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Research Article

SPHENOID BONE LIGAMENTS' ENTHESOPATHY WITH THEIR CLINICAL MANIFESTATIONS

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ABSTRACT

Objective: The Cortical bone formation at enthesial sites of ligament attachments to the sphenoid bone is indeed multifactorial, involving various biological, mechanical, and biomechanical processes. The present study is aimed to observe the ossified ligaments of sphenoid bone of skull manifesting various neurological complications.

Methods: An observational study conducted on sphenoid bones of 36 dried human skulls of unknown gender and age procured from the Department of Anatomy at Gautam Buddha Chikitsa Mahavidyalaya, Dehradun and People's College of Medical Sciences and Research Centre, Bhopal. These bones were observed for enthesopathic modifications in their ligaments.

Results: The present study showed ossified caroticoclinoid ligament (intra cranial ligament) predominated by 41.66% followed by pterygospinous ligament ossification (extra cranial ligament) with total 38.88% prevalence.

Conclusion: Altered morphology of sphenoid bone knowledge is a must for neurosurgeons and orthopedic surgeons while operating at these sites to avoid hindrances and has scope for newer approaches for better prognosis.

Keywords: Intracranial sphenoid ligaments, Extracranial sphenoid ligaments, Enthesopathy, Enthesis.

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INTRODUCTION

The word sphenoid is derived from the Greek word sphenoeides which means "wedge shaped." It resembles a bat with a central body and its extensions spread and outstretch as 2 greater and lesser wings and stands on its legs, pterygoid processes, located at the base of the skull. Its significance lies in various foramina and fissures present in its surface, which acts as a gateway to many neurovascular structures to and fro the cranial cavity. Its articulation with other neighboring bones of the skull together forms an absolute abode for the brain [1]. It is also representative of an unpaired pneumatic bone, and sphenoidal air sinus lies within its body making skull bone lighter and provides resonance.

It ossification has two parts, pre-sphenoidal and post-sphenoidal part divisible by the tuberculum sellae and both fuses in the 7th or 8th months of intrauterine life. Pre-sphenoidal includes body, both lesser wings and medial parts of greater wings ossify in cartilage while post-sphenoidal part includes greater wings and pterygoid processes are ossified in membrane. A completely fused sphenoid bone develops during 1st year of life [1].

Sphenoid bone has both extracranial and intracranial ligaments. Attachment of ligaments or connective tissue to the bone is known as enthesis. In 19th century, many researchers found that any pathology involved at these enthesis sites occurred due to lifestyles and habits [2,3]. The formation of cortical defects at these enthesis sites due to various physical activities such as occupational or any physical stress leads to enthesopathies [4]. Variable predisposing factors such as local stress or strain, rheumatoid arthritis, diabetes mellitus, trauma, or genetics are the causes of enthesopathies. Enthesopathy of sphenoid bone ligaments' can cause pain, restricted movement, and other neurovascular compression involving several neurological pathologies.

Extra cranial ligaments

1. Pterygospinous ligament/ligament of Civinini [5] extends from the spine of sphenoid bone to the tubercle at the posterior border of the lateral pterygoid plate. The presence of bony bar if ossified in vicinity of foramen ovale and its structures pass through foramen of Civinini formed.
2. Pterygoalar ligament extends from the root of the lateral pterygoid plate to the inferior surface of the greater wing of sphenoid bone. Its ossification lateral or beneath the foramen ovale affecting the mandibular nerve distributed to muscles of mastication.

Intracranial ligaments

These ligaments are located in the middle cranial fossa around the sella turcica and clinoid processes.

3. Caroticoclinoid ligament located between anterior and middle clinoid processes. Osseous bridge between the two processes may encircle the internal carotid artery passing through caroticoclinoid foramen thus formed.
4. Interclinoid ligaments are located between clinoid processes. Osseous bony bars formed may impinge upon cavernous sinus and internal carotid artery, thus raising intracranial pressure.
5. Petrosphenoid ligament: The lateral margin of dorsum sellae presents a petrosal process connected to the tip of the petrous part of temporal bone, beneath passes the oculomotor and abducent nerves. Osseous bridge formation leads to the formation of Dorello's canal [6] impinging both the nerves and their palsy causes increased intracranial tension.

