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Study of Pterygospinous and Pterygoalar Bars In Dry Human Skulls

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Abstract

Introduction: Pterygospinous and pterygoalar ligaments at the base of skull, sometimes, might get ossified leading to the formation of complete or incomplete bony bars in relation to foramen ovale. These are of clinical importance because if the ossified bar obliterates the foramen ovale causing mandibular neuralgia, it might pose problems in performing thermocoagulation and anaesthesia for trigeminal neuralgia. Because of these factors the anatomy of these bony bars is of grave significance. **Aims and objectives**: The present study is undertaken to evaluate the incidence, clinical relevance and phylogenic significance of ossified pterygospinous and pterygoalar ligaments in the skulls of Indian population. **Methodology**: A total of 100 dry human skulls of Indian were collected irrespective of age and sex, base of the skull was studied for location of pterygospinous and pterygoalar ligaments (right, left or bilateral), the degree of ossification (complete or incomplete) and relation of the bar to foramen ovale (medial, lateral, across) **Results**: The incidence of pterygospinous and pterygoalar bars in our study is 10% and 6% respectively. The pterygospinous bar was most commonly seen to cross the foramen inferiorly and in few cases was medial to the foramen ovale. **Conclusion**: The presence of the

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pterygospinous and pterygoalar bars can lead to variety of neurovascular entrapment syndrome and also pose difficulty in surgical approaches to the base of skull. Hence the anatomical knowledge of these osseous bars is essential for clinicians.

Keywords: Pterygospinous ligament, pterygoalar ligament,parapharyngeal spaces, skull base surgery

Introduction

The pterygospinous ligament stretches between the spine of sphenoid to the upper part of the posterior border of lateral pterygoid plate. The ligament may undergo complete or incomplete ossification. Complete ossification of this ligament was named after Fillipo Civinini (1837) as Civinini's bar or pterygospinous bar.[1] The foramen formed by the pterygospinous bar was called as Foramen of Civinini or pterygospinous foramen.[2,3,4]

Most of the standard textbooks remain silent in describing about another intrinsic ligament called pterygoalar ligament. This ligament may be ossified completely or incompletely. Complete ossification of pterygoalar ligament leads to formation of a foramen called, porus crotophitico-buccinatorius or pterygoalar foramen. [5,6] The pterygospinous and pterygoalar bars were considered as the outcome of secondary ossification of intrinsic ligaments of sphenoid.[2] However, the presence of these bony bridges in skulls of children suggested the possible play of genetic factors.[4] The incidence of pterygospinous and pterygoalar bars is more common in Africans and this may be due to racial variations.[7]

The presence of pterygospinous and pterygoalar bars pose a challenge to surgeons approaching retro and parapharyngeal spaces. These osseous bridges if present act as an obstacle during trigeminal ganglion block through foramen ovale.[3,8,9]

Aims and Objectives

The present study is undertaken to

- Evaluate the incidence,
- To discuss clinical relevance and
- To understand phylogenic significance of ossified pterygospinous and pterygoalar ligaments in the skulls of Indian population.

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Materials And Methods: A total of 100 dry human skulls of Indian were collected irrespective of age and sex at S. Nijalingappa Medical college, Bagalkot. The base of the skull was studied for the following:

- Location of pterygospinous and pterygoalar ligaments (right, left or bilateral)
- The degree of ossification (complete or incomplete)
- Relation of the bar to foramen ovale (medial, lateral, across)

The quantitative data collected has been expressed in frequencies, further for statistical analysis frequencies were calculated as percentages. Tables have been used to express the frequency distribution, and, null hypothesis has been used to test the significance of important parameters.

Results

Out of the 100 skulls studied, twelve showed the presence of pterygospinous and pterygoalar bars. We classified these twelve skulls into 3 types. Type I showed the presence of only pterygospinous bar, Type II showed only pterygoalar bar and Type III showed the combination of both. Type I pattern of distribution was seen in six skulls (50%), Type II in two skulls (16.66%) and Type III in four skulls (33.33%). Among those which showed Type I pattern, no skulls (0%) showed the presence of bars on the right side, one skull (8.33%) on left and in five skulls bilateral. Among those skulls which showed Type II pattern, no skulls (0%) showed the bars on right, two skulls (16.66%) on left. Among the skulls which showed Type III pattern, in one case (8.33%) both pterygospinous and pterygoalar bars were seen on left side, in the remaining three skulls (12%) one skull showed bilateral pterygospinous bar with right pterygoalar bar, one skull showed bilateral pterygospinous bar with left pterygoalar bar and one skull showed bilateral pterygospinous and pterygoalar bars.

In the 100 skulls studied, pterygospinous bars (found in Type I and Type III cases) were seen in total of 10 skulls, out of which one skull (10%) showed the presence of complete bar and nine skulls (90%) showed the presence of incomplete bars. The only complete pterygospinous bar we found was seen on the right side, one skull (10%) on left and in sevsn cases (70%) the bars were bilateral. These osseous bars were in close relation to the foramen ovale, five passed medial to it and two crossed the foramen inferiorly.

