

Study of Carotico- Clinoid Foramen in Dry Human Skulls in North India

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Abstract

Introduction: The Carotico-clinoid foramen is an inconstant structure which is formed by the union of the anterior and middle clinoid processes by a ligament known as the carotico-clinoid ligament which may be ossified

Aim: The present study is to know the prevalence of carotico-clinoid foramen in dry skulls available in Anatomy department of Medical Colleges in Jammu & Kashmir.

Methodology: For the present study, dry unknown human skulls were collected in the Department of Anatomy, Of Government Medical College, Jammu & SKIMS Medical College. The carotico-clinoid foramen was studied in dry human skulls and was observed for various parameters like complete or incomplete, unilateral or bilateral.

Results: The Study was done on 50 Skulls and carotico-clinoid foramen was found in 5 skull bones (10%). Complete bilateral /unilateral foramen was not found in any Skull,three on the right side and two on the left side. Variations in the anterior clinoid process (ACP) other than ossific. The ossified carotico-clinoid ligament (CCL) may have compressive effects on the internal carotid artery.

Conclusion: Thus anatomical knowledge of clinoid space is of utmost importance for a neurosurgeon/ENT

Surgeon approaching the internal carotid artery or other skull based surgery. Excision of the clinoid process may be required for many skull based surgical procedures and the presence of any anomalies such as ossification of ligaments in that area may pose a problem for Head/neck surgeons.

Keywords: Carotico-Clinoid Foramen, Carotico-Clinoid Ligament, Clinoid Space, Internal Carotid Artery.

Introduction

The carotico clinoid foramen, first described by Henle (1855), is formed by an osseous bridge between the tip of the middle and anterior clinoid processes of the sphenoid bone (1).The sella turcica is a saddle shaped depression on intracranial surface of body of sphenoid bone. There are three Clinoid processes present oneither side of sella turcica: The anterior clinoid processes are formed by the medial and anterior prolongations of the lesser wing of the sphenoid bone. The posterior clinoid processes are present at the end of the dorsum sellae. The middle clinoid processes are present on either side of tuberculum sellae (2). Anterior and middle clinoid processes in the living are normally linked by a ligament which is not seen in the dry skulls. However, sometimes if this ligament ossifies a foramen is formed through which internal carotid artery passes as it courses upwards medial to the anterior clinoid

process to supply the brain. This foramen is known as "Foramen ClinoidoCaroticum". (3) Ossification of interclinoid ligament that connects the anterior and posterior clinoid processes is termed as interclinoid osseous bridge or sella turcica Bridge (4). Rarely, the three processes fuse with each other (5). These bridges are related to the cavernous sinus, internal carotid artery, and pituitary gland. The existence of a bony or osseous carotico clinoid foramen may cause compression, tightening or stretching of the internal carotid artery, especially of the clinoidal segment and cause complications in regional surgery. The existence of a bony or osseous CCF may cause compression, tightening or stretching of the internal carotid artery, especially of the clinoidal segment. Research studies have also reported the fact that an ossified CCL, makes the removal of anterior clinoid process more difficult, especially in the presence of an aneurysm(6)Safe surgical exposure of the supra and parasellar region has become critically important for many lesions including jugum sphenoidale (planum sphenoidale), clinoidal and tuberculum sellae meningiomas, paraclinoidal aneurysms, and cavernous sinus tumors. The anatomical relationships of the anterior clinoid process, optic nerve, optic chiasma, internal carotid artery (ICA), ophthalmic artery (OA) and falciform ligament (FL) are complex and represent important variations. This region also is one of the most common that can be affected by many neoplastic and vascular neurosurgical lesions. Several skull base approaches (orbito-zygomatic, transbasal, cranio-orbital, pretemporal transzygomatic), conventional craniotomies (pterional, subfrontal) and endoscopic approaches have been performed to treat various lesions .Detailed anatomical, clinical and radiological studies have been conducted, yet patients would benefit from a more in-

depth understanding of the region. This study is designed to focus on the variations of the anterior clinoid process. Variations in sellar region like the interclinoid bar and the carotico clinoid foramen may cause difficulty for clinoidectomy procedures especially in the presence of an aneurysm and in surgical management while dealing with the vascular, neoplastic or traumatic lesions of the central skull base (7). Considering its significance in various neurological disorders and neurosurgeries, the present study was undertaken to determine the prevalence and study the morphology of the carotico clinoid foramen in adult human skulls. In our study, we tried to know the prevalence of CCF, among the skull samples studied and to classify the foramen as complete unilateral or complete bilateral and incomplete unilateral or incomplete bilateral. Knowledge about the ossification of the CCL may be immensely beneficial for neurosurgeons/ENT Surgeons

Materials and Methods: This cross sectional study was conducted on 50 dry unknown human skulls from the departments of Anatomy . The calvarias were removed.