The present study aimed to observe the ossification of pterygospinous, pterygoalar, interclinoid, caroticoclinoid, and petrosphenoid ligaments of sphenoid bone and to determine their occurrences in skull unilaterally or bilaterally with complete or incomplete ossification as the knowledge of these osseous bridges of sphenoid bone ligaments is of utmost importance to surgeons while performing regional neurosurgery or to release neurovascular compression as they may act as impediment for the surgical corridors of the skull.

METHODS

The present study was performed on 36 dried human skulls of unknown gender and age procured from the Department of Anatomy at Gautam Buddha Chikitsa Mahavidyalaya, Dehradun, and People's College of Medical Sciences and Research Center, Bhopal. All the skulls were bilaterally observed on 72 sides for the presence of ossified extra and intracranial ligaments (partial or complete). Ossification types along with side (unilateral right/left or bilateral) were recorded.

The exclusion criteria during the selection of the skull, traumatized, or any pathology involved in the sphenoid bone were not considered.

The data obtained was subjected to statistical analysis using Excel in MS window 11. Percentage was calculated for incidence purposes and for evaluation of sidedness and type of ossification, and Chi-square test was applied. p-value was also obtained at 95% confidence interval.

RESULTS AND OBSERVATIONS

A total of 36 dried human skulls were studied bilaterally 72 sides for observing both extracranial and intracranial ossified ligaments of sphenoid bone. Out of which ossified caroticoclinoid ligament (intra cranial ligament) predominated by 41.66% (Fig. 1) followed by pterygospinous ligament ossification (extracranial ligament) with total 38.88% prevalence (Fig. 2). However, observing the p-values obtained revealed no significant differences between unilateral (right and left sided) or bilateral ligament ossification. Thus, side symmetry was recorded along with proportional distribution of ossified ligaments of sphenoid bone which can be summarized from Table 1.

DISCUSSION

Ligaments' ossification is a complex tissue repair process after repeated inflammation at the enthesis site triggered by mechanical stress, where degeneration of their fibers with decrease in the organic content with abnormal deposition of calcium and phosphate minerals in response to immune system by releasing cytokines. The sphenoid bone gives attachment to muscles of mastication, especially pterygoid muscles in vicinity to pterygospinous and pterygoalar ligaments. Excessive chewing forces on one side of the jaw or other may be the inducive factor for repeated mechanical stress causing enthesopathy of sphenoid bone ligaments, especially in metabolic disorders.

In the present study, the most ossified extracranial ligament was pterygospinous (38.88%) (Fig. 2) followed by pterygoalar ligament (27.77%) (Fig. 3).

Piagkou *et al*. [7] showed the prevalence of pterygoalar ligament (32.69%) than pterygospinous ligament (16.03%).

According to Nikolova *et al*. [8] observed in their study the frequency of pterygospinous ligament of 12.4% to that of pterygoalar ligament only 2.4%.

Galdames *et al*. [9], in their Brazilian study, observed pterygoalar ligament complete ossification in 12 cases (3.84%) while only in 5 samples, pterygospinous ligament was completely ossified (1.6%).

