

Original article

Anatomical Dimensions and Types of the Anterior Clinoid Process in Libyan population by Using Computed Tomography: A cross Sectional Study

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ABSTRACT

The anterior clinoid process (ACP) has a complex anatomical feature and surrounded by important structures which may complicate the surgical procedures during the anterior clinoidectomy. Our objective was to measure dimensions of anterior clinoid process, and to determine variations of its types. Forty-nine of cranial computed tomography scans were performed from adult Libyan patients on routine examination of paranasal sinus at Benghazi Medical Center between February 1, 2023, and April 14, 2023. The right and left ACP length and the base width were measured on the axial CT images. Data analysis was done using SPSS version 23. The means and standard deviations were calculated. The paired Student's *t* test was used to determine the statistically significant differences in means between the right and left ACP. ($P \leq 0.05$) was considered statistically significant at (95%) confidence interval. The length of the right and left ACPs were 11.2 ± 2.2 mm and 11.6 ± 2.4 mm, respectively. The width of the right and left ACPs were 5.37 ± 1.22 mm and 5.42 ± 1.24 mm, respectively. Type 2 anterior clinoid process was the commonest (75.5 %) while type 1 was the least common (4.1 %). There was no statistically significant difference between right and left sided measurements. Our study outcomes may be helpful for pre-operative planning. Presence of any variations may result in unnecessary injury to the complicated surgical procedures that involve removal of ACPs. Further research studies required with large sample size of population will give well understanding about the parameter of ACPs.

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INTRODUCTION

The anterior clinoid process (ACP) protrudes posteriorly from the lesser sphenoid wing of the sphenoid bone, comprising the anterior portion of the cavernous sinus roof. The base of the ACP has three attachment points with the adjacent sphenoid bone: The lateral attachment is the medial border of the lesser sphenoid wing and, laterally, the

anterior root of the lesser sphenoid wing extends from the base of the ACP to the sphenoid body, forming the roof of the optic canal, also called the planum sphenoidale. The third point is a minor sphenoid bone, called the optic strut, that extends below the optic nerve, reaching the body of the sphenoid and forming the floor of the optic canal and roof of the superior orbital fissure [1,2]. The optic pillar is a small bony bridge that extends from the inferomedial surface of the ACP base to the sphenoid body, immediately ahead of the carotid sulcus. From its junction with the ACP, the optic strut slopes gently downward as it approaches the body of the sphenoid. Within the context of the anatomy of the sphenoid bone, the ACP has considered importance for the surgical techniques since its removal is a critical step in the treatment of paraclinoid lesions. Examples of conditions requiring ACP removal include aneurysms of the ophthalmic segment of the internal carotid artery, meningiomas of the cavernous sinus, and the medial third of the lesser sphenoid wing and also giant pituitary adenomas [3-5]. The microsurgical procedure of anterior clinoidectomy is a crucial to the treatment of pathologies that arise from the paraclinoid region. Still, the major complications of this procedure are risks of visual disturbances, oculomotor nerve palsy/paralysis, bleeding from the opening of the cavernous sinus, lesion of the internal carotid artery as well as of the ophthalmic artery, opening of the paranasal sinuses, and cerebrospinal fluid fistula possibly leading to meningitis and death. For example, in case of paraclinoid aneurysm surgery, the reported rates of morbidity, mortality, and cerebrospinal fluid fistula with or without meningitis are 5.8–18%, 0.6–45.4%, and 2.2–14%, respectively. Furthermore, these rates are likely to be similar to those in patients with paraclinoid diseases undergoing surgery [6]. Intradural and extradural surgical techniques of anterior clinoidectomy have been described in detail by many researchers [7-9]. Last but not least, Anterior clinoidectomy provides improved exposure of structures in and around the optic nerve, ICA and optic canal. It also enhances mobilization of the intracranial ICA and optic nerve with less brain retraction [10-12]. The main objective of our study was to measure dimensions of anterior clinoid process, and to determine variations of its types.

METHODS

Target population

The study was conducted on 49 adult Libyan patients whose ages ranged between (18-71) years were selected purposively. Data collected from Benghazi medical center between February 1, 2023, and April 14, 2023. We excluded the cases of skull base injuries or intracranial pathology.