Inclusion Criteria: Dry unknown human skulls which were well ossified were studied.

Exclusion Criteria: Fragmented broken skull bones and those with damaged clinoid process were excluded from the study.

included while fragmented, broken skulls were excluded from the study. The skulls were observed under daylight and photographed. The following parameters were recorded:

- Presence/absence of the foramen
- Complete/incomplete foramen
- Unilateral/bilateral foramen

For the classification of the interclinoid bars, the method proposed by Rani Archana et al (8) and the method proposed by Keyers (9) were used:

Rani Archana et al (8) classified interclinoid bars into four types:

Type I: - Bridge present between anterior and middle clinoid process (carotico clinoid foramen).

Type II: - Bridge between anterior, middle and posterior clinoid process.

Type III (Sella Turcica Bridge):- Bridge between anterior and posterior clinoid process.

Type IV: - Bridge between the middle and posterior clinoid process.

Keyers (9) 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.

Complete type: - A complete fusion between two bony bars.

Contact type: - Presence of a dividing line or suture between bony bars.

Incomplete type: - If a spicule of bone was extending from one clinoid process towards the other with a gap in between.

Results

In our Study the results are presented in tabulated form as shown in Table 1.

Figure 1:



Figure 2 :

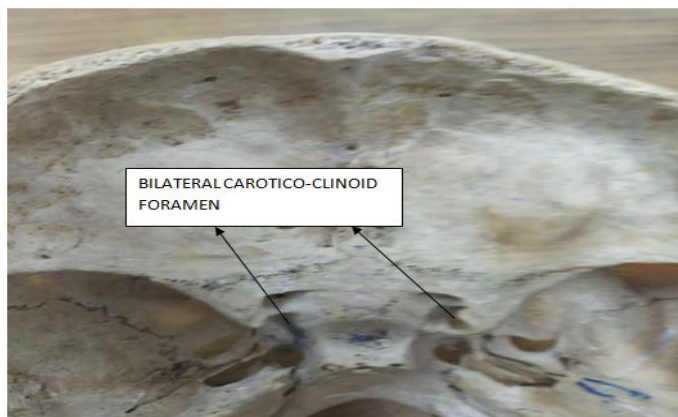


Figure 3 :

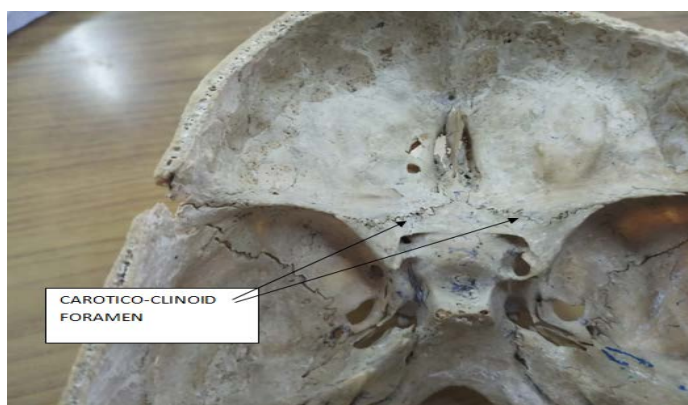


Table 1: Various Types Of Carotico Clinoid Foramina Seen , Are Tabulated As Follows.

Types Of Carotico-Clinoid Foramina	Number Of Cases
Complete-Unilateral Right	1
Complete-Unilateral Left	1
Complete-Bilateral	7
Incomplete-Unilateral Right	1
Incomplete-Unilateral Left	-
Incomplete-Bilateral	3
Bilateral-One Side Complete And The Other Side Incomplete	-

	No of Specimen	Carotico-Clinoid Foramen (CCF)		
		Unilateral	Bilateral	Total
Present study (2019)	50	3 (6%)	10(20%)	13(26%)

