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A Study on Ossified Carotico-Clinoid Ligament in Human Skulls in Rayalaseema Zone

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Abstract: *Introduction**:** Anomalous presence or absence, agenesis or multiplications of these foramina's are of interest in human skulls, in order to achieve better comprehension of neurovascular content through them. Ligaments bridging the notches sometimes ossify which may lead to compression of the structures passing through forámina's thereby they may have significant clinical signs and symptoms. Presence of carotico-clinoid foramen is the result of ossification of either carotico-clinoid ligament or of dural fold extending between anterior and middle clinoid processes of sphenoid bone. Materials and methods: The study was done in 50 adult dry human skulls collected from Sri Padmavathi Medical College for Women, SVIMS, Tirupati and S.V. Medical college and S.V University (Anthropology department). Results: In 100 adult dry human skulls, 12 skulls of unknown sex showed "Ossified carotico-clinoid ligament" out of which 7 were on the left side and 5 were on right. Conclusion**:** The study is important to know the Bony bar bridging carotico-clinoid notch connecting both the clinoid processes which can compress internal carotid artery deep to it and compression of adjacent structures producing neurological symptoms.*

Key Words: *Ossified ligament of sphenoid, ossified interclinoid ligament, carotico-clinoid ligament, internal carotid artery.*

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I. Introduction

Interior of the base of skull is divided into three fossae namely anterior, middle and posterior cranial fossae [1] occupied by frontal, temporal and occipital lobes of cerebrum respectively. In addition posterior cranial fossa contains cerebellum below the tentorium cerebelli. Anterior cranial fossa extends from frontal bone anteriorly to posterior border of lesser wing and body of sphenoid called jugum sphenoidale posteriorly. Medial ends of posterior border of lesser wing projects backwards to form anterior clinoid process to which free margin of tentorium cerebelli is attached.

Sphenoid with its two wings, squamous and petrous parts of temporal along with parietal bone contributes for the formation of butterfly shaped middle cranial fossa. Body of sphenoid bone is situated in the centre of middle cranial fossa and consists of sella-turcica with tuberculum sellae, hypophysial fossa and dorsum sellae. Tuberculum sellae presents two small bony prominences laterally that are called middle clinoid processes to which diaghrama sellae, the dural fold roofing hypophyseal fossa is attached. Dorsum sellae presents two projections called posterior clinoid processes to which attached margins of tentorium cerebella is attached.

II. Materials And Methods

The study was done in 100 adult dry human skulls collected from Sri Padmavathi Medical College for Women, SVIMS, Tirupati and S.V. Medical college and S.V University (Anthropology department). Anteroposterior, transverse diameters and length of ossified carotico-clinoid ligament were measured using digital vernier callipers.

III. Observations And Results

The present study done in Sri Padmavati Medical College for Women, SVIMS Tirupati observed an anomalous unilateral ossified carotico-clinoid ligament /Clinoideo-Caroticum ligament/foramen in 12 unknown dry human skulls. The ossified carotico-clinoid ligament was found extending from anterior clinoid process to middle clinoid process leading to the formation of carotico-clinoid foramen of HENLE behind optic canal and anterolateral to pituitary fossa in Fig.1 on left side and in Fig.2 on right side. RESULTS:12 adult dry human

skulls presented with ossified carotico-clinoid ligament" out of which 7 were on the left side and 5 were on right.

