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A CROSS-SECTIONAL RESEARCH ON THE VARIATION ASSESSMENT DURING OPTIC NERVE REGARDING SPHENOID SINUS THROUGH CT SCAN

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Abstract:

Objective: *To evaluate the variations in the course of optic nerve in connection with sphenoid sinus by the use of CT scan examination.*

Methodology:*This is a cross sectional study was carried out on 270 subjects through computed tomographic (CT) paranasal sinus scans at Services Hospital, Lahore (March – July, 2017). Sampling technique used in the study was non-probability consecutive sampling. SPSS was used for entry of collected data. Inclusion criteria encompass the adults with CT brain and head. They did not exhibit any ethmoid sinuses and bony anomaly of sphenoid or adjoining structure. Exclusion criteria were those subjects who were having sinonasal tumors, facial fracture, congenital craniofacial anomaly, chronic rhinosinusitis, nasal polyposis and prior sinus surgery. Optic nerve analysis was conducted in accordance with DeLano's classification.*

Results: *The most common type found was Type 1 optic nerve with the percentage of 55.93. It was followed by type 2 with the percentage of 26.85. Type 3 and type 4 were found with the percentages of 11.1 and 6.11 respectively. Upon comparison of right and left sides, type 1 optic nerve frequency was greater on both sides having the values as 56.30 percent and 55.5 percent respectively. Type 2 displayed 26.67 percent and 27 percent frequencies to the right and left sides respectively. Type 3 was 11.4 percent on right side and 10.7 percent on the left side. Type 4 was revealed to be the least common with the percentages of 5.56 and 6.67 on right and left sides respectively.*

Conclusion: *During the course of ESS, optic nerve type II and type III indicated combined frequency of 37.96 percent with the greater risks associated with ON injury. CT tests are effective means to ensure the identification of bony variations of paranasal sinuses. They ensure the efficacy and safety of paranasal sinus surgery during pre-operative strategies.*

Keywords: *Ethmoid sinus, paranasal sinuses, X-ray CT scan, optic nerve, sphenoid sinus.*

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INTRODUCTION:

More and more physicians are concerned about the paranasal sinus (PNS) pathophysiology and anatomy with the advancement of endoscopic sinus surgery (ESS). The restoration of mucociliary clearance and sinuses aeration are the decisive objective of these surgeons [1]. To treat sinus linked diseases endoscopic sinus surgery is getting vast prominence [2]. There is possibility of treating and visualising of every sinus drainage passage nowadays. High resolution CT has facilitated tremendous mapping of sinuses. The degree of mucosal disease can also be determined by this medical facility [3]. In order to ensure patient care, the radiologists are required to comprehend the normal anatomy and changes connected with sinus structure and sinus disease related complications and pathologic appearances.

High structural complexity is exhibited by sphenoid bone which is an unpaired bone of the neurocranium. It shape is like an extended wings butterfly. It consists of wings, body and pterygoid plates. The growth of sphenoid sinus occurs in sphenoid bone [4]. The sphenoid body constructs the floor of the middle cranial fossa by flanking the enlarged wings on every side. Sphenoid body ossification centres are in close contact with neurovascular structures e.g. the optic nerve, the vidian nerve, the maxillary nerve and the internal carotid artery. They elucidate the close relationship with the sphenoid sinus. Sphenoid sinus has dissimilar developmental pattern as compared to other paranasal sinuses. The presence of recess between sphenoid concha and presphenoid body marks the beginning of it. The fusion of sphenoid concha with the presphenoid paves the way to the formation the cavity for sphenoid sinus during the 2nd and 3rd year of its life. In consequence, the sphenoethmoidal recess is formed due to the presphenoid recess. After this stage, occurrence of pneumatisation takes place in basisphenoid and pre-sphenoid of the sphenoid bone [5].

