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Original Research Article

AN OSTEOLOGICAL STUDY OF OSSIFIED CAROTICO-CLINOID LIGAMENTS AS POTENTIAL RISK FOR INTERNAL CAROTID ARTERY COMPRESSION

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ABSTRACT

Introduction: Knowledge of morphological structure such as anterior clinoid process and the middle clinoid process is essential during the surgical approach of the cavernous sinus and internal carotid artery. In addition, osseous variations such as ossified interclinoid and carotico clinoid ligament are significant in clinical practice because they can produce various neurological disturbances or block the passage of an internal carotid artery which changes its direction and runs medially out of the cavernous sinus through the osseous bar. The aim of the present study was to evaluate the incidence of the ossified carotico clinoid ligament in Bengal population.

Material and Methods: 56 dry unknown skull bones were studied from the Department of Anatomy, IQ City Medical College, Durgapur, West Bengal. The incidence of partial or complete and unilateral and bilateral ossification of carotico clinoid ligaments (CCL) was observed and photographed.

Results: In the present study, the incidence of the ossified carotico clinoid ligament (CCL) was observed in 38 (33.93%) sides of skulls. The incidence of complete ossification of the carotico clinoid ligament (CCL) was observed in 9 (16.07%) skulls (unilateral-5 and bilateral-4). Incomplete ossification of the carotico clinoid ligament (CCL) was found in 17 (30.35%) skulls (unilateral- 9 and bilateral-8).

Conclusion: A potential risk for compression of the internal carotid artery is due to ossification of the carotico clinoid ligament. Hence, a detailed anatomical and morphometric knowledge of the region is necessary to perform the successful surgeries. The aim of the present study was to evaluate the incidence of the ossified carotico clinoid ligament in Bengal population as well as to discuss its clinical relevance.

KEY WORDS: Clinoid process, Sphenoid bone, Anterior clinoidectomy, Internal carotid artery compression.

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INTRODUCTION

The medial end of the lesser wing of sphenoid bone presents a triangular projection called anterior clinoid process (ACP) to which the free border of the tentorium cerebelli is attached. The carotico clinoid ligament (CCL) connects the

anterior clinoid process (ACP) to the middle clinoid process (MCP) which is present on the lateral end of tuberculum sellae. In some cases, CCL may become ossified to form a foramen known as 'carotico clinoid foramen' (CCF). It was first described by Henle (1855) [1, 2].

The CCL is related to many anatomical structures and when ossified, may cause compression of these structures especially to the internal carotid artery and the oculomotor nerve. Excision of the anterior clinoid process is an important and premise steps for neurosurgeons in exposing structures during any skull based surgical procedure [3]. Therefore, detailed anatomical and morphometric knowledge of the region is necessary to perform the successful surgeries. The aim of the present study was to evaluate the incidence of the ossified carotico clinoid ligament in Bengal population as well as to discuss its clinical relevance as described in the literature.

MATERIALS AND METHODS

112 carotico clinoid ligaments (CCL) belonging to 56 dry unknown skull bones were studied with respect to the ossified carotico clinoid ligament from the Department of Anatomy, IQ City Medical College, Durgapur, West Bengal. The damaged anterior clinoid process skulls were excluded from the study. Skulls with the ossified carotico clinoid ligament (CCL) were photographed and studied with respect to the formation of the carotico clinoid foramen. The incidence of partial or complete and unilateral and bilateral ossification of carotico clinoid ligaments (CCL) was observed and photographed.

RESULTS

56 adult dried skulls (112 sides) were studied for the occurrence of unilateral as well as bilateral and complete as well as incomplete ossification of CCL. It was observed that in 38 (33.93%) sides of skulls had ossified carotico clinoid ligament (CCL) while in 74 (66.07%) sides of skulls, the carotico clinoid ligament (CCL) had not ossified. The incidence of complete ossification of the carotico clinoid ligament (CCL) was observed in 9 (16.07%) skulls. Out of which unilateral complete ossification was seen in 5 skulls and bilateral complete ossification was seen in 4 skulls. Incomplete ossification of the carotico clinoid ligament (CCL) was found in 17 (30.35%) skulls. Of these unilateral incomplete ossification was seen in 9 skulls and bilateral incomplete ossification was seen in 8 skulls (Figure 1 & 2). Incidence of ossified CCL is summarized in table 1.

Fig. 1: Sphenoid bone showing unilateral complete carotico-clinoid ligament ossification. A) Left side B) Right side.