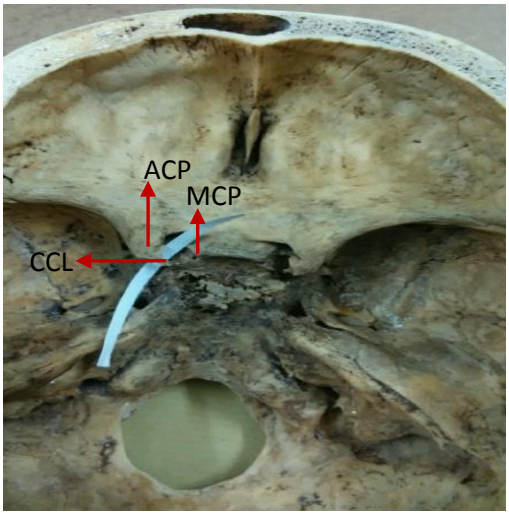

Fig:1

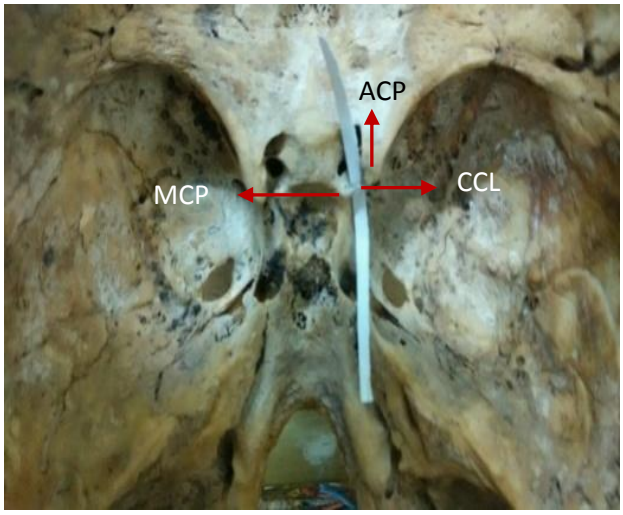

Fig:2

Sl.no.	Right side of skull			Left side of skull		
	Anteroposterior diameter	Transverse diameter	Length of ossified CCL	Anteroposterior diameter	Transverse diameter	Length of ossified CCL
1	5.38mm	5.28mm	5.54mm	4.44mm	5.50mm	5.45mm
2	5.28mm	4.89mm	5.32mm	4.50mm	5.54mm	4.96mm
3	5.42mm	4.98mm	5.28mm	4.52mm	4.99mm	5.55mm
4	5.22mm	5.20mm	5.48mm	4.86mm	5.45mm	5.27mm
5	5.00mm	5.16mm	5.50mm	4.99mm	5.52mm	5.34mm
6	5.83mm	5.30mm	5.54mm	4.54mm	5.57mm	5.57mm
7	5.63mm	4.82mm	5.36mm	4.51mm	5.36mm	4.96mm
8	5.12mm	5.18mm	5.44mm	4.53mm	5.55mm	5.42mm
9	5.81mm	4.99mm	5.44mm	4.44mm	5.24mm	4.78mm
10	5.20mm	5.19mm	4.95mm	4.12mm	5.38mm	5.23mm
11	4.96mm	4.95mm	4.99mm	3.99mm	5.40mm	4.78mm
12	4.96mm	5.30mm	5.28mm	4.12mm	5.53mm	5.41mm

On right side of skulls**:** Maximum anteroposterior diameter was 5.83mm and Minimum anteroposterior diameter was 4.96mm
Maximum transverse diameter was 5.30mm and Minimum transverse diameter was 4.89mm
Maximum length of carotico-clinoid ligament was 5.54mm and Minimum length of carotico-clinoid ligament was 4.95mm
On left side of skulls: Maximum anteroposterior diameter was 4.54mm and Minimum anteroposterior diameter was 4.12mm
Maximum transverse diameter was 5.57mm and Minimum transverse diameter was 4.99mm
Maximum length of carotico-clinoid ligament was 5.57mm and Minimum length of carotico-clinoid ligament was 4.78mm

IV. Discussion

Williams et al[1] reported that certain parts of sphenoid are connected by ligaments which occasionally ossify. Bony bridge formed by the ossified ligaments may compress important structures like internal carotid artery and may influence the flow of blood through them[2]. Srisoparks[3] and skrzat et al[4] stated that the ossification of some normally occurring ligaments of human skull produce new structures like the bony bridges that connect the clinoid processes with other surrounding structures. Ozdogmus et al[5] found that these are sellar bridges and may be unilateral or bilateral[6]. Galdames et al[7] reported these ligaments as carotico-clinoid, inter clinoid, petrosphenoid and pterygospinous. These ligaments are related to many anatomical structures and when ossified may cause compression of these structures. According to Basmajian[8] and Breathnach[9] the carotico-clinoid ligaments are related to internal carotid artery, occulomotor nerve. The petrosphenoid ligament is related to abducent nerve while pterygospinous ligament is related to the branches of mandibular nerve and chorda tympani nerve

The word clinoid is derived from the greek word 'cline' which means a bed and 'oid' that means similarity to. It is also derived from greek word 'Klinein' or latin word 'clinare' both of which means sloped or inclined.

