

The Relationship between Optic Nerve Canal and Posterior Paranasal Sinuses and Categorizes Them with Delano's Classification in South Indian Ethnic

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Received: 27-12-2022 / Revised: 29-01-2023 / Accepted: 24-02-2023

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Conflict of interest: Nil

Abstract

Background: The aim of the study is to evaluate the relationship between optic nerve canal and posterior paranasal sinuses and categorizes them with Delano's classification in south Indian ethnics. To delineate the anatomy of optic nerve canal and posterior paranasal sinuses. To categorize their relationship according to Delano's classification.

Objective: The aim of this study was to observe the relationship of the sphenoid sinus and posterior ethmoidal cells with the optic nerve.

Subjects and Methods: It is a retrospective study conducted in the department of Radio diagnosis in Trichy SRM Medical College Hospital and Research center, Trichy. A total of 100 reports of the patients who had taken CT paranasal sinus were taken for the study by convenience sampling. Coronal reformatted images are used to determine the course of optic nerve canal and its relationship to the posterior paranasal sinus. They were categorized into 4 types based on Delano's classification.

Results: Incidence of optic nerve into four types by relation to posterior ethmoidal and sphenoidal sinuses according to DeLano et al., showed Type 1 with proportion of 68.5% (137 nerves), type 2 was detected in 25.5% (51 nerves), type 3 was identified 4.5% (9 cases) and type 4 in 3 (1.5%) cases. Dehiscence of the bony wall of the optic nerve was found in 53(26.5%) cases of which 31(15%) were right sided and 22(11%) were left sided. Pneumatisation of anterior clinoid process was seen in 39 (19.5%) cases of which 17 (8.5%) was on right side and 22(11%) on left, bilateral in 7 (4%) cases.

Conclusion: Our study shows that CT examination is an ideal method for detection of bony variation of paranasal sinuses. Axial and coronal scans are necessary for visualization of position of optic nerve and for preoperative planning to ensure the safety and efficacy of paranasal sinus surgery.

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Introduction

The optic nerve has a close relationship to the sphenoid sinus and posterior ethmoidal sinus. Due to various degree of pneumatization of sinuses the position of optic nerve may get changed and may produce an indentation into them. Anterior clinoid process, optic nerve, foramen rotundum, vidian canal, pterygoid process, maxilloethmoidal process may be surrounded by sphenoid sinus due to extensive pneumatization. Posterior ethmoidal cell pneumatization is behind the annular tendinuscommunis where the optic nerve is unprotected by surrounding extra ocular muscles, scanty tissue. Hence, periorbital region is the surgically dangerous area.

Detailed knowledge of Para nasal sinuses, anatomical structures and variations are essential to avoid unintentional damage to these structures.

Material and Methods

Computed tomography study of Nasal Sinuses was reevaluated retrospectively. A total of 100 CT scans (200 slides) of Para nasal sinuses of were investigated. The age range was taken between 18 to 69 years. Among them were 47 male and 54 female. Patients less than 18 years and extremes of age were excluded.[1]

Patients were scanned on siemens somatom GO ALL 64 slice CT scan machine.

Data was acquired on sagittal, axial and coronal planes. Axial CT scans are better for visualizing the extension, and assessment of optic nerve course to sphenoid and ethmoidal sinuses.

Delano (1996) classification was used to assess the relationship of optic nerve to sphenoid and ethmoidal sinus and were classified into four types.

Type 1: The nerve does not contact on either the sphenoid / posterior ethmoidal cells.

Type 2: The nerve indents the sphenoid sinus without contacting the posterior ethmoidal cells.(fig.1)

Type 3: The nerve courses through the sphenoid sinus and is surrounded by pneumatized sinus for at least 50% (fig.1,3)

Type 4: The nerve courses in close proximity to both the sphenoid sinus and posterior ethmoidal sinus.[1] (fig.3)

Sirika et al and unal et al criteria for evaluation of bony dehiscence of optic nerve wall were used. In coronal section protrusion was defined as presence of more than half the circumference of the concerned structures into the sinus cavity with or without defects in their bony margin. Bony dehiscence was determined as absence of visible bone density separating the sinus from course of the optic nerve.[2](fig.2)

Result

Table 1: Incidence of optic nerve into four types by relation to posterior ethmoidal and sphenoidal sinuses according to DeLano et al

	Number of optic nerve	%
Type I	137	68.5
Type II	51	25.5
Type III	9	4.5
Type IV	3	1.5

Incidence of optic nerve into four types by relation to posterior ethmoidal and sphenoidal sinuses according to DeLano et al., Type 1 with proportion of

68.5% (137 nerves), type 2 was detected in 25.5% (51 nerves), type 3 was identified 4.5% (9 cases) and type 4 in 3(1.5 %) cases.



