COMPLETE AND INCOMPLETE BONY BRIDGES NEAR FORAMEN OVALE WITH POTENTIAL SURGICAL AND CLINICAL IMPLICATIONS

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ABSTRACT

Objectives: Pterygospinous or Pterygoalar ligaments may pose mandibular nerve compression by when present near foramen ovale. The presence of ossified pterygospinous or pterygoalar ligaments might cause trouble to surgeons in performing percutaneous rhizotomy for trigeminal neuralgia, electroencephalographic procedures, or taking biopsy from cavernous sinus tumors. The present study aims to find the incidence and specific morphological variations related to the ossification of pterygospinous and pterygoalar ligaments.

Methods: The study was conducted on 200 dried adult human cadaveric skull of unknown age and sex in the department of Anatomy, Mahatma Gandhi Medical College and Hospital, Jaipur. Skulls were obtained from different medical colleges of the Rajasthan region. The study included fully dried, intact, adult human skull bones with no structural defects. Damaged, fractured, skull with the developmental anomaly, injured or pathologically malformed skull especially at or near the foramen ovale on either side were excluded from the study. Ossification of pterygospinous and pterygoalar bars was studied on both sides. Statistical analyses were performed using SPSS Version 26 software.

Results: Ossified ligaments were studied in 400 sides of 200 skulls. The ossification of pterygospinous bar was observed in 53 cases (13.25%). The pterygospinous bar was complete in twelve (3%) cases and incomplete in 41 cases (10.25%). The ossified pterygoalar ligament was observed in 62 cases (15.5%). Ossification was complete in 15 cases (3.75%) and incomplete in 47 cases (11.75%).

Conclusion: Ossification of pterygospinous and pterygoalar bars was observed in skulls obtained from medical colleges in the Rajasthan region. Knowledge of such morphological variations of the skull base will improve the therapeutic outcomes in the treatment of trigeminal neuralgia.

Keywords: Foramen ovale, Pterygospinous bar, Pterygoalar bar, Trigeminal neuralgia.

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INTRODUCTION

Osseous bridging occurs in different areas of the body and is often age-dependent. This is a poorly understood consequence of secondary ossification of fibrous structures [1]. Nonetheless, the idea of genetic origins was raised by the observation of these bone bridges in children [2]. Many skull ligaments are derived from a clinical standpoint. The pterygospinous and pterygoalar ligaments are situated near the foramen ovale and have a significant clinical relationship with this structure. In contrast to the pterygospinous bar, which runs beneath the foramen ovale and divides it into two sections, the pterygospinous bar is either medial or below the foramen ovale [1].

Patients with compressive syndrome have shown that, in the absence of any clear etiology, the disorder is caused by ligament ossification. Ossification of the cranial base ligaments may hinder operating access and surgical routes in this area [3].

The pterygospinous ligament made up of the thicker fascia between the medial and lateral pterygoid muscles. It extends from the sphenoid spine to the top portion of the lateral pterygoid plate’s posterior edge. Occasionally, muscular developments like the pterygospinous muscle, which is inserted into the temporal mandibular joint capsule and extends to the articular disc, replace the pterygospinous ligament. The pterygospinous ligament may ossify completely or partially at times [4-6]. Mandibular nerve block may be hampered by the ossification of this ligament, which may entrap the neurovascular structures [7].

The purpose of this study is to examine the occurrence and architecture of pterygospinous and pterygoalar bars in human skulls and to understand their clinical significance.

METHODS

The present study was an observational study conducted to describe the ossification of pterygospinous and pterygoalar ligaments near foramen ovale.

The study was carried out on 400 foramen ovale using 200 adult human skulls. The specimens included in the study were of unknown sexes and ages. Skulls were obtained from different medical colleges of the Rajasthan region. The study included fully dried, intact, adult human skulls bones with no structural defects. Damaged, fractured, skull with developmental anomaly, injured or pathologically malformed skull especially at or near the foramen ovale, and the lateral plate of the pterygoid process on either side were excluded from the study. Ossification of pterygospinous and pterygoalar bar was studied and variations on the right and left sides were noted.

Statistical analysis

The data were tabulated and statistically analyzed by using SPSS version 26 software. The categorical variables were described as numbers and percentages. The Chi-square test was applied to know the relatedness between categorical variables and p<0.05 (two-tailed) was considered statistically significant.
RESULTS
In this study, a total of 200 dry skulls of adults from the Rajasthan population were examined for the presence or absence of pterygospinous and pterygoalar bar on both sides of foramen ovale.

There were 05 (2.5%) and 07 (3.5%) cases on the right and left side respectively where the pterygospinous bar was complete (Fig. 1), and in 27 (13.5%) and 14 (7%) cases where the pterygospinous bar was partially formed or incomplete (Fig. 2) and in 168 (84%) and 179 (89.5%) cases there was no pterygospinous bar present on the lateral pterygoid plate, respectively (Table 1).

There were 6 (3%) and 9 (4.5%) cases on the right and left side respectively where the pterygoalar bar was complete (Fig. 3), and incomplete in 21 (10.5%) and 26 (13%) cases where the pterygoalar bar was partially formed or incomplete (Fig. 4). In 173 (86.5%) and 165 (82.5%) cases, there was no pterygoalar bar present on the lateral pterygoid plate, respectively (Table 2).