Pterygoalar bars (seen in Type II and Type III) were present in six skulls of which one skull (16.66%) showed the presence of complete bar and five skulls (83.33%) had incomplete

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pterygoalar bars. The only complete pterygoalar bar we found was seen bilaterally (100%). Among the five skulls with incomplete pterygoalar bars, two skulls (40%) had them on right side, three skulls (60%) on left side. The pterygoalar bars were in close relation to the foramen ovale, one passed medial, three passed lateral and two crossed the foramen inferiorly.

Table no. 1: Distribution of pterygospinous and pterygoalar bridges (bars) related to appearance of osseous variation

	Pterygospinous bridges	Pterygoalar bridges	Z	P
Absence	90 (90%)	94 (94%)	0.6	0.42
Incomplete	9 (9%)	5 (5%)	0.69	0.42
Complete	1 (1%)	1 (1%)	1	Not significant
Total	100 (100%)	100 (100%)		

Table no. 2: Distribution of pterygospinous and pterygoalar bars according to side of skull

	Pterygospinous bar						Pterygoalar bar					
	Right		Left		Bilateral		Right		Left		Bilateral	
	N	%	n	%	n	%	n	%	n	%	n	%
Complete	1	1	0	0	0	0	0	0	0	0	1	11
Incomplete	1	1	1	1	7	7	2	2	3	3	0	0
Absent	98	98	98	98	93	93	98	98	97	97	99	99
Total	100	100	100	100	100	100	100	100	100	100	100	100

Table 3:Distribution of types I,II,& III of pterygospinous and pterygoalar bars

	Type I	Type II	Type III	Total
Right side	0	0	0	0

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Left side	1	2	1	4
Bilateral	5	0	3	8
Total	6	2	4	12

Discussion

Table 4: Showing occurrence of pterygospinous bar and pterygoalar bar in different populations as per different authors.

Study	Population	Pterygospinous bar			Pterygoalar bar		
		Complete	Incomplete	Total	Complete	Incomplete	Total
Tubbs et al[10]	American	0.65	0.65	1.3	0.65	0.65	1.3
Kapur et al[11]	Croatian	1.31	14.74	16.05	5.9	14.4	20.3
Peker et al[12]	Anatolian	5.5	-	-	4.9	-	-
Pinar et al[13]	Turkish	3.3	9.7	13	1.1	4.98	6.08
Skrzat et al[14]	Polish	-	-	-	1.43	5.7	7.1
Natsis et al[15]	Greek	-	-	-	4.1	27.6	31.7
Antonopoulou et al [16]	Greek	2	25	27	1	7	8
Rosa et al[17]	Brazilian	8.61	19.36	31.2	12.9	49.4	62.4
Galdames et al[18]	Brazilian	1.6	13.14	14.74	3.84	22.43	26.27
Devi et al[19]	Indian	0.98	10.78	11.78	2.45	3.92	6.37
Chakravarthi et al[20]	Indian	-	-	-	19.7	8.5	28.2
Saran et al[21]	Indian	1.25	7.5	8.75	-	-	-
Das et al[22]	Indian	0	1	1	-	-	-
Verma et al[23]	Indian	1.2	12.93	18.1	-	-	-
Nayak et al[24]	Indian	5.76	3.84	9.61	-	-	-
Kamat et al[25]	Indian	1	16	17	1	29	30
Present study	Indian (south)	1	9	10	1	5	6

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Present study is one among the very few which provides data on the incidence of both pterygospinous and pterygoalar bars in north Karnataka population. The incidence of pterygospinous and pterygoalar bars in our study is 10% and 6% respectively. The incidence of pterygospinous bars as found in other studies (above table) ranged from 1% to 31.2% whereas that of pterygoalar bars ranged between 1.3% to 62.4%.[10, 16, 21] Findings from our study were within this range.

According to previous studies, the position of pterygospinous bar was medial or inferior to foramen ovale and the pterygoalar bar was medial, lateral or inferior to the foramen ovale.[20,16,14] In the present study, the pterygospinous bar was most commonly seen to cross the foramen inferiorly and in few cases was medial to the foramen ovale. The pterygoalar bar was most commonly found lateral or inferior to the foramen ovale.

In our study both the bars were seen more frequently on the left side. Some of the previous studies reported a preference for left side in the unilateral occurrence of the pterygoalar bar which was similar to our findings.[10, 25, 12] The pterygospinous was reported to occur predominantly bilaterally or on the left side when unilateral.[12] No explanation is given in the literature so far to account for the left sided predominance of these bars.

