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Metrical and Non-Metrical Study of Anterior Clinoid Proces in Adult Indian Skulls

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Abstract:-

Background:-The complex architecture of the anterior clinoid process (ACP), which is usually removed during the surgical elimination of tumors or aneurysms of sellar region, has surgical importance. For effective clinoidectomy, a neurosurgeon must have the prior knowledge of anatmoical variations of ACP.

Aim And Objective:- The purpose of this study was to investigate the dimensions and variation in the shape of ACP in dry adult skulls of Indian origin.

Methods:-

30 dry adult Indian skulls will be observed .Basal width, length and thickness of ACP will be measured on both the sides using Vernier caliper. Non-metrical parameters such as shape, direction of ACP will be recorded.

Reason:-

Special attention should be paid to the anatomic landmarks indicating the relationship between the anterior clinoid process and adjacent structures. Beside that, pneumatization of the anterior clinoid process should be evaluated preoperatively with computed tomography to avoid complications.

Keywords:- Anterior clinoid process, anatomical variations , sphenoid bone, anterior clinoidectomy

INTRODUCTION:-

The Sphenoid bone, an unpaired pneumatic bone form parts of anterior and middle cranial fossae of skull.It consists of a central body,greater and lesser wings and two pterygoid processes.The lesser wings end medially to form eminences termed as anterior clinoid processes(ACP) which are attached to the free margin of tentorium-cerebelli.(1) The anatomical relationships of the ACP, ON, chiasm, 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 of this region. (2) An anterior clinoidectomy can provide enormous benefits, facilitating the management of paraclinoid and upper basilar artery lesion,but it also carries the potential risk of cerebrospinal fluid leaks.(3)

Detailed knowledge of dimensions and anatomical variations of anterior clinoid process is very essential for planning a safe and effective clinoidectomy. This investigation is focused to study the anatomical variations and different dimensions of anterior clinoid process in dry adult Indian skull.

MATERIALS AND METHODS:-

The study was carried out on 30 dry adult skulls of either sex obtained from preserved set of bones received at the Department of Anatomy, Saveetha dental college and hospital, chennai, India . Damaged and diseased skulls were not included in the study.

The following morphometric parameters were studied on either side of skull using vernier calipers.

A. Basal width- measured from lateral margin of optic foramen to lateral margin of anterior clinoid process, on both right and left side.(AB line)

B. Length of anterior clinoid process - perpendicular length taken between apex and base.(CD line)

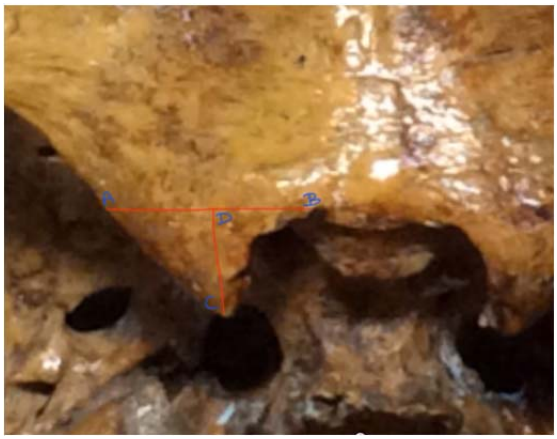


Figure 1 : photograph showing the procedure followed in measurement of ACP

C. Thickness of anterior clinoid process- it was measured at the base of anterior clinoid process.

In addition to the above parameters, the anterior clinoid process were observed for anatomical variations with respect to shape and direction of posterior end, surface and tip of ACP.

Statistical Analysis:-

The data represents the mean and standard deviation of actual values. The data was analysed by unpaired student's t test using SPSS software (version 21). The level of significant difference was $p<0.05$.

RESULTS:-

The age of the skulls were in range between 25 and 50 years. Among 30 skulls, 20 were of males and 10 were of females. The mean basal width of right side of the ACP was 11.38±1.306mm and of left side was 11.59±1.658mm . The mean length of ACP was 12.61±2.591mm and 12.99± 2.275mm on right and left sides. The mean thickness of ACP of right and left sides observed were 6.50±1.418mm and 6.09± 1.200mm, respectively . Statistical evaluation of the data suggested that the difference in dimensions of anterior clinoid process between right and left sides were non-significant . (Table 1)

Several variations in the shape of ACP was observed :- (table 2)

Triangular , pentagonal , finger-like , nipple-like and J-shaped. Unilaterally triangular ACP of right side was the most common shape observed which was found in 12 out of 30 skulls(40%). Unilaterally triangular ACP of left side was found in 3 out of 30 skulls(10%). Bilaterally triangular ACP was found in 3 out of 30 skulls(10%).

