

Analyzing the Occurrence of the Various Types of Optic Nerve Classification Based on DeLano's System in Gender on Both Sides

Optic Nerve Classification Based on DeLano's System

Mubina Lakhani¹, Madeeha Sadiq¹, Sahrish Mukhtar², Iffat Raza³, Sana Azwar¹ and Nuzhat Hassan¹

ABSTRACT

Objective: To assess the types of Optic Nerve (ON) in relation to sphenoid sinus in a subset of Karachi population using computed tomography.

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Department of Radiology, Ziauddin Hospital Clifton campus from January to May 2017.

Methods: We included a total of 270 participants (both genders) in this study. The study participants were between 21 to 60 years of age. CT scans were done using 16 slice Toshiba Alexion CT scanner. After gaining sequential axial images, volume data was created. Multiplanar reconstructions were made in all three planes namely sagittal, axial and coronal. Three-dimensional volume image construction was done in bone algorithm. ON was assessed according to DeLano's classification.

Results: On the right-side, type I Optic Nerve was observed most frequently in both genders with frequency of 53.31% in males and 60.9% in females. This was followed by type III and type III Optic Nerve whereas, type IV was found to be least frequent in both genders. Similar pattern was observed on the left side where type I Optic Nerve was most commonly observed in both genders while type IV was found to be least common with a frequency of 5.63% in males and 8.18% in females. There was insignificant difference in the frequencies of the types of optic nerve among gender on right side. ($p = 0.251$). Similarly, the p value on left side between the gender was also found to be insignificant ($P = 0.542$).

Conclusion: Type II and type III optic nerve are associated with increased chances of nerve injury these two types were observed with frequency of 37.96% on both sides in our study which indicates increased chances of nerve injury during surgery.

Key Words: Occurrence, Optic Nerve, DeLano's System

Citation of article: Lakhani M, Sadiq M, Mukhtar S, Raza I, Azwar S, Hassan N. Analyzing the Occurrence of the Various Types of Optic Nerve Classification Based on DeLano's System in Gender on Both Sides. *Med Forum* 2023;34(11):33-36. doi:10.60110/medforum.341108.

INTRODUCTION

Otolaryngologist are surgeons who perform sinus surgery and transseptal or transsphenoidal surgeries and for them. Its mandatory to be completely aware of sphenoid sinus anatomy along with its neighboring structures.

¹. Department of Anatomy, Ziauddin University, Karachi.

². Department of Anatomy, JMDC, Karachi.

³. Department of Anatomy, KIMS, Karachi.

Correspondence: Sana Azwar, Lecturer Department of Anatomy, Ziauddin University, Karachi.

Contact No: 0332-4000613

Email: sana.azwar@zu.edu.pk

Received: February, 2023

Accepted: July, 2023

Printed: November, 2023

The important neurovascular structures related to sphenoid sinus include, cavernous sinus and its contents that comprise of the cranial nerves III, IV, VI and maxillary division of trigeminal nerve. Optic nerve is present superolateral to SS whereas the sphenoid sinus is also in close relation to cavernous and clinoidal segment of internal carotid artery. These structures can be easily damaged during the surgical procedures involving SS and serious complications may arise if the surgeon lacks knowledge of the sphenoid sinus region. Cranial nerve II, which is the optic nerve is responsible for carrying vision and can be easily damaged resulting in blindness. Consequences like postoperative blindness has been reported by many authors^{1,2}.

Out of the four paranasal sinuses, the sphenoid sinus is the most posterior and least accessible as it is located deep in the cranial base. Due to this surgeon require a detailed analysis through CT scans while performing surgeries in which the sphenoid sinus is utilized as a

corridor to reach the cranial base to avoid any complications.

Sphenoid sinuses are basically housed within the sphenoid bone as pair of large irregular cavities. They are located superior to the nasopharynx and among all the paranasal sinuses these are anatomically most variable. Their pneumatization can be minimum or it can be very extensive due to which neurovascular structures protrude in its cavity³.