Clinical significance: Disordered ossification of these ligaments can compress the neighbouring structures, may cause complications in regional surgeries and can also seriously hamper clinical and diagnostic procedures.[11] These formations occupy a deep and high portion in the infratemporal fossa establishing important relationships with mandibular nerve and its branches, otic ganglion, middle meningeal vessels, tympanic nerve and medial and lateral pterygoid muscles. These are compressed against the bone formations and are capable of generating clinically important manifestations alterations.[17] The neighboring osseous bars around the foramen ovale could influence the anatomical organization of the structures that run through this opening and can change their course resulting in their entrapment between the osseous structures and muscles causing neuralgia.[14] Compression or entrapment of motor branches of mandibular nerve can lead to paresis or weakness in the innervated muscle and that of sensory branches can provoke neuralgia or paraesthesia.[4]

An ossified pterygospinous ligament can cause entrapment of lingual nerve which runs between the fibers of lingual nerve and divide it into anterior and posterior parts. The posterior fibres

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pass lateral to bony bridge, while anterior fibres pass medially in between the tensor veli palatini and the bony bridge, thus vulnerable to risk of compression.[26] This can lead to sensory impairment in anterior two thirds of the tongue, anaesthesia of lingual gums and pain related to articulation. Dentists should therefore be aware of the possible signs of neurovascular compression in regions where lingual nerve is distributed.[3] Chorda tympani branch of facial nerve can also get compressed by an ossified pterygospinous ligament and may result in impaired taste sensation from anterior two thirds of tongue.[21] This ligament could also occlude the blood vessels supplying the trigeminal ganglion.[10]

Pterygoalar ligament can potentially compress the deep temporal, lateral pterygoid, buccal nerve, auriculotemporal nerve, chorda tympani or lingual nerve. This can cause several neurological symptoms such as chewing disorders, pain and numbness of buccal region and tongue and salivatory changes of the parotid gland.[12,19]

The complete pterygoalar bar is of greater clinical importance than the complete pterygospinous bar since it may obliterate the foramen ovale.[16,32] In surgical interventions required for relieving trigeminal neuralgia, these ossified ligaments can obstruct the passage of needle into the foramen ovale, thereby disabling the anaesthetization of the trigeminal ganglion or the mandibular nerve.[14,32] These bars may make thermoregulation of trigeminal ganglion difficult or impossible.[18.21] CT scan of the cranial base may be obtained to better delineate the anatomy of obstructive lesions around the foramen ovale.[10] The Hirtz axial radiograph and submentovertex projection permit a clear observation of anatomical structures at the skull base.[16] If these bars are identified before the procedures, it is recommended to prefer inframandibular approach to the trigeminal ganglion instead of routine supramandibular or transzygomatic approach to overcome failure of trigeminal ganglion block. Thus, radiological guidance is required to visualize the foramen ovale and its related structures, which makes puncture easier and more precise.[14] Such information may be of particular use to anaesthetists, dentists, oral maxillofacial surgeons and neurosurgeons to perform invasive procedures in or near the infratemporal fossa.[10]

The presence of ossified pterygospinous and pterygoalar bars may obliterate the space between the lateral pterygoid plate and spine of sphenoid which restricts access to retropharyngeal and parapharyngeal spaces by surgeons.[18] Presence of these bony bars have to be borne in mind when one finds difficulty during surgical approach to base of skull and special care has to be

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taken to avoid injuries to structures which pass under these ossified ligaments.[28] Anatomical knowledge of these bony bridges around the foramen ovale may be helpful for diagnostic and neurosurgical procedures like percutaneous biopsy of cavernous sinus tumors, electroencephalographic analysis and microvascular decompression by percutaneous trigeminal rhizotomy.[28] From a clinical standpoint, ossified ligaments have become very critical whenever considering block anaesthesia for mandibular nerve.[27] Mandibular nerve block is a preferred method for pain relief especially for the fractures of mandible of cancer patients.[22]

Conclusion: The presence of the pterygospinous and pterygoalar bars can lead to variety of neurovascular entrapment syndrome and also pose difficulty in surgical approaches to the base of skull. Hence the anatomical knowledge of these osseous bars is essential for clinicians.

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Conflicts of interest

There are no conflicts of interest.

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Figures

Fig.1 Complete pterygospinous and pterygoalar ligament

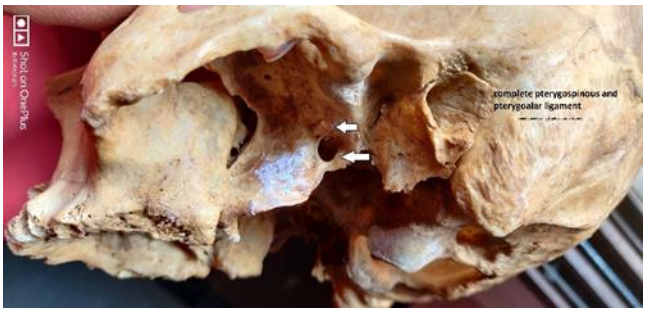

Fig.2 Relation of pterygoalar bar with mandibular foramen