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Original Research Article

Tomographical study of optic strut location and its significance

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ABSTRACT

Aims and Objective: To determine the attachment of optic strut relative to anterior clinoid process. To categorize optic strut into the sulcal, pre-sulcal, post-sulcal. To determine the association between laterality and optic strut attachment pattern.

Materials and Methods: The study was conducted on 100 normal CT scans of Head and Para nasal sinus. Optic strut was classified as pre-sulcal, sulcal, post-sulcal, and asymmetric in relation to the prechiasmatic sulcus. Optic strut location was determined as anterior, middle and posterior with respect to anterior clinoid process.

Results: The optic strut was found to be anterior in 28% specimen, middle in 57% specimen and posterior in 15% specimen. The optic strut was pre-sulcal in 31% specimens, sulcal in 50%, post-sulcal in 16%. The above were observed bilaterally, and 3% were unilateral.

Conclusions: Anatomical variations in the optic strut are significant in planning for anterior clinoidectomy and optic-canal decompression.

1. Introduction

The prechiasmatic sulcus (PCS) is a groove seen on the upper surface of the sphenoid bone that spans across both sides of the optic canal (OC). This sulcus is bounded by the limbus sphenoidale in front and the tuberculum sella at the back.[1,2] Additionally, there are bony projections known as optic struts (OS) that connect the base of the anterior clinoid process (ACP) to the sphenoid body. The optic strut is positioned between the OC and the superior orbital fissure.[3] It was first described by Jefferson way back in 1936 during his study involving radiology of optic canal.[4] Optic strut and Prechiasmatic sulcus are important anatomic landmarks for accessing ophthalmic artery aneurysms or tumors in the regions adjoining sella turcica.[5–7] OS along with the ACP are separated from the lesser wing of sphenoid to provide better access to Internal Carotid artery and cavernous sinus in cases of aneurysms or tumors involving cavernous sinus.[8–11] There is a paucity of studies on the morphometry of optic strut in the Indian population. Owing to the increasing number of endoscopic approaches carried out in the region, this study was carried out with the following objectives -

1. To determine the attachment of OS relative to the ACP, whether attachment limited to anterior 1/3, middle 1/3 or posterior 1/3 of anterior clinoid process.
2. To classify the OS into sulcal, presulcal and postsulcal type based on the location of posteromedial margin of the OS relative to PCS.
3. To determine if there is any association between gender and optic strut attachment pattern.

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4. To determine the association between laterality and optic strut attachment pattern.

2. Materials and Methods

This retrospective study was carried out in the Department of Radiology of MVJMC&RH. 100 normal CT scans of Head and Para nasal sinus in the age group of 18 to 60 years were studied following approval by Institutional ethical committee. Abnormal CT scans showing beam hardening artifacts and calcifications involving internal carotid artery were excluded. Sample size was calculated based on previous studies with a precision of 5% and 95% confidence interval.[1]

The 3D reconstructed images were aligned to offer insights into the sellar and paraesellar region, specifically focusing on the connection of the OS to the body of the sphenoid. This attachment was categorized as presulcal if the uppermost inner edge of the optic strut was located in front of the limbus sphenoidale, sulcal if it was adjacent to the anterior two-thirds of the PCS, and postsulcal if it was positioned behind the anterior two-thirds of the PCS (Figure 1 A-C). The attachment of the optic strut was also examined in relation to the ACP and classified as anterior (attached to the anterior of ACP), middle (attached to the middle one-third of ACP), and posterior (attached to the posterior one-third of ACP). Data was analysed using SPSS software.

3. Results

100 3D constructed images of normal CT scans of head and neck were analyzed in the present study. It was observed that on the right side the attachment of OS to the ACP was most commonly observed in middle third of ACP (57%) followed by anterior third (28%) and least incidence in posterior one third (15%). The same pattern was also observed on the left side (Table 1).

Based on the positioning of OS in relation to the PCS, specimens were classified into presulcal, sulcal and postsulcal. Sulcal optic strut was the commonest variant observed (50%) followed by presulcal variant (31%) postsulcal variant was the least common variant observed (16%). The above incidence was observed bilaterally. 3% cases showed the presence of unilateral presulcal variant on the left side whereas on the right side postsulcal variant and sulcal variant were observed in 1 case and 2 cases respectively.

There was a significant gender difference in the type of optic strut observed in male and female it was observed that asymmetric optic strut was observed in 3% cases of which 2 were males and 1 was female. Symmetric optic strut was observed in 97% with sulcal variety as the commonest in both males and females accounting for 50%. Incidence of postsulcal variety was more in females (24.4%) compared to males (10.2%). Presulcal variant was observed predominantly in males (40.7%).