Outcomes Measures

The measurements were performed on the axial CT images with slice of 1 mm, the measurements of the ACP length and base width were performed according to Lee HW et al 2013 [13] and Lee HY et al 1997[14] as follows: a) The Length of the ACP is the distance between the Anterior clinoid tip and the medial margin of the optic canal, b) The Basal width of the ACP is the distance between the Medial margin of the optic canal and the lateral edge of the anterior clinoid process, and c) All the measurements were recorded in millimeters.

The ACP was classified into four types based on the dimensions using the criteria given by Cecen et al 2016[15] as follows: type 1 short (<10.5mm) and wide (>8.14), type 2 long (>10.5mm) and narrow (<8.14mm), type 3a short (<10.5) and narrow (<8.14mm), and type 3b long (>10.5) and wide (>8.14)

Statistical analysis

The statistical analysis included calculating basic parameters of descriptive statistics like mean value and standard deviation. The results are presented in tables. The testing was performed by Student's t-test to determine the statistically significant differences in means between the right and left ACP and $p < 0.05$ is considered statistically significant. Data analysis was done using SPSS version 23.

RESULTS

The present study included a sample of 49 cases. the mean age of target population was 40.4 years.

Dimensions of the length and width of ACP on both sides

The mean of the length of the left ACP was (11.6 mm) which is greater than that on the right side (11.2 mm), but not statistically significant $P = (0.0391)$. while, the mean of the width of the left ACP was (5.43 mm) which is smaller than that on the right side (5.48 mm), however statistically is not significant $P = (0.841)$ (Table 1).

Table 1. Dimensions of the length and width of ACP on both sides

Dimensions(mm)	Mean \pm SD		P-Value
	Right ACP	Left ACP	
Length	11.2 \pm 2.2	11.6 \pm 2.4	0.391
Width	5.48 \pm 1.28	5.43 \pm 1.18	0.841

Types of Anterior Clinoid Process

The most common type of ACP was type 2 seen in 37(75.5%) ACPs, followed by type 3a which is seen in 10 (20.4%) whereas type 1 had the lowest prevalence and was seen in only 2 (4.1%). The type3b was not observed in the sample that may be attributed to small sample size (**figure 1**).

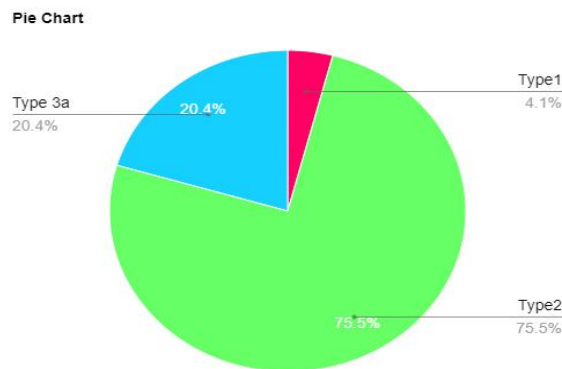


Figure 1. Types of Anterior Clinoid Process

DISCUSSION

Our study revealed that, the average ACP length was longer when compared to Indian [16], European [17], Brazilian [18], Nepalese [19], Korean [14], Kenyan [20] and Turkish [21] populations. On the other hand, the average width of the ACP was wider than Nepalese [19] and Korean [14] populations, but narrower than the Indian [16], and Turkish populations [21]. **Table (2)** presented the Comparison of the anterior clinoid process dimensions in the current study with other previous populations studies from different region of the world.

Table 2. Comparison of the anterior clinoid process dimensions of current study with other populations studies

Study	Population	Length	Width
Lee et al., 1997	Korean	9.18 \pm 1.55	9.63\pm1.49
Gupta et al., 2005	Nepalese	10.74 \pm 2.37	10.83\pm1.20
Hunnargi et al., 2008	Indian	10.68 \pm 1.90	12.40\pm2.58
Kapur and Mehic, 2012	European	9.90 \pm 1.60	9.40 \pm1.40
da Costa et 2016	Brazilian	10.31 \pm 2.10	7.70 \pm1.73
Sibuor et al.,2018	Kenyan	10.92 \pm 2.79	10.43\pm2.67
Cecen et al.,2016	Turkish	10.74 \pm 3.35	8.04\pm1.74
*Current study (2023)	Libyan	Right side 11.2 \pm 2.2 Left side 11.6\pm2.4	Right side 5.48\pm1.28 Left side 5.43\pm1.18