Figure 1: Coronal CT image showing pneumatisation of left anterior clinoid process, type 2 optic nerve on right and type 3 optic nerve on left



Figure 2: Coronal CT showing dehiscence of bony wall of optic nerve on right side



Figure 3: Coronal CT showing type 4 optic nerve on right and type 3 optic nerve on left, pneumatisation of anterior clinoid process on right

Table 1: Sex wise distribution of types of optic nerve

Sex	Type I	Type II	Type III	Type IV	Total
Male	57	27	8	2	94
Female	80	24	1	1	106

Table 2: Prevalence of dehiscence of bony wall and pneumatization of anterior clinoid process

	Right side	Left side	Bilateral	Total
Dehiscence	31 (15.5%)	25(12.5%)	17(8.5%)	56(28%)
Pneumatization of anterior clinoid process	17(8.5%)	21(10.5%)	7(3.5%)	38(19%)

Dehiscence of the bony wall of the optic nerve was found in 53(26.5%) of cases of which 31(15%) was right sided and 22(11%) were left sided. Pneumatization of anterior clinoid process was seen in 39(19.5%) cases of which 17(8.5%) was on right side and 22(11%) and bilateral in 7 (4%) cases.

Table 3: Sex distribution and sidedness of bony dehiscence over the optic nerve.

Sex	Bilateral	Unilateral		Number of nerves with dehiscence
		Right	Left	
Female	3	8	11	19
Male	14	17	20	37
Total	17	25	31	56

Table 4: Sex distribution and sidedness of pneumatization of anterior clinoid process

Sex	Bilateral	Unilateral		Number of pneumatization of anterior clinoid process
		Left side	Right side	
Female	2	9	8	17
Male	5	12	9	21
Total	7	21	17	38

Discussion

Sphenoid sinus is an aerated mucosa lined cavity. It is present since birth and pneumatization continues into adulthood. This pneumatization of sphenoid sinus varies from person to person and can extend into adjacent structures.[3] The optic nerve, not a true cranial nerve since it is covered by a dural sheath can be divided into 4 parts namely- intraocular, intraorbital, intracanalicular, and intracranial.[4] The optic nerve generally courses in close proximity to both the ethmoid and sphenoid sinuses and one among the several important structures indenting on the wall of sphenoid sinus. CT of the paranasal sinus is the best imaging technique to assess the morphological relationship of optic nerve canal to sphenoid and posterior ethmoid sinuses.[5]

Damage to optic nerve is a major complication of endoscopic sinus surgeries. Hence, it is important to know the course and relation of optic nerve to the sinus to avoid any complications during sinus surgeries[6]. The optic nerve is usually covered by the bony covering of greater wing of sphenoid. Another important risk factor is the excessive pneumatization of sphenoid sinus that can extend into the surrounding structures like anterior and posterior clinoid processes and pterygoid process. Excessive aeration of the sphenoid and surrounding structures can lead to the indentation of the canal of optic nerve into the sphenoid sinus and bony dehiscence[2]. High sphenoidal sinus volume is yet another predisposing factor for optic nerve injury during endoscopic surgeries.[3]

Delano et al., was the earliest to classify the relation of optic nerve canal to the posterior ethmoid and sphenoid sinus into 4 types. Type 1: The nerve courses just adjacent to the sphenoidal cell without imprinting on either the sphenoid/posterior ethmoidal cells. Type 2: The nerve indents the sphenoid sinus without contacting the posterior ethmoidal cells. Type 3: The nerve courses through the sphenoid sinus and is surrounded by pneumatized sinus for at least 50%.[7]

Frequency of optic nerve canal according to Delano's classification was optic nerve (type 1 – 77.5%), (type 2 – 15%), (type 3 – 3.5%), (type 4 – 4%). Frequency of the optic nerve canal in this study were according to Delano's classification.

Conclusion

The anatomical configurations that predispose to optic nerve injury during surgical interventions are course of the optic nerve, bony dehiscence over the nerve, and pneumatization of the anterior clinoid process. Our study shows that CT

examination is an ideal method for detection of bony variation of paranasal sinuses[5]. Axial and coronal scans are necessary for visualization of position of optic nerve and for preoperative planning to ensure the safety and efficacy of paranasal sinus surgery.

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