4, 5] and according to some authors, it constitutes a late process, directly age-related [2].

Ligament ossification, incomplete or complete, has great clinical importance associated with the understanding of compressive mechanisms of nervous and vascular structures, chewing disorders, facial pain and salivation disorders [3, 4, 6, 7]. Likewise, the presence of these formations can constitute a mechanical obstacle for surgical access and therapeutic interventions in the retropharyngeal and parapharyngeal space, and to the mandibular nerve and trigeminal ganglion in the treatment of trigeminal neuralgias [4, 7, 8].

Within this perspective, the present study seeks to provide subsidies for understanding the anatomy of the complete ossification of the pterygoalar ligament, its topography and morphometry, considering its clinical importance.

MATERIALS AND METHODS

Twenty dried human skulls of adult individuals from both sexes, belonging to the collection of the Didactic Laboratory of Human Anatomy of the School of Medicine (EC Opinion: 2,486,815) were analyzed.

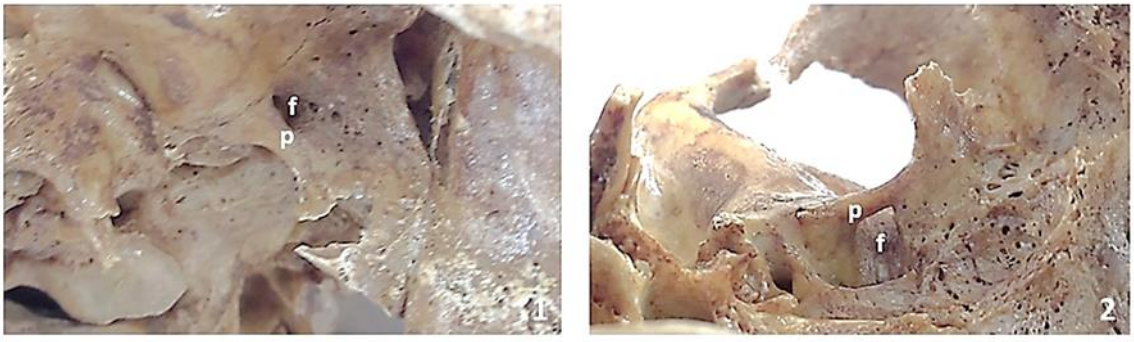
The samples with formation of the pterygoalar bridge were submitted to morphometry using a Mitutoyo ® digital caliper, in which measurements of the total length of the bone bridge, its width, as well as the dimension of the crotaditic-bucinatory foramen were obtained. The identification of the sex and ethnic group of the samples followed the criteria established by White and Folkens, 2005 [9].

The photographic record of the material was carried out with a Sony digital camera, Super Shot model, 9.1 mega pixels, optical zoom 15.

RESULTS

The complete ossification of the pterygoalar ligament was found in 10% of the samples, constituting a pterygoalar bridge from the lateral margin of the lateral lamina of the pterygoid process to the lower face of the greater wing of the sphenoid bone and with the formation of the crotaphytic-bucinatory foramen, according to the Type III according to the Classification of Gualdames, Matamala and Smith, 2010 [8] for the bone bridges of the infratemporal fossa (Figures 1 and 2).

Figure 1. Lateral aspect of total ossification of the pterygoalar ligament present on the right side of the skull, with formation of the pterygoalar bridge (p) and crotaphytic-bucinatory foramen (f), classification Type III; **Figure 2.** Medial face, right side, of the same sample.



Credit source: Author data, 2023

The first skull was identified as a male, Negroid, aged approximately 40 years old. It presents a pterygoalar bridge on the right side, with formation of the crotaphytic-bucinatory foramen. The bone bridge had dimensions of 16 mm in length and 3 mm in width, and the crotaphytic-bucinator foramen had a greater diameter equal to 6.6 mm and a smaller diameter equal to 4.5 mm.

The second skull was identified as a male, Caucasian, aged approximately 30 years old, with a pterygoalar bridge on the right side measuring 18 mm in length and 5 mm in width. The crotaphytic-bucinatory foramen had a larger diameter equal to 5.6 mm and a smaller diameter equal to 1.4 mm**.**

DISCUSSION

The ossification of the pterygoalar ligament may be incomplete or complete, unilateral or bilateral. Several studies have revealed that incomplete ossification of the ligament is prevalent and the presence of a unilateral pterygoalar bridge is more common than the bilateral one [4, 8]. In our analysis, only the unilateral formation was observed, with a complete bone bridge.