Despite the formation of definitive cavity at puberty, the exact sinus cavity does appear at the age of eight to ten years [6]. The identification of the origin of the sphenoid sinus can be made by its ostium location on the posterior nasal wall. An otolaryngologist, who conducts sinus surgery, should have an adequate knowledge about the anatomic relationships of the sphenoid sinus and its adjoining structures. Insufficient knowledge can cause acute complications owing to proximity of vital structures with sphenoid sinus i.e. internal carotid artery, orbit, cavernous sinus and brain. The optic nerve confronts a potential threat in this regard. There are reports of postoperative blindness [7-9]. The sphenoidal sinus is octagonal in structure. Two sides of it are faced by nasal cavity. However, remaining sides face towards endocranium. They are least in access of surgeons since they are located at posterior positions. They are in a pair of huge irregular cavities contained in sphenoid bone body. They are placed posterior to the upper part of the nasal cavity. Pneumatisation varies from nominal to extensive [10]. One sinus overlaps the other in rare cases. From their lateral walls, bony ridges may project into the sinuses [4-11]. In addition, optic nerve projection can also be seen in approximately fifteen percent subjects. Sphenoidal sinus' superior wall is along the side of ethmoidal sinus' roof. It makes a direct link with hypophysis cerebri, the optic chiasma and olfactory nerves [12]. The optical canal may be encircled partially by one or both sinuses [1, 4]. Optical nerve is very less grown at the optical canal. Resultantly, it is extremely prone to injury via sinus direct inflammatory invasion [14].

Number of sinus surgeries has been on the rise after advanced technologies and equipment for the purpose of endoscopic sinus surgery came to the surface. It has come with the increasing lawsuits practices [15]. The most frequent complications regarding ESS lawsuits are orbital injury and optic nerve responsible for blindness [16, 17].
There is a close association amongst optic nerve, sphenoid sinuses and posterior ethmoid sinuses. If damaged during surgery, the optic nerve mishandling can have disastrous consequences leading to blindness in the long run. [18, 20].

METHODS:

This is a cross sectional study was carried out on 270 subjects through computed tomographic (CT) paranasal sinus scans at Services Hospital, Lahore (March – July, 2017). Both females and males gender who were aged between 21 to 60 years were the participants of this study. Exclusion criteria were those subjects who were having Sino nasal tumours, facial fracture, congenital craniofacial anomaly, chronic rhinosinusitis, nasal polyposis and prior sinus surgery. Inclusion criteria encompass the adults with CT brain and head. They did not exhibit any ethmoid sinuses and bony anomaly of sphenoid or adjoining structure. Sampling technique used in the study was non-probability consecutive sampling. OpenEpi calculator was used to calculate the sample size of 270 subjects keeping in view the variation prevalence of paranasal sinuses at fifty two percent [21]. On a sixteen slice Toshiba Alexion, CT scan of two hundred and seventy subjects was carried out. By rotating scanner's X- ray beam around the head, a series of images from the different angles were

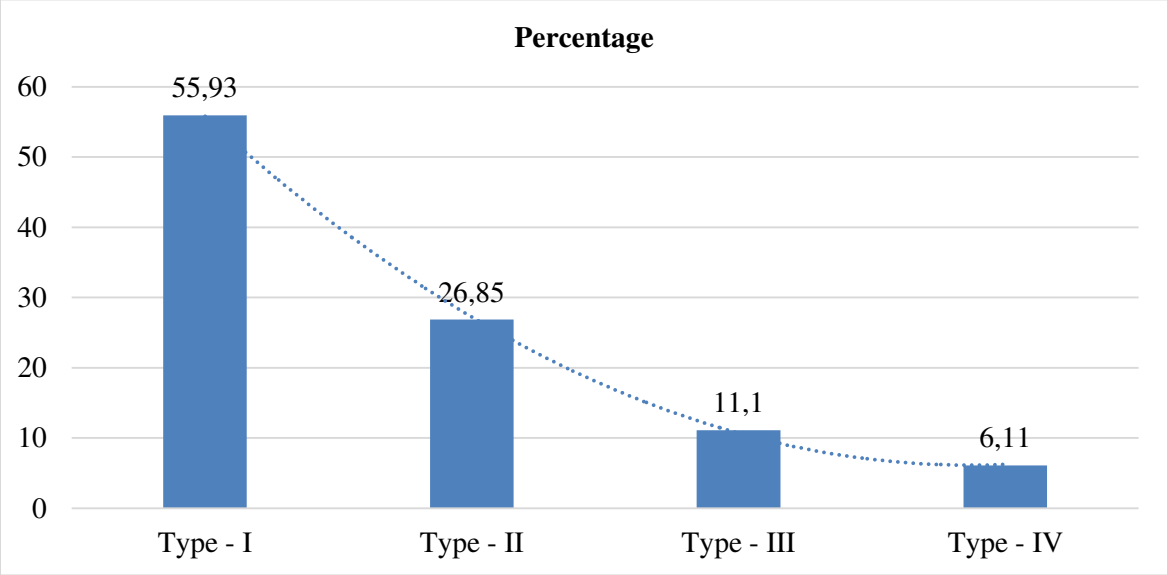
obtained. Sequential axial images were received. In order to form volume data, they were further processed. Multiplanar reconstructions were obtained in sagittal, axial and coronal planes with the help of volume data. The construction of 3D volume rendered images in bone algorithm was obtained too. Evaluation of every image in axial and coronal planes was conducted. The analysis of CT films coronal views was employed in bony windows. The data sheet was used to report the results afterwards. As per Table 1, the assessment of optic nerve was done in accordance with DeLano's classification. As displayed in Table 1, DeLano, et al classified four kinds of association between posterior paranasal sinuses and optic nerve in the year 1996 [8, 22 – 26].