The triangular shaped anterior clinoid process was further classified into following types:-

Triangle with narrow base

Triangle with broad base

Triangle with notched inner border

Triangle with equal sides

Unilaterally triangular ACP with narrow base on right and left sides was observed in 1 (3%) and 4 (13%) skulls. Unilaterally triangular ACP with broad base on right and left sides was observed in 4 (13%) and 2 (7%) skulls. Bilaterally triangular ACP with notched inner border was found in 3 (10%) out of 30 skulls. Unilaterally triangular ACP with notched inner border on right and left sides was found in 3 (10%) and 4 (13%) skulls. Bilaterally triangular ACP with equal sides was found in 1(3%) skull.

Unilateral triangular ACP with equal side on left side was observed in 2 (7%) skulls. Unilaterally pentagonal ACP on left side was found in 4 (13%) skulls. Bilaterally finger-like ACP was found in 1 (3%) skull. Unilaterally finger-like ACP on left side was found in 2 (7%) skulls. Unilaterally nipple-like ACP on both right and left side was found in 1 (3%) skull. Unilaterally J-shaped ACP on right and left side was found in 1 (3%) skull and 5 (17%) skulls.Based on direction , two types of ACP was observed:-(table 3)

Straight and inwardly curved anterior clinoid process . In majority of skulls, the ACP was unilaterally straight on right side in 11 (37%) out of 30 skulls and unilaterally curved on left side in 11 (37%) out of 30 skulls. Bilaterally straight ACP was found in 4 (13%) skulls. Unilaterally straight ACP on left side was found in 4 (13%) skulls. Bilaterally curved ACP was found in 1 (3%) skull. Unilaterally curved ACP on right side was found in 7 (23%) skulls.

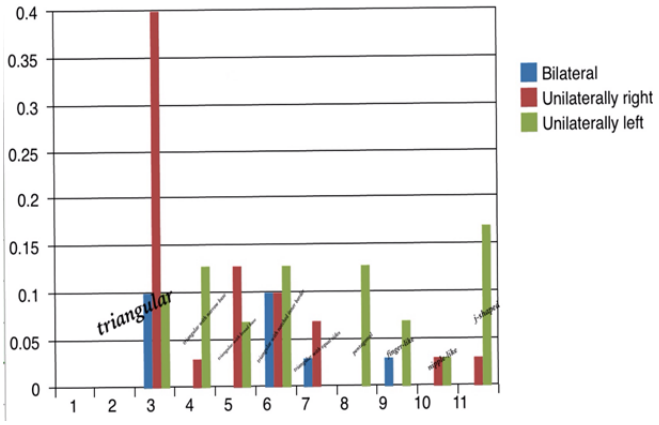
The tip of the anterior clinoid process was either pointed or blunt. Bilaterally pointed end ACP was found in 3 (10%) skulls. Unilaterally pointed end ACP on right and left side was found in 4 (13%) skulls and 7 (23%) skulls. Unilaterally blunt end ACP on right and left side was found in 3 (10%) skulls and 1(3%) skull

Table 1 - different dimensions of anterior clinoid process(mm)

Dimensions	*Right side*	*Left side*
	Mean ± SD	*Mean±SD*
Basal width	11.38±1.306	11.59±1.658
Length	12.61±2.591	12.99±2.275
Thickness	6.50±1.418	6.09±1.200