The cavities of sphenoid sinus are very minute when the child is born. Development of sphenoid sinus begins at about 6 months of age and continues even after puberty. A bony septum is usually present which divides the sinus cavity into unequal halves, forming paired sphenoid sinuses in an individual with variable size and form. The sinus is frequently separated by a septum which deviates from the midline. The cavity is sometimes further partially divided by some bony accessory septa. These paired sinuses normally overlap each other and there is rarely any communication between them. In many cases, bony ridges can be observed projecting into the sinus cavity from its lateral walls. These ridges are formed due to protrusion of adjacent structures such as internal carotid artery, maxillary nerve, optic nerve or vidian canal into sinus cavity^{4,5}.

Superiorly, the sphenoidal sinuses (SSs) are related to the optic chiasma and hypophysis cerebri and on each side to the ICA and cavernous sinus. SS may also partially encircle the optic canal.^{4,6} Along the course of optic nerve, the place where it gets least nourishment is optic canal. Inflammation can directly invade the sinus and affect the nerve posing a risk of damage and blindness.⁷

Over the years, the number of sinus surgeries performed has increased. This is mainly due to the development in the field which deals with the technology and instruments used for performing endoscopic sinus surgery. With such increased number of surgeries, a rise in malpractice lawsuits is also documented.⁸ Rhinology claims have been shown to represented 70% of the total indemnity compensation. Across the world, for 20 years it has been observed that ESS is the surgical procedure involved. When ESS lawsuits are taken into account, it has been observed that the most common complication resulting from ESS is injury to optic nerve which leads to blindness.^{9,10}

Anatomically, a close relationship exists between the sphenoidal air sinuses and the optic nerve. As this nerve generally passes superolateral to SS, therefore it is also intimately related to air cells of posterior ethmoidal sinus. A highly pneumatized SS may cause the Optic nerve to protrude into sinus cavity^{11,13} which increases the risk of optic nerve injury during sinus surgery causing blindness.

Anatomical knowledge is required regarding variations in relation of sphenoid sinus with optic nerve in our

population to prevent chances of Optic nerve injury during surgeries.

METHODS

A total of 270 participants (including both males and females) were included in the study. The age range was between 21 to 60 years. Inclusion criteria were patients who were not suffering from chronic rhinosinusitis, did not have any sinonasal tumor, with no facial fractures or presence of nasal polyposis. Also, patients with any history of previous sinus surgery or having congenital craniofacial anomalies or trauma that may affect the structure of sphenoid sinus and its relation to nearby vasculature were excluded from the study.

This was a cross-sectional study conducted from January to May 2017 (5 months). Study was conducted at Department of Radiology of Ziauddin Hospital, Clifton campus after getting IRB approval⁽¹⁵⁾. CT scans were done using 16 slice Toshiba Alexion CT scanner. After gaining sequential axial images volume data was created. Multiplanar reconstructions were made in all three planes namely sagittal, axial and coronal. Construction of 3D volume images was done utilizing bone algorithm. Image evaluation was carried out in both axial and coronal planes. After viewing CT scans in coronal views and the analysis in bony windows, the results were reported in data sheet.

RESULTS

Optic nerve was assessed according to DeLano's classification introduced by DeLano, et al. in 1996. The classification is shown in Table 1.^{1,15-18}

Table No. 1: On type with description

On Type	Description
1.	Nerve courses directly adjacent to sphenoid sinus
2.	Nerve causes indentation on sphenoid sinus wall
3.	Nerve traverses through the sphenoid sinus
4.	Nerve lies adjacent to sphenoid sinus and posterior ethmoidal air cells

Frequency of optic nerve was also studied according to gender. On right side it was observed that, type I optic nerve was found to be the highest among all four types that is 53.31% in males and 60.9% in females. Type II optic nerve was found to be 30.63% in males and 20.91% in females. Type III optic nerve was identified in 10% in males and 13.64% in females. The frequency of type IV optic nerve was found to be the least that is 6.25% in males and 4.55% in females.

Similar pattern was observed for the frequency of optic nerve on left side. The frequency of type I optic nerve was highest in both genders with a value of 53.75% in males and 58.18% in females. Type II optic nerve was

present in 30% in males and 22.73% in females. The frequency of type III and type IV remained low. Type III was identified in 10.63% in males and 10.91% in females. Type IV was observed only in 5.63% in males and 8.18% in females.

There was insignificant difference in the frequencies of the types of optic nerve among gender on right side. (p = 0.251)

Similarly, the p value on left side between the gender was also found to be insignificant (P= 0.542).

