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Original Article

Study of ossified clinoid ligaments in sphenoid bone of north Indian skulls

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ABSTRACT

Introduction: The sphenoid bone lies in the base of the skull between the frontal, temporal and occipital bones. Certain parts of the sphenoid bone are connected to each other by ligaments, such as caroticoclinoid ligament and interclinoid ligament which occasionally ossify and result in the formation of foramen.

Methods: This study was performed on 40 specimens i.e. 30 dried skulls and 10 sphenoid bones, obtained from the Department of Anatomy, SRMS IMS, Bareilly. In all skulls and sphenoids the anterior, middle and posterior clinoid processes were examined to reveal their relationship and the incidence of clinoid foramina and ossification of ligaments around pituitary fossa were noted.

Results: The incidence of anterior clinoid foramen is more as compared to posterior clinoid foramen. The ossification of caroticoclinoid ligament is more common than interclinoid ligament. The incidence of presence of anterior clinoid foramen on right and left side is same. Posterior clinoid foramen is present in one sphenoid bone only out of 40 bones.

Discussion: The knowledge of anatomy of ossified interclinoid ligament and caroticoclinoid ligament in sphenoid bone around pituitary fossa is important from diagnostic, surgical (especially surgeries involving removal of anterior clinoid process) and clinical point of view and should be evaluated by neurosurgeons before proceeding to skull based surgery. The presence of an ossified CCL ligament is likely to cause compression and straightening of the internal carotid artery thus giving rise to vascular complications.

1. Introduction

The sphenoid bone lies in the base of the skull between the frontal, temporal and occipital bones. Certain parts of the sphenoid bone are connected to each other by ligaments, which occasionally ossify, such as the pterygospinous ligament (between the spine of the sphenoid and the upper part of the lateral pterygoid plate), the interclinoid ligament (between the anterior and posterior clinoid processes) and the carotico-clinoid ligament (between the anterior and middle clinoid processes).[1]

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The ligamentous or bony interclinoid connections have important neuronal and vascular relations therefore they are both clinically and surgically important. The knowledge of detailed anatomy of the interclinoid and caroticoclinoid ligaments is important as these ossified ligaments causes confusion in the evaluation of MRI or CT and also in the regional surgery planning. Like, aneurysms surgery of the intracavernous portion of the internal carotid artery[2–5] and surgery for tuberculum sella meningiomas.[6] Removing the anterior clinoid process is an important step in exposing the structures in the cavernous sinus and is highly complicated due to the neuronal and vascular relationships viz occulomotor, trochlear, abducens, ophthalmic and mandibular nerves, internal carotid artery, cavernous sinus. Therefore in the presence of ossified interclinoid ligaments the removal of the anterior clinoid process becomes more difficult.[2] When a paraclinoid aneurysm occurs, the anterior clinoid process is removed as treatment for the above condition.[3,4] This treatment is more difficult when the caroticoclinoid foramen is present, causing higher possibility of serious bleeding in this region.[7] It was observed that caliber of ICA in its clinoid segment being larger than CCF; it was found that there is a high possibility to induce a headache caused by compression of ICA in the presence of CCF. This feature is crucial for the choice of surgical removal of anterior clinoid process.[8]

The anterior clinoid process (ACP) may be joined to the middle clinoid process (MCP) by a ligament or dural fold.[1] The bony bridge joining the ACP and MCP converts distal end of the carotid sulcus into an ostium known as the caroticoclinoid (CCL) foramen[2] or anterior clinoid foramen. The presence of an ossified CCL ligament is likely to cause compression and straightening of the internal carotid artery[8] thus giving rise to vascular complications.

Depending upon the extent of ossification of interclinoid ligaments osseous bridges were classified into four types[9] according to Archana et al.

Type 1 – Bridge present between anterior and middle clinoid process
Type 2 – Bridge between the anterior, middle and posterior clinoid process
Type 3 – Bridge between anterior and posterior clinoid process
Type 4 – Bridge between the middle and posterior clinoid process

Keyers[10] further classified each type of bridge into three subtypes depending upon the extent of fusion between the bony bars arising from the respective clinoid process.

a. Complete type: A complete fusion between two bony bars
b. Contact type: Presence of a dividing line or suture between bony bars
c. Incomplete type: If a spicule of bone was extending from one clinoid process towards the other with a gap in between.

The aim of this study was to present the ossified interclinoid and caroticoclinoid ligament morphologically and to assess its possible impact on the surrounding neurovascular structures. The existence of bony or ossified caroticoclinoid and interclinoid ligament causes compression, tightening or stretching of the internal carotid artery, especially of the clinoidal segment. Research studies have also reported the fact that an ossified caroticoclinoid ligament makes the removal of anterior clinoid process more difficult, especially in the presence of an aneurysm.[10]

2. Materials and methods

This study was performed on 40 specimens i.e. 30 dried skulls and 10 sphenoid bones, obtained from the Department of Anatomy, SRMS IMS, Bareilly. In all skulls and sphenoids the anterior, middle and posterior clinoid processes were examined to reveal their relationship and the incidence of clinoid foramina and ossification of ligaments around pituitary fossa were noted.

In the present study we found ossified caroticoclinoid, interclinoid ligaments and clinoid foramina. Clinoid foramen may be anterior and posterior. The presence of bony trabeculae was noted. The length of bony trabeculae was measured from anterior to the posterior clinoid process.

The morphometry of foramen was performed using a digital vernier calliper and measuring the maximum transverse diameter of each foramen. To avoid errors, the measurement was performed three times by the same examiner considering the repeated values to increase the accuracy. We took average of these values. These values were obtained in millimeters (mm).

3. Results

The sphenoid bones collected from Department of Anatomy were observed and findings were noted down. The present study revealed the presence of various types of interclinoid bony bars were 7.5% (n = 3 out of 40 sphenoids). Our study revealed the presence of bilateral ossification of caroticoclinoid ligament in one sphenoid out of 40 (2.5%), as it was forming anterior clinoid foramen. Anterior clinoid foramen was therefore present bilaterally (2.5%).The presence of complete bridge (measuring length – 11.90 mm) on left side from anterior to posterior clinoid process resulting into formation of both anterior and posterior clinoid foramen (2.5%), was also observed in the same sphenoid.

Our study also revealed the unilateral presence of ossified caroticoclinoid ligament (Figs. 1 and 2) in 2 sphenoids out of 40 (5%).It was found one on each side and the frequency of occurrence in above is same i.e. 2.5%. Therefore, type 1 interclinoid bars were present in 3 sphenoids (7.5%) and type 3 interclinoid bar was present in 1 sphenoid[9] (2.5%) out of 40. All the bars were having complete fusion.[10]

We also observed incomplete ossification of caroticoclinoid ligament (Fig. 3) in 8 sphenoids out of 40 (20%) i.e. incomplete ossification which did not destined to the formation of foramina.

Incidence of caroticoclinoid foramen in the sphenoids (n = 40) evaluated, according to sides (left, right, unilateral, bilateral). Also shows the values of morphometry of the foramen.