On comparing ossification of pterygospinous and pterygoalar bars on both sides, it was observed that pterygospinous and pterygoalar bars were bilateral in 7 (3.5%) and 6 (3%) skulls (Fig. 5), 39 (19.5%) and 50 (25%) unilateral, and absent in 154 (77%) and 144 (72%) respectively (Table 3).

DISCUSSION
The present study is one of the few that provides information on the prevalence of pterygospinous and pterygoalar bars in the medical colleges in Rajasthan. The prevalence of pterygospinous and pterygoalar bars (full and incomplete) in our study was 15.5% and 13.25%, respectively. According to other studies, the prevalence of pterygospinous bars ranged from 1% to 31.2%, while pterygoalar bars ranged from 1.3% to 62.4%. [3,8,9]. The incidence of pterygospinous and pterygoalar bar was higher among Brazilian [8] population, followed by Greeks, [1] Indians [5], and Croatians [10]. Findings from our study correlate with these studies.

Complete ossification of pterygospinous bar in our study was 3% and it has also been noted in several studies and the incidence ranged from 2 to 6% [10-13]. Complete ossification of pterygoalar bar was noted
in 3.75% of skulls in the present study. Similar finding was noted by Natsis et al. in Greeks skulls [1]. The highest incidence was noted in an Indian study conducted by Chakravarthi and Babu [14]. Our study showed unilateral pterygospinous bar was seen in 39 (19.5%) skulls and unilateral pterygoalar bar in 50 (25%) skulls. Similar findings were noted by Kavitha Kamath and Vasantha [5] in Karnataka, India population but very low incidence was noted by Jansirani et al. [15] and Yadav et al. [12].

In Table 4 we have summarized the differences between pterygospinous and pterygoalar bar in various ethnic populations conducted worldwide (Table 4).

These ligaments’ abnormal ossification can compress nearby structures, leading to challenges during localized surgeries, and significantly impede clinical and diagnostic processes [16]. These formations create crucial interactions with the otic ganglion, middle meningeal vessel, tympanic nerve, medial and lateral pterygoid muscles, mandibular nerve and its branches, and these formations occupy a deep and high area of the infratemporal fossa. These can produce changes that are clinically significant when they are crushed up against the bony structures [17,18]. The nearby osseous bars around the foramen ovale may have an impact on how the structures pass through this aperture anatomically and may alter their path, trapping them between the muscles and osseous structures and resulting in neuralgia [19]. An ossified pterygospinous ligament can compress the facial nerve’s chorda tympani branch, impairing taste perception in the anterior two-thirds of the tongue [9] and blood supply to the trigeminal ganglion [3]. In addition, neurological symptoms, including parotid gland alterations in saliva, chewing difficulties, and pain and numbness in the buccal and tongue regions [14,20,21].

Mandibular nerve compression or entrapment of the motor or sensory branches can cause paresis, or weakening, in the innervated muscle, and paresthesia or neuralgia in the sensory branches [22]. The pterygoalar ligament totally precludes passage from the foramen ovale to the mandibular nerve or trigeminal ganglion via the supra or infrrazygomatic approach. The majority of previous studies noted the prevalence of ossified ligaments in various parts of the world. These have extremely little clinical implications. Because the combination of additional traits makes them the rarest of the rare, different impediments, in addition to the pterygospinous and pterygoalar bar, have been explored [23].

The lingual nerve, which passes between the ossified pterygospinous ligament and the medial pterygoid muscle, may become trapped as a result [24]. This may result in pain associated with articulation, anesthesia of the lingual gums, and sensory impairment in the anterior two-thirds of the tongue. Dentists must always be aware of the possible signs of neurovascular compression in regions where the lingual nerve is situated [4,25].

Since the entire pterygoalar bar is more pronounced and has the potential to completely obliterate the passage to foramen ovale, it is clinically more significant than the complete pterygospinous bar [8,26]. These ossified ligaments may impede the needle’s ability to pass through the foramen ovale during surgical procedures necessary to relieve trigeminal neuralgia, making it impossible to anesthetize the trigeminal ganglia or the mandibular nerve [19,25].

It is advised to use an inframandibular route to the trigeminal ganglion rather than a standard supramandibular or transzygomatic method to overcome the failure of a trigeminal ganglion block if these bars are found before the procedures. Therefore, to see the foramen ovale and its associated structures, radiological guidance is necessary, which facilitates and improves puncture accuracy [19]. While doing invasive
Table 4: Comparison between pterygospinous and pterygoalar bar in various populations

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Author</th>
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CONCLUSION

Given the prevalence of these bars in the human population, it becomes imperative to broaden our understanding of the morphology and topography of these formations. Surgeons and practitioners require more precise information regarding the heterogeneity of human shape in order to increase treatment outcomes. Understanding the cranial base’s osseous bridges is helpful in diagnosing and treating complex clinical neuropathies that affect the oral and maxillofacial regions.

Therefore, knowledge of anatomical structures and to evaluate them radiographically aids surgeons in making appropriate plans that improve the success rate of surgeries for trigeminal neuralgias. Therefore, a thorough anatomical analysis of this variation can aid them radio...