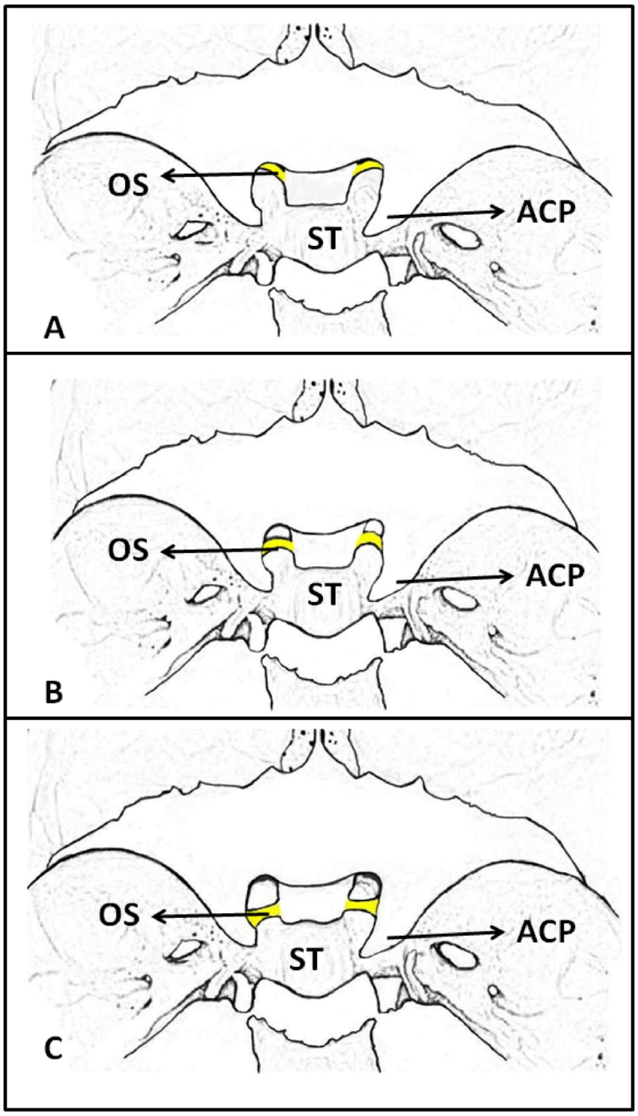

Figure 1: Schematic representation of types of OS in relation to sulcus terminalis. **A**) Presulcal type, **B**) Sulcal type **C**) Post sulcal type. ST: Sella turcica, ACP: Anterior clinoid process, OS: Optic struct

4. Discussion

Kerr et al. classified Optic strut based on its location relative to PCS into presulcal, sulcal and postsulcal variants. In the present study, Optic strut was studied based on above Classification. Kerr et al. stated that sulcal variant was the commonest observed followed by postsulcal and presulcal in Greek population. They also reported that sulcal variant was commonly observed in Indians and Americans.[7] In our study postsulcal variant was least common variant observed and sulcal variant was the most common variant observed

Table 1: Attachment of OS in relation to ACP

OS location relative to ACP	Right side		Total	P value	Left side		Total	P value
	Female	Male			Female	Male		
Anterior 1/3rd	7	21	28		6	20	26	
	17.1%	35.6%	28.0%		14.6%	33.9%	26.0%	
Middle 1/3rd	23	34	57		24	33	57	
	56.1%	57.6%	57.0%	0.009	58.5%	55.9%	57.0%	0.024
Posterior 1/3rd	11	4	15		11	6	17	
	26.8%	6.8%	15.0%		26.8%	10.2%	17.0%	
Total	41	59	100		41	59	100	
	100.0%	100.0%	100.0%		100.0%	100.0%	100.0%	

Table 2: Classification of optic strut in relation to sulcus terminalis

Laterality	Types	Frequency	Percent
Bilateral	Nil	3	3.0
	Postsulcal	16	16.0
	Presulcal	31	31.0
	Sulcal	50	50.0
Unilateral – Left Side	Nil	97	97.0
	Presulcal	3	3.0
Unilateral - Right Side	Nil	97	97.0
	Postsulcal	1	1.0
	Sulcal	2	2.0