Carotico-clinoid foramen of Henle is formed after ossification of the fibrous ligament that connects anterior clinoid process with middle clinoid process. In the absence of ossification of this ligament a space between anterior and middle clinoid process is observed in dry skulls[10]. The ossification of fibrous ligament is considered as normal physiological process that occurs with aging, however this process is an exception when one considers the formation of carotico-clinoid foramen[11]. This foramen allows the passage of 6th segment i.e. the clinoid segment of internal carotid artery. Formation of this foramen may cause compression and narrowing of internal carotid artery which is located medial to anterior clinoid process. Changes in internal carotid artery may cause compression of cavernous sinus because of its medial position[10]. According to Das et al [12] presence of carotico-clinoid foramen causes morphological changes in internal carotid artery in almost all cases. These variations due to the presence of the foramen cause difficulty in performing neurosurgical techniques in this region [10].

In a case of para-clinoid aneurysm, the anterior clinoid process is removed as a treatment[10] and this surgery is more difficult when Carotico-clinoid foramen is present, causing higher possibility of serious bleeding in this region[10]. Due to the greater calibre of Internal Carotid Artery in this region the possibility of headache due to its compression in the foramen is high[13].

A study by Rani[14] et al have classified the Interclinoid bars between the three clinoid processes into 4 types

1. Type 1- Bridge between anterior and middle clinoid processes i.e carotico-clinoid foramen.
2. Type 2- bridge between anterior, middle and posterior clinoid processes.
3. Type 3 - bridge between anterior and posterior clinoid processes i.e sella turcica bridge.
4. Type 4-Bridge between middle and posterior clinoid processes.

Thus the skulls being reported here falls into type1.

Freire et al[15], has reported that it is more commonly found in females, while Lee et al[16] and Dido & Ischida[17], have found it more common in males . Racial incidences of carotico-clinoid ligament is high in Turkish population (35, 67%)[11] followed by Caucasian Americans (34.84%), and low incidence was reported in Koreans (15.7%) and Japanese (9.9%)[6,11]. Carotico-Clinoid foramen is an important structure due to its relations with cavernous sinus and its contents, sphenoid sinus and pituitary gland [11]. On one hand a wide foramen may provide safety cover for the artery, on other hand it may confuse radiologists while doing carotid angiogram and pneumatisation or marrow assessments of anterior clinoid process[6].

Internal Carotid Artery enters the subarchnoid space through a thick ring of duramater called distal dural ring. The Internal Carotid Artery is also surrounded with another ring of dura, the proximal dural ring which is exposed by removing the anterior clinoid process. The area in between these two rings i.e., between anterior and middle clinoid processes is called clinoidal space. Clinoidal segment of Internal Carotid Artery located in this space is exposed by removing the anterior clinoid process, during surgical approach to sellar region for tumours and aneurysms. Removal of anterior clinoid process carries the risk of damage to ICA[6]. Oculomotor nerve may also be damaged during the removal of anterior clinoid process. Serious weighing of risks and benefits of operating procedure and risks of neural and vascular injury[6] are important. Presence of carotico-clinoid formen makes retraction or mobilisation of cavernous segment of internal carotid artery is impossible even after releasing the proximal and distal carotid rings. Hence, preoperative recognition of carotico-clinoid foramen is important as undue retraction of cavernous segment of Internal carotid artery may tear or rupture it and cause fatal cerebral infarction[6]. The present study correlates with the studies done by Kavitha Kamath.B[6] and Dr.Arun Kumar S. Bilodi[11] **,** Rani[14]. The present study also correlates with statements done by Srisopark[3] and skrzat et al[4]

V. Summary & Conclusion

Human skull is a complex structure which mainly consists of various named and unnamed foramina's knowledge about these foramina's and structures passing through it and its clinical importance are necessary while performing neurosurgical procedures and knowledge of prevalence of carotico-clinoid foramen helps neurosurgeons for preoperative scanning and planning to prevent fatal complications during surgery. Description of carotico-clinoid ligament/carotico-clinoid foramen and the present observations are useful in day to day clinical practice and knowledge of their presence holds strategic importance for in reducing post surgical complications.

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