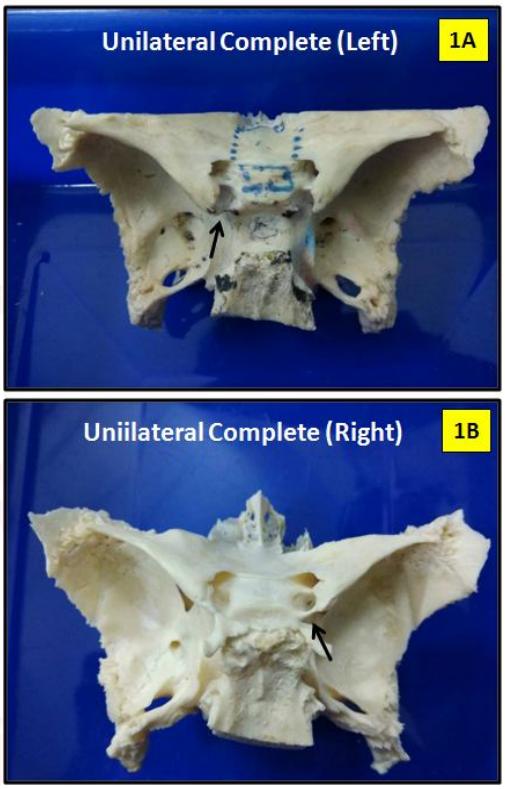


Fig. 2: Sphenoid bone showing unilateral incomplete carotico-clinoid ligament ossification. A) Left side B) Right side.

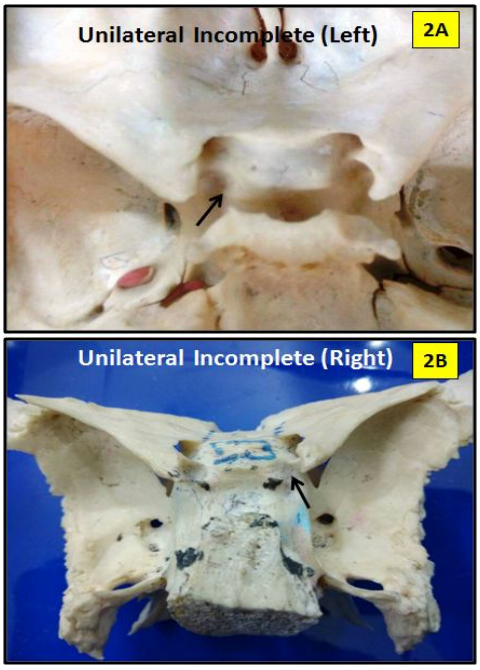


Table 1: Showing unilateral, bilateral and complete or incomplete carotico clinoid foramen.

	Side	Complete	Incomplete	Total
Unilateral	Right	3	5	8
	Left	2	4	6
Bilateral		2	6	8
Bilateral	Right	3	1	4
	Left	1	3	

DISCUSSION

In the literature, we frequently encounter the ossification of ligamentous structures in various parts of the body. Similarly, certain ligaments which connect the different parts of the sphenoid bone occasionally ossify such as the pterygospinous (between the lateral pterygoid plate and the spine of sphenoid), the interclinoid (between the anterior and posterior clinoid processes) and the carotico clinoid (between the anterior and middle clinoid processes) [4].

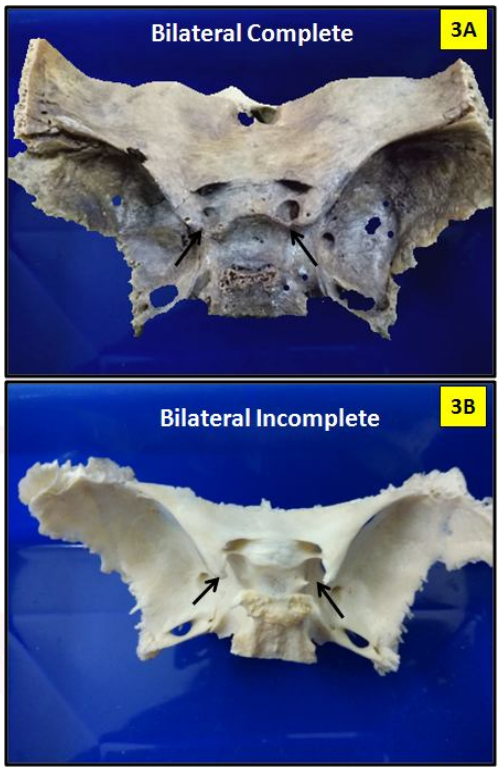
In the living being, as a rule, anterior and middle clinoid processes are connected by a carotico clinoid ligament (CCL) which is not seen in the dry skulls. However, in some cases, CCL may become ossified to form a foramen known as 'carotico clinoid foramen' (CCF). The carotico-clinoid foramen thus formed between the ligament and the body of sphenoid transmits upturned course of the internal carotid artery [3, 4].