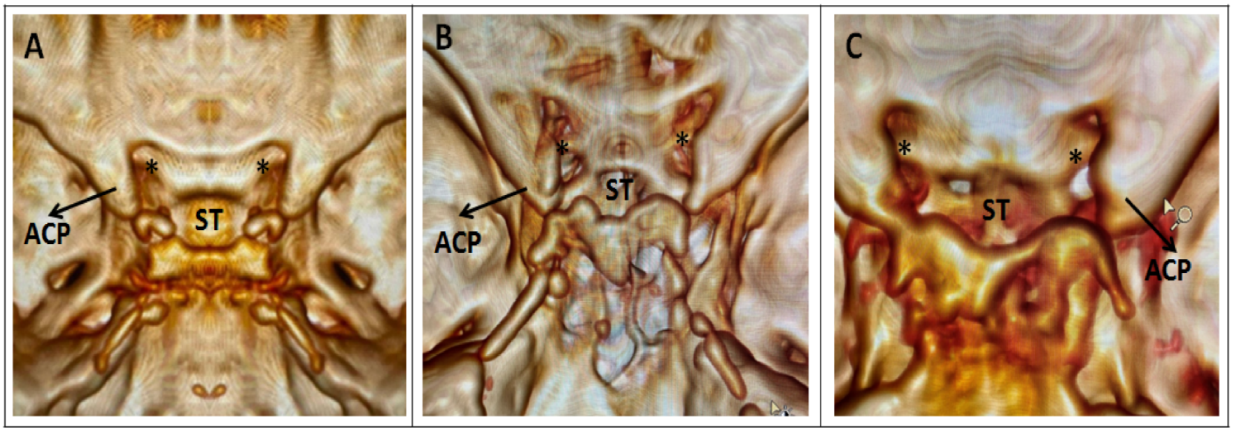

Figure 2: Showing **A**) Presulcal type **B**) Sulcal type **C**) Postsulcal type. ST: Sella turcica, ACP: Anterior clinoid process, Asterisks*: Optic struct

Table 3: Association between gender and type of optic strut

Types	Gender		Total	P value
	Female	Male		
NIL	1	2	3	
	2.4%	3.4%	3.0%	
Postsulcal	10	6	16	
	24.4%	10.2%	16.0%	
Presulcal	7	24	31	0.046 (SIG)
	17.1%	40.7%	31.0%	
Sulcal	23	27	50	
	56.1%	45.8%	50.0%	
Total	41	59	100	
	100.0%	100.0%	100.0%	

similar to the above study.

The majority of optic struts were observed to be attached to the anterior 2/5 of the anterior clinoid process (ACP) in both Korean and Indian populations, as reported in studies by Kanellopoulou et al.[5] A study by Kapur and Mehic analysed on 200 dry human skulls of both sexes including 109 males and 91 females yielded similar findings, with 42% on the right side and 47.8% on the left side showing this attachment pattern.[12] Menasinkai and Savitha conducted another research study on 37 dry skulls, and their results were consistent (45.95% on the right side and 37.83% on the left side) with those of Kanellopoulou et al. and Kapur and Mehic.[13] Results of present study are in concordance with the above findings, most of the OS were attached to middle third of the anterior clinoid process followed by anterior third. But it was contradicting to Gupta & Priya findings,[14] who reported OS were more commonly attached to the anterior 1/3 of the ACP on both sides.

Gonzalez and colleagues suggested that the positioning of an internal carotid artery aneurysm in relation to the OS serves as a dependable indicator to determine whether the aneurysm is situated within the subarachnoid space or in the extradural clinoid segment. The location of the optic strut could also play a significant role in selecting the appropriate surgical approach.[13] For example, in cases of optic nerve decompression resulting from trauma, the position of the optic strut would influence the choice of the surgical procedure, whether it's an endoscopic transnasal approach, a minimally invasive supraorbital approach, or a peritoneal approach.[11,15,16]

Kanellopoulou V et al[5] classified prechiasmatic sulci using Guthikonda[13] classification based on its dimensions i.e interoptic distance sulcal length and sulcal angle in Greek population. They classified prechiasmatic sulcus into narrow sulcus (less than 0.7 cm) and wide sulcus (greater than 0.7 cm) based on the sulcal length (mean sulcal length 0.7 cm). Based on the sulcal angle the prechiasmatic sulci were classified as flat (sulcal angle less than 24 degree) and steep (sulcal angle greater than 24 degree). They observed that mean interoptic distance was less in females compared to males whereas sulcal length was slightly greater in females than males. The mean sulcal angle was less in females than males.

They classified skulls into four types. Type 1 with narrow steep sulcus, Type 2 with narrow flat sulcus, Type 3 with wide steep sulcus and type 4 with wide flat sulcus. Type 1 was the most common variant observed followed by Type 4 and Type 2. Type 3 was the least common variant observed.

Any surgeries involving cavernous sinus mandate the excision of both optic strut and anterior clinoid process failing which there might internal carotid artery or optic nerve are liable to get injured. Excision of the strut should be from anteromedial to posterolateral. During excision one must ensure to remove the optic strut prior to anterior clinoid process enabling itself to release completely.[12]

5. Conclusion

There are not many reliable anatomic markers to discriminate intradural and extradural aneurysms in the parasellar region. Opthalmic artery, anterior clinoid process and optic strut have been considered in the previous literature as landmarks for discriminating aneurysms. Of all the anatomical landmarks mentioned, the optic strut emerges as the most dependable, primarily owing to its relatively small size. This compact size affords radiologists the capability to accurately pinpoint the exact position of the dural ring, a critical reference point that plays a pivotal role in the planning of suitable treatment modalities.

6. Author Contributions

Initials of the contributing authors are listed in brackets at the relevant parts of the research: Study concept & design (K.H.A.M.), Literature search (S.M), Data collection (ARAV, TRV, SVP, SB) Statistical data analysis, Data interpretation and drafting the manuscript (K.H.A.M., S.M). All the authors approved the final version of the article.

7. Source of Funding

The authors have no relevant financial information to disclose.

8. Conflicts of Interest

The authors have no conflicts of interest to declare.

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