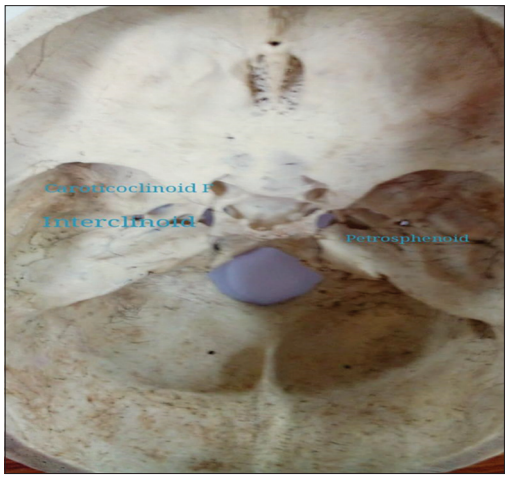

Fig. 1: Ossification of intracranial ligaments of sphenoid bone

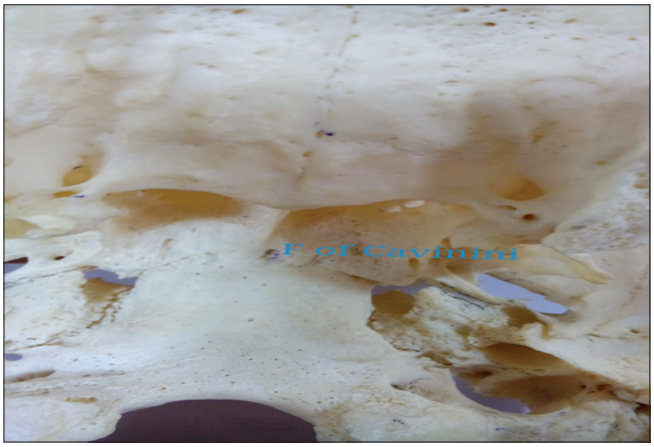

Fig. 2: Ossification of pterygospinous ligament with formed foramen of Civinini

Table 1: Incidence of ossified ligaments of sphenoid bone

Ossified ligaments	Unilateral n (%)		Bilateral n (%)	Total n (%)	Chi-square with Yates correction	p-value
	Right n (%)	Left n (%)				
Pterygospinous						
Complete	2 (5.55)	1 (2.77)	3 (8.33)	14 (38.88)	0.32	0.57
Partial	3 (8.33)	2 (5.55)	-			
Pterygoalar						
Complete	2 (5.55)	1 (2.77)	2 (5.55)	10 (27.77)	0.75	0.38
Partial	2 (5.55)	1 (2.77)	-			
Caroticoclinoid						
Complete	2 (5.55)	2 (5.55)	2 (5.55)	15 (41.66)	0.003	0.95
Partial	5 (13.88)	2 (5.55)	-			
Interclinoid						
Complete	2 (5.55)	2 (5.55)	1 (2.77)	13 (36.11)	0.16	0.68
Partial	4 (11.11)	3 (8.33)	-			
Petrosphenoid						
Complete	1 (2.77)	1 (2.77)	2 (5.55)	9 (25)	0.31	0.57
Partial	2 (5.55)	1 (2.77)	-			

As p>0.5 therefore insignificant result

Fig. 3: Ossification of pterygoalar ligament with its foramen formed

Nayak *et al.* [10] in their study observed pterygospinous bony bridges in 5.76% completely ossified in Indian skulls.

Sindhe *et al.* [11] found pterygospinous ligament incompletely ossified in only 2 cases out of 65 skulls.

The clinical impact of ossified sphenoid bone ligaments' is manifold, with compression of neurovascular structures in the vicinity of bony bars causing irritation, pain, loss of movement of joints, etc. Even sometimes, performing transsphenoidal surgeries and clinoidoidectomy become tough and impossible as ossified bars impedance at surgical corridors. Thus, 3D computed tomography scan, magnetic resonance imagings, and standard endoscopic endonasal operations done at the sellar region with accuracy and minimal risk of neurological complications.

CONCLUSION

This study recorded caroticoclinoid ligament predominated over all other intracranial ligaments and prevalence of pterygospinous ligament outnumbered other extracranial ligaments. Detailed structural knowledge and abnormal morphology of sphenoid bone are a must for surgeons to have newer approach techniques to surgical corridors to avoid complications.

AUTHOR'S CONTRIBUTION

Self.

CONFLICT OF INTEREST

Nil.

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Nil.

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