Table 2 different Shapes of anterior clinoid process

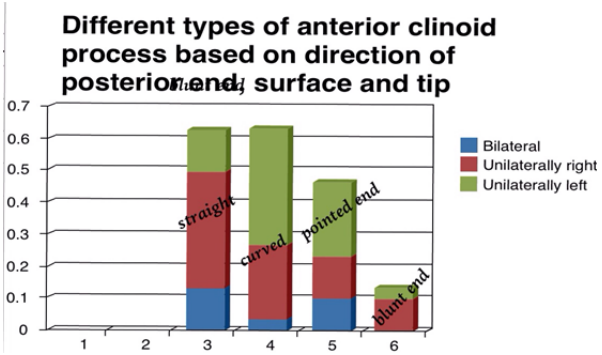
	Bilateral	Unilateral	
		Right	*Left*
Triangular	3(10%)	12(40%)	3(10%)
Triangle with narrow base	-	1(3.3%)	4(13.3%)
Triangle with broad base	-	4(13.3%)	2(6.7%)
Triangle with notched inner border	3(10%)	3(10%)	4(13.3%)
Triangle with equal sides	1(3.3%)	2(6.7%)	-
pentagonal	-	-	4(13.3%)
finger-like	1(3.3%)	-	2(6.7%)
nipple-like	-	1(3.3%)	1(3.3%)
J-shaped	-	1(3.3%)	5(16.7%)



Graph 1 different shapes of anterior clinoid process

Table 3 different types of anterior clinoid process based on direction of posterior end , surface and tip

	Bilateral	Unilateral	
		Right	*Left*
Straight	4(13.3%)	11(36.7%)	4(13.3%)
Curved	1(3.3%	7(23.3%)	11(36.7%)
Pointed end	3(10%)	4(13.3%)	7(23.3%)
Blunt end		3(10%)	1(3.3%)



Graph 2 different types of anterior clinoid process based on direction of posterior end, surface and tip

DISCUSSION:

The region of sella turcica is an important area ,due to its anatomical relations with the cavernous sinus and its contents, sphenoid sinus & pituitary gland. Complete or partial removal of the ACP is an important step in the superior approach to the cavernous sinus, radical removal of tumours, management of carotid- ophthalmic, giant ICA, & paraclinoid aneurysms. Presence of any abnormality in the anatomical structure of ACP combined with a completely ossified CCF, removing the ACP may have high risk. .The main risk is injury to the ICA.The curve of ICA in and above the Cavernous sinus as seen in a lateral carotid arteriogram (like a V on its side, opening backwards) i s commonly called the carotid siphon .Removal of ACP permits visualization of approximately 6mm more of the proximal ICA without entering the cavernous sinus. Therefore, understanding the complex morphometric anatomy of ACP and knowledge of its surrounding structures is of great importance for a surgeon to increase the success of sugery.(1)

In the present study mean length of ACP on right and left side was 12.61±2.591mm& 12.99±2.275mm.Lee et al (4) in a Korean study reported average length as 9.26±1.43 and 9.09±1.67mm & Gupta et al (5) in a Nepalese study reported 10.74±2.37mm, 9.91± 1.50mm on right and left side which is marginally less than this study. The mean basal width and thickness of ACP on right and left side was 11.38±1.306mm and 11.59±1.658mm and 6.50±1.418mm, 6.09±1.20mm was marginally great to the Korean study by Lee et al with width and thickness of ACP as reported 9.97±1.58 and 9.29±1.39mm and 5.44±1.02 , 5.19± 1.12mm on right and left side. No significant difference was observed between the two sides ($p>0.05$).

Variation in shape of the skull bones among a population is common phenomenon observed. In present study , there are variations in the shape of ACP , which were either bilateral or unilateral . Triangular, pentagonal, nipple-shaped and J-shaped ACP were observed among which triangular ACP was the most common one. In addition to the variation in shape, direction of ACP was also variable.

The anatomy of a bone can be influenced by several factors such as age, gender , race, geographical distribution,genetic factors, environmental factors and socioeconomic status of the population.(6)(7) The skulls studied in present study were between 25-50 years at which the bone density cannot change much. Since majority of skulls used in this study were of male skulls , it is difficult to analyse gender related changes in metrical parameters of ACP. it is not clear whether genetic factors contribute to morphological change in mammalian skull bone.(8)

The anatomical variation of ACP with respect to shape and direction in this study may be due to pneumatization and ossification process.

CONCLUSION:-

The Anterior clinoid process and falciform ligament are bony and dural structures which obscure the supraclinoid Internal Carotid Artery and the Optic nerve , and thus pose a significant challenge for safe exposure of this region. Variations and practical measurements provided by the present study may help clinicians to better understand the regional anatomy pertinent to neurosurgical procedures, as well as increase their likelihood of avoiding serious complications.

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