Discussion

The anterior and middle clinoid processes in the living are normally linked by a ligament which is not seen in the dry skull. If it does not ossify, it leaves behind a space between the anterior and middle clinoid process called the clinoid space. If the ligament ossifies it forms a foramen through which the internal carotid artery courses to supply the brain. This foramen is called “foramen clinoido caroticum”, the carotico clinoid foramen [10]. The ossification of fibrous ligaments is considered a normal physiological process that occurs with age (1). However this process is an exception when one considers the formation of the Carotico clinoid foramen. Carotico clinoid foramen becomes exceedingly important for neurosurgeons as fatal complications may arise during skull base surgery if relevant pre-operative scanning with special relevance to this structure is not done. Clinoidectomy is an essential step in skull base surgeries and the osseous carotico clinoid foramen is an underestimated structure which has important neuronal and vascular relations (11) The presence of carotico clinoid foramen causes morphological changes in the internal carotid artery traversing the canal which in turn may cause compression of the cavernous sinus because of its medial position. The carotico-clinoid foramen is the result of ossification either of the fibrous carotico-clinoid ligament or of a dural fold extending between the anterior and the middle clinoid processes of the sphenoid bone. When there is no ossification of the fibrous ligament, only a space between the anterior and middle clinoid processes is observed which is known as clinoid space. (12) The existence of a bony carotico-clinoid foramen

may cause compression, tightening or stretching of the internal carotid artery. Changes in the internal carotid artery may cause compression of the cavernous sinus because of its medial position. (13). The study of Das et al showed that the presence of carotico-clinoid foramen causes morphological changes in the internal carotid artery especially of the clinoidal segment, in almost all cases.(14) The study of Ozdogmus et al(15) demonstrated that due to calibre of the internal carotid artery in this area of the skull being larger than the diameter of carotico-clinoid foramen, it was reported that there is a high possibility to induce headache caused by compression of the internal carotid artery in the presence of carotico-clinoid foramen. In clinical practice, when a paraclinoid aneurysm occurs, the anterior clinoid process is removed as a treatment for this disease [16]. This treatment is more difficult when the carotico-clinoid foramen is present, causing higher possibility of serious bleeding in this region. After removal of the anterior clinoid process, a space is observed, the clinoid space, which has triangular form and small size. This space varies according to dimension of the anterior clinoid process and the internal carotid artery(17) Further, removal of the anterior clinoid process is one of the most critical procedures to the successful and safe management of ophthalmic segment aneurysms and tumours located in the paraclinoid region and cavernous sinus. Besides that, pneumatization of the anterior clinoid process should be evaluated preoperatively with computed tomography to avoid complications such as rhinorrhea and pneumocephalus. The presence or the absence of CCF was observed in 50 dry human skulls and it was found that in 13 skull bones (26%), the CCF was present. Mete Erturk et al.(1) reported in a study involving 119 adult dry skulls and 52 adult cadaveric heads of Turkish population that CCF was

observed in 36.97% and 32.69% respectively; the total incidence being 61(35.67%).Freire A. R et al (12)studied 80 dry human skulls and found 2.5% of the skulls with bilateral foramen and 6.25% with unilateral foramen,the total incidence of the foramen being 8.75%which is also less when compared to the present study.Lee H. Y's study(18) in 73 dried Korean skulls, complete CCF was observed in 4.1% and an incomplete type was observed in 11.6% which is similar to the present study.

Conclusion

Knowledge of the prevalence of carotico-clinoid foramen helps the neuro-surgeons for pre-operative scanning and precautions can be taken to prevent fatal complications during surgery. Considering the fact that the anatomy text books do not provide a detailed description of the carotico-clinoid ligament or foramen, the present study proves especially relevant to neurosurgeons in day to day clinical practice.Further, removal of the anterior clinoid process is an important step in regional surgery, for which additional risk is involved. Therefore detailed anatomical knowledge of the Carotico-ClinoidForamen is of utmost importance, to increase the success of regional surgery The presence of the carotico clinoid foramen may even cause a headache in patients due to compression of the internal carotid artery in this foramen. After removal of the anterior clinoid process, the triangular clinoid space is observed. This space varies according to dimension of the anterior clinoid process and the internal carotid artery. Further, removal of the anterior clinoid process is one of the most critical procedures to the successful and safe management of ophthalmic segment aneurysms and tumours located in the paraclinoid region and cavernous sinus Therefore detailed anatomical knowledge of the carotico clinoid foramen is of utmost importance, to

increase the success of regional surgeries and diagnostic evaluations.

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