Recent studies based on dry skulls sampled from the Brazilian population [8] revealed that, among 312 skulls studied, a total of 116 skulls

presented some type of alteration and concluded that the most frequent variation was the presence of incomplete ossification of the pterygoalar ligament.

Skrzat, Walocha and Srodek, 2005 [10], found the presence of the pterygoalar bridge with the crotaphytic-bucinatory foramen in 7.1% of the 70 skulls evaluated.

The study conducted by Daimi, Siddigui and Gill, 2011 [11] with 90 dry skulls of adult individuals revealed the presence of the complete pterygoalar bridge and the presence of the crotaphytic-bucinatorium foramen in 7.77% of the samples and bilaterally in only 1.11%, showing thus, the unilateral presence of the pterygoalar pons is more common than the bilateral one.

Natsis et al., 2013 [2] report the presence of the pterygoalar ligament fully ossified in 4.1% and partially ossified in 27.6%, revealing a lower frequency of complete ossification, as well as in the study by Pękala et al., 2017 [12], the pterygoalar ligament completely ossified was found in 4.4% of the skulls and partially ossified in 8.4% of the skulls, evidencing the predominance of incomplete ossification.

According to Ryu et al., 2016 [13], the complete ossification of the pterygoalar ligament was found in only 2.8% of the skulls and incomplete ossification in 5.6% of the skulls. Our data reveal a higher prevalence (10%) than that reported in the literature [6, 13], considering the sample size restriction employed in the present study.

Despite the agreement regarding unilaterality, our observations differ from Kamath and Vasantha, 2014 [3] and Pękala et al., 2017 [12] regarding the presence of ossification on the left side and that they are consistent with similar studies [2, 4, 6], confirming the prevalence in males, on the right side, with equal distribution according to ethnicity.

Some works point out that the process of ossification and formation of the pterygo-alar bridge would be correlated with the progression of age [2, 14]. However, in the present study, both samples with pterygo-alar bridge are observed in adult men up to the 4th decade of life, which suggests that the role of factors other than age as promoters of ossification of the pterygoalar ligament and formation of the bone bridge. Nastis et al., 2013 [2] point to a prevalence of incomplete ossification of 97.5% for this age group, which demonstrates the atypical presentation of the reported variation.

There is, therefore, no direct correspondence between the data obtained in the present study and the morphological patterns of the pterygoalar bridge presented in previous studies, evidencing the variability of this formation within human populations.

The clinical repercussions of ossification of the pterygoalar ligament include impairment of the functions of the auriculotemporal nerve, the chorda tympani, chewing disorders, pain and numbness in the buccal region and tongue, and salivary alterations in the parotid gland, which may even obliterate the foramen ovale [2, 3].

In our study, the morphometric analysis of the crotaphytic-bucinatory foramen revealed significant narrowing of the foramen in one of the samples (1.4 mm), which would potentially offer greater restriction to the passage of the buccal and masseteric nerves with possible

compression. Considering the pathogenesis of trigeminal neuralgia, in 20% of cases it is the result of factors other than classical nerve or vascular compression, and may be correlated with ossification of the pterygoalar ligament [4].

Likewise, the presence of an ossified pterygoalar ligament can result in iatrogenic injuries, and it is important to use appropriate techniques that allow the diagnosis and establishment of safe therapeutic approaches, with alternative access routes [15].

Therefore, knowledge of the variation in the topography of the infratemporal fossa is of great importance for interventions carried out by oral and maxillofacial surgeons, neurosurgeons and anesthesiologists, in addition to enabling a better understanding of the complex neuralgias of this region [3], some of them associated with asymmetry of the skull base, specifically the foramen ovale [16].

CONCLUSION

According to our results, we can conclude that the findings do not correspond in their entirety to the data presented in the literature, and thus provide subsidy for expanding the discussion about the anatomical variation and its clinical implications, considering the restrictions imposed by the size of the analyzed sample.

In addition, the formation of the pterygoalar bridge in the skulls of young adults suggests the action of other factors as ossification promoters, and not essentially aging, as pointed out in the literature.

For that reason, prior study of the topography of the skull base when approaching the patient as an individual should be pointed out as a consistent element for a greater understanding of the pathological processes that develops in the infratemporal fossa, as well as in the safe planning of therapeutic interventions for the same region.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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