RESULTS:

According to DeLano's classification, the assessment of optic nerve position in connection with sphenoid sinus was carried out. After the CT scan analysis of two hundred and seventy subjects, it was observed that the most common type found was Type 1 optic nerve with the percentage of 55.93. It was followed by type 2 with the percentage of 26.85. Type 3 and type 4 were 11.1 percent and 6.11 percent respectively being the less frequent as per Table – I.

Table – I: DeLano's classification of optical nerve (Total)

Type	Percentage
Type - I	55.93
Type - II	26.85
Type - III	11.1
Type - IV	6.11



Upon comparison of right and left sides, type 1 optic nerve frequency was greater on both sides having the values as 56.30 percent and 55.5 percent respectively. Type 2 displayed 26.67 percent and 27 percent frequencies to the right and left sides respectively. Type 3 was 11.4 percent on right side and 10.7 percent on the left side. Type 4 was revealed to be the least common with the percentages of 5.56 and 6.67 on right and left sides respectively as per Table – II, III and IV.

Table – II: DeLano's classification on right side

Type	Number	Percentage
Type - I	152	56.3
Type - II	72	26.67
Type - III	31	11.48
Type - IV	15	5.56

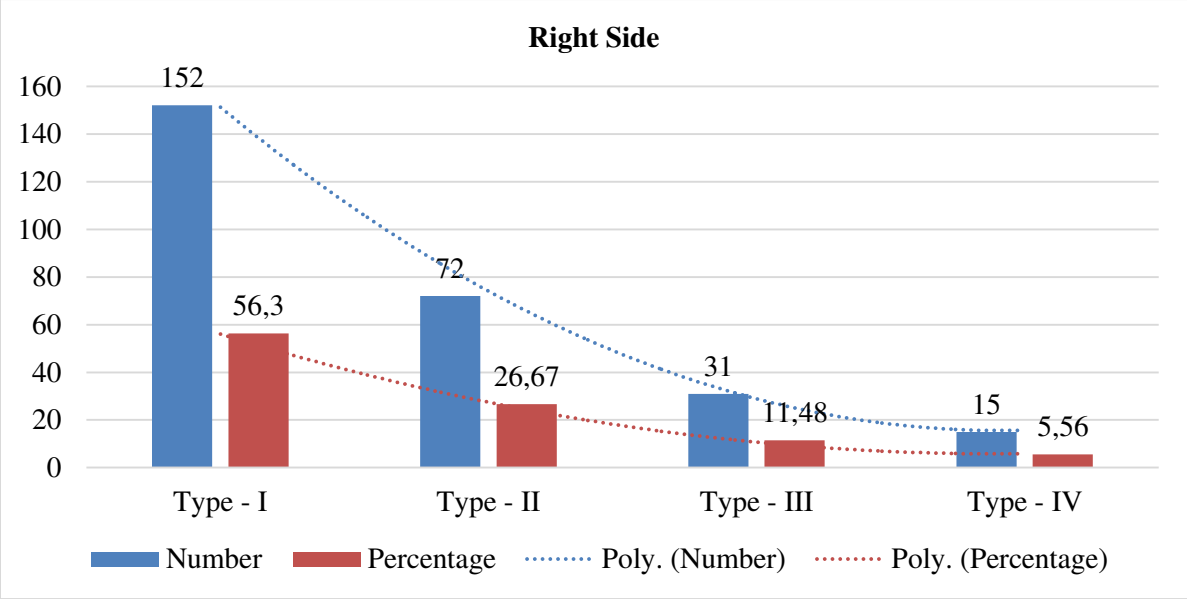


Table – III: DeLano's classification on left side

Type	Number	Percentage
Type - I	150	55.56
Type - II	73	27.04
Type - III	29	10.74
Type - IV	18	6.67