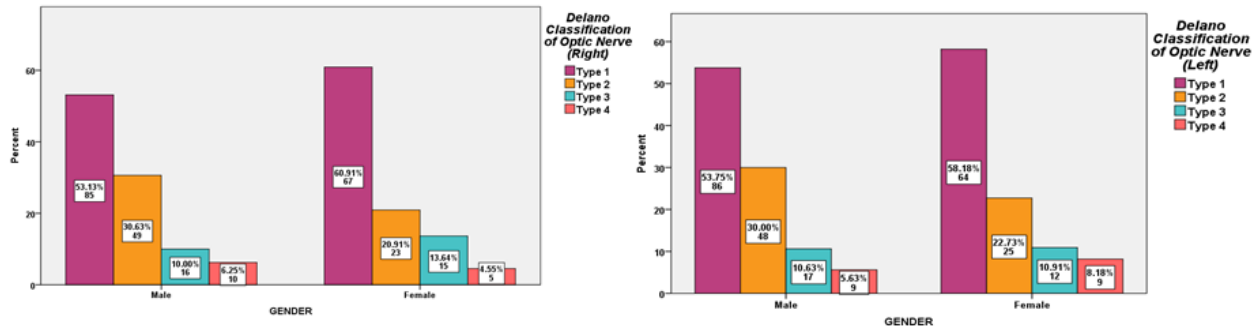


Figure No. 1: (a) Distribution of type of optic nerve according to gender on right side (b) Distribution of type of optic nerve according to gender on left side.

Delano Classification – RiQht Side						
Gender	Total	Type 1 N (%)	Type 2 N (%)	Type 3 N (%)	Type 4 N (%)	P.Value
Male	160	85 (53)	49 (31)	16 (10)	10 (06)	0.251
Female	110	67 (61)	23 (21)	15 (14)	05 (05)	
Total	270	152 (56)	72 (27)	31 (11)	15 (06)	

DISCUSSION

The surgeon should be aware of anatomical variations in sphenoid sinus and its related structures in order to perform successful endoscopic and transsphenoidal surgery. The variations of sphenoid sinus region should be taken into account and thorough knowledge should be acquired in order to avoid complications which may arise intraoperatively. For optimum patient treatment, the interpretation of CT PNS scans should be carried out with extreme care and to achieve this it is necessary that effective communication is there between the radiologist and the surgeon.

As the optic nerve is closely related to sphenoid sinus, therefore its close proximity makes its more prone to iatrogenic injury during surgery. This increased probability of nerve injury may result in blindness which is one of the most traumatizing complications.

According to our knowledge, this is the first study to report the types of optic nerve in relation to sphenoid sinus in Pakistani population in both genders on right and left side. Many other studies worldwide have documented this data related to their population but those studies were done on a comparatively smaller sample size which can be considered as of one the limitation of these studies. In addition to that, literature documenting the frequencies of different types of optic nerve in gender on the two sides is scarce.

In 2018, a study published on Iraqi population by Tameemi et al had described the frequencies of different types of optic nerve in gender on the two sides¹⁹.The results are in accordance with our study with a little difference. This difference is present only

in male gender on both right and left sides where the frequency of type III optic nerve is least. However, our study shows a downward trend when comparing the frequencies of different types of optic nerve in both genders on both sides. Another difference is that, in female gender, type III optic nerve on left side only and type IV optic nerve on both sides are found to be least whereas in our study, type III ranks third regardless of gender and sides.

Our study shows an insignificant difference in the frequencies of the types of optic nerve among gender on the right and left sides and our findings are in accordance with the study done on Iraqi population by Tameemi et al.¹⁹

CONCLUSION

Increased chances of injury were reported with type II and type III optic nerve. Type II and type III optic nerve are associated with increased chances of nerve injury. These two types were observed with frequency of 37.96% on both sides in our study which indicates increased chances of nerve injury during surgery. Therefore, a CT scan should always be conducted to detect the anatomical variations of sphenoid sinus and its relation to optic nerve to plan the procedure accordingly and to avoid any complications.

Author’s Contribution:

Concept & Design of Study: Mubina Lakhani
 Drafting: Madeeha Sadiq, Sahrish Mukhtar
 Data Analysis: Iffat Raza, Sana Azwar, Nuzhat Hassan

Revisiting Critically: Mubina Lakhani,
Madeeha Sadiq
Final Approval of version: Mubina Lakhani

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No. 00311116MLANA dated 02.12.2016.