Table 2: Incidence Of Ossified Carotico-Clinoid Ligament In Different Population.

Author	No. of Specimen	Ossified Carotico-clinoid Ligament		Total
		Unilateral	Bilateral	
Azeredo et al (1988) [7]	270	6 (2.22%)	11 (4.05%)	17 (6.27%)
Inoue et al. (1990) [3]	50	11 (22%)	7 (14%)	18 (36%)
Cireli et al (1990) [5]	50	3 (6%)	-	3 (6%)
Lee et al (1997) [8]	73	11 (15.06%)	1 (1.4%)	12 (16.4%)
Gurun et al (1994) [10]	198	16 (8.08%)	11 (5.55%)	27 (13.63%)
Erturk et al (2002) [2]	171	41 (23.98%)	20 (11.69%)	61 (35.67%)
Desai et al (2010) [6]	223	53 (23.74%)	30 (13.45%)	83 (37.19%)
Sanobar et al (2012)[9]	100	10 (10%)	14 (14%)	24 (24%)
Anne D Souza et al (2016) [11]	27	7 (12.96%)	5 (9.2%)	12(22.22%)
Present Study (2017)	56	14 (25%)	12 (21.43%)	38(33.93%)

The incidence of ossified CCL including both unilateral as well as bilateral in the literature varies from 6% to almost 38% [5, 6]. In our study, ossified CCL was reported in 38 sides of skulls (33.93%). Our results were comparable with that of Erturk et al and Inoue et al who reported an incidence of ossified CCL in 35.67% and 36% respectively[2, 3]. But Desai et al have reported 37.19% incidence which is slightly high as compared to our study [6]. Previous studies done on ossified CCL are summarized in Table 2.

Fig. 3: Sphenoid bone showing unilateral carotico-clinoid ligament ossification. A) Complete B) Incomplete.



Various studies show that the prevalence of unilateral ossified CCL ranges from 2.2 - 24% [7, 2]. We found a high incidence of unilateral ossification of CCL and were recorded in 14 skulls (25%). Out of 14 skulls, unilateral ossified CCL was found in 8 skulls (14. 28%) on right side and in 6 skulls (10.7%) on left side. Our findings were almost similar to Desai et al and Erturk et al who reported in 23.74% and 23.98% respectively [6, 2].

In an analysis of almost all published cases, the prevalence of bilateral ossified CCL varies from 1.4% to almost 14% [8, 3, 9]. The prevalence of bilateral ossified CCL in the present study is in 12 skulls (21.43%). Of the 12, complete ossified CCL were observed in 4 skulls (7.14%) and incomplete ossified CCL were observed in 8 (14.28%) skulls (Figure 3).

The frequency of unilateral and bilateral ossified CCL was higher in our study compared with previous studies. This disparity with former studies may be due to different specimens (dry skull and fixed cadavers) and difference of the study populations.

The present study analyzed the presence of complete or incomplete ossification of the carotico-clinoid ligaments. These formations occupy a superficial and parasellar portion in the middle cranial fossa, establishing important relationships with the cavernous sinus, internal carotid artery, and optic nerve. These are compressed against the osseous bar especially internal carotid artery and are capable of generating clinically important alterations. After leaving the cavernous sinus, an internal carotid artery passes upwards with a sharp hair-pin bend called as carotid siphon. If ossified CCL is present, internal carotid artery changes its direction and runs medially out of the cavernous sinus through osseous bar [2]. Therefore, detailed and precise knowledge of the close relationship between the anterior clinoid process and cavernous sinus is important in any surgical approach to this region.

Limitations: The major limitation of our study was the low sample size. We suggest further studies with bigger sample sizes to validate our results.

CONCLUSION

In conclusion, excision of the anterior clinoid process is the premise step for neurosurgeons in regional surgery. A detailed analysis of the anterior clinoid process and related ossification of the ligament inserted can improve our understanding of the vascular complication and complex clinical neuralgias affecting this region. This study was done in the hope to increases the success of diagnostic evaluation and to improve the effectiveness of surgical approaches to this region.

Conflicts of Interests: **None**

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