Noticeably, the current study presented that the right sides were wider and the left sides were longer which is in agreement with the South Indian skulls study, on the other hand it is different to Turkish and Nepalese skulls studies where the right sides were shorter and the left sides were wider. Yet, the right- and left side measurements did not statistically significant [15], Globally, research evidences contribute to the facts suggesting that the age, gender, race, geographical distribution, genetic factors and socioeconomic status of the population show significant role on the

morphometry of the skull base [21]. Our findings show that, most of the ACPs were type 2 (long and narrow). This is comparable to the results of Cecen et al. on a Brazilian population where type 3 ACPs were the commonest (65.7%), while in the Kenyan the type 3b seen in (47.1%) ACPs and finally type 3a had the lowest prevalence and was seen in only 8 cases (7.8%) of the ACPs [20]. Significantly, the types of ACPs may affect the method of the surgical approach used during the anterior clinoidectomy in order to achieve minimum operative time as well as reduce the amount of bone dust produced by drilling and prevents the carotid or optic nerve damage.

CONCLUSION

Presence of any variations may result in unnecessary injury to the complicated surgical procedures that involve removal of ACPs. Our study may be helpful for pre-operative planning. Further studies required with large sample size of population will give better understanding about the parameter of ACPs that make good knowledge about the parasellar area.

Conflicts of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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الأبعاد التشريحية وأنواع النَّاتِي السَّرِيرِيَّ الإمامي لدى السكان الليبيين باستخدام التصوير المقطعي: دراسة مقطعية

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المستخلص

النَّاتِي السَّرِيرِيَّ الإمامي له مواصفات تشريحية معقدة ومحاط بتركيبات مهمة قد تؤدي إلى تعقيد العمليات الجراحية أثناء استئصال النَّاتِي السَّرِيرِيَّ الإمامي. كان هدفنا هو قياس أبعاد النَّاتِي السَّرِيرِيَّ الإمامي وتحديد الاختلافات في أنواعه. تم إجراء تسعة وأربعين فحصاً بالتصوير المقطعي للججمة على مرضى ليبيين بالغين أثناء الفحص الروتيني للجيوب الأنفية في مركز بنغازي الطبي في الفترة ما بين 1 فبراير 2023 و14 أبريل 2023 وتم قياس الطول و العرض للنَّاتِي السَّرِيرِيَّ الإمامي الأيمن والأيسر على الصور المقطعية وتحليل البيانات باستخدام البرنامج الإحصائي إصدار 23 و حساب المتوسطات والانحرافات المعيارية و استخدام اختبار الطالب المقترن لتحديد فروق ذات دلالة إحصائية بين النَّاتِي السَّرِيرِيَّ الإمامي الأيمن والأيسر وكانت النتائج كالآتي: طول النَّاتِي السَّرِيرِيَّ الإمامي الأيمن والأيسر 2.2 ± 11.2 مم و 1.24 ± 5.42 مم على التوالي و كان عرض النَّاتِي السَّرِيرِيَّ الإمامي الأيمن والأيسر 1.22 ± 5.37 مم و 1.22 ± 5.42 مم على التوالي. كان النوع الثاني من النَّاتِي السَّرِيرِيَّ الإمامي هو الأكثر شيوعاً (75.5%) بينما كان النوع الأول هو الأقل شيوعاً (4.1%). لم يكن هناك فروق ذات دلالة إحصائية بين القياسات على الجانب الأيمن والأيسر. تعتبر نتائج هذه الدراسة مفيدة للتخطيط قبل الجراحة. وتؤكد الدراسة على ان وجود أي اختلافات قد يؤدي إلى إصابات يمكن الاستغناء عنها أثناء العمليات الجراحية. المزيد من الدراسات البحثية مع حجم عينة كبير من السكان سيعطي فهماً جيداً عن المعايير للنَّاتِي السَّرِيرِيَّ الإمامي.

الكلمات الدالة: استئصال الإكلينيوي، التصوير المقطعي المحوسب، العملية الإكلينيكية الأمامية.