REFERENCES

- Unal B, Bademci G, Bilgili YK, Batay F, Avci E. Risky anatomic variations of sphenoid sinus for surgery. *Surgical Radiol Anatomy* 2006;28(2):195-201.
- Nörovasküler PS. Surgical importance of neurovascular relationships of paranasal sinus region. *Turkish Neurosurg* 2005;15(2):93-6.
- Prabhu L, Kumar A, Pai M, Kvn D. The anatomical variations in the neurovascular relations of the sphenoid sinus: an evaluation by coronal computed tomography. *Turkish Neurosurg* 2014; 25(2):289-93.
- Gray H. In: Standring S, editor. *Gray's Anatomy*. Fortieth ed: Elsevier;2008.p.556.
- Lakshmi RS, Gugapriya T, Kumar NV, Guru AT. Positional Variation of Optic Nerve in Relation to Sphenoid Sinuses and its Association with Pneumatisation Of Anterior Clinoid Process: A Radiological Study. *J Evidence Based Med Hlthcare* 2015;2(32):4719 - 28.
- Awadalla AM, Hussein Y, ELKammash TH. Anatomical and Radiological Parameters of the Sphenoid Sinus among Egyptians and its Impact on Sellar Region Surgery. *Egypt J Neurosurg* 2015;30:1-12.
- Kazkayasi M, Karadeniz Y, Arikan OK. Anatomic variations of the sphenoid sinus on computed tomography. *Rhinol* 2005;43(2):109-14.
- Re M, Magliulo G, Romeo R, Gioacchini F, Pasquini E. Risks and medico-legal aspects of endoscopic sinus surgery: a review. *Eur Archives Oto-Rhino-Laryngol* 2014;271(8):2103-17.
- Dawson DE, Kraus EM. Medical malpractice and rhinology. *Am J Rhinol* 2007;21(5):584-90.
- Lydiatt DD, Sewell RK. Medical malpractice and sinonasal disease. *Otolaryngology-Head and Neck Surg* 2008;139(5):677-81.
- Batra PS, Citardi MJ, Gallivan RP, Roh H-J, Lanza DC. Software-enabled CT analysis of optic nerve position and paranasal sinus pneumatization patterns. *Otolaryngol-Head Neck Surg* 2004;131(6):940-5.
- Li Y, Sun J, Zhu X, Zhao C, Xu J, Jiang P, et al. Study of the relationship between sphenoid sinus volume and protrusions in the sphenoid sinus. *Forensic Med Anat Res* 2014;2:2-7.
- Davoodi M, Saki N, Saki G, Rahim F. Anatomical variations of neurovascular structures adjacent sphenoid sinus by using CT scan. *Pak J Biological Sciences : PJBS* 2009;12(6):522-5.
- Abdulhadi BN, Shyaa AI, ALTamimi L. Computed tomography assessment of the ethmoid roof based on Keros classification in Iraqi patients undergoing functional endoscopic sinus surgery. *J Ideas Health* 2021;4(2):365-70.
- Reddy UDMA, Dev B. Pictorial essay: Anatomical variations of paranasal sinuses on multidetector computed tomography-How does it help FESS surgeons? *Ind J Radiol Imaging* 2012;22(4): 317-24.
- Urusopone P. Delineation of Optic Nerve by Its Relationship with the Posterior Ethmoid and Sphenoid Sinuses According to Delano Classification Using Computed Tomography in Lerdsin General Hospital. *Bulletin Department Med Services* 2014;39(1):17 - 22.
- Heskova G, Mellova Y, Holomanova A, Vybohova D, Kunertova L, Marcekova M, et al. Assessment of the relation of the optic nerve to the posterior ethmoid and sphenoid sinuses by computed tomography. *Biomedical Papers* 2009;153(2): 149-52.
- Sapçi T, Derin E, Almaç S, Cumali R, Saydam B, Karavuş M. The relationship between the sphenoid and the posterior ethmoid sinuses and the optic nerves in Turkish patients. *Rhinol* 2004;42(1):30-4.
- Al-Tameemia HN, Hassanb HAKJCMS, Vol. Anatomical relationship of optic nerve canal to the posterior paranasal sinuses on computerized tomography in Iraqi patients 2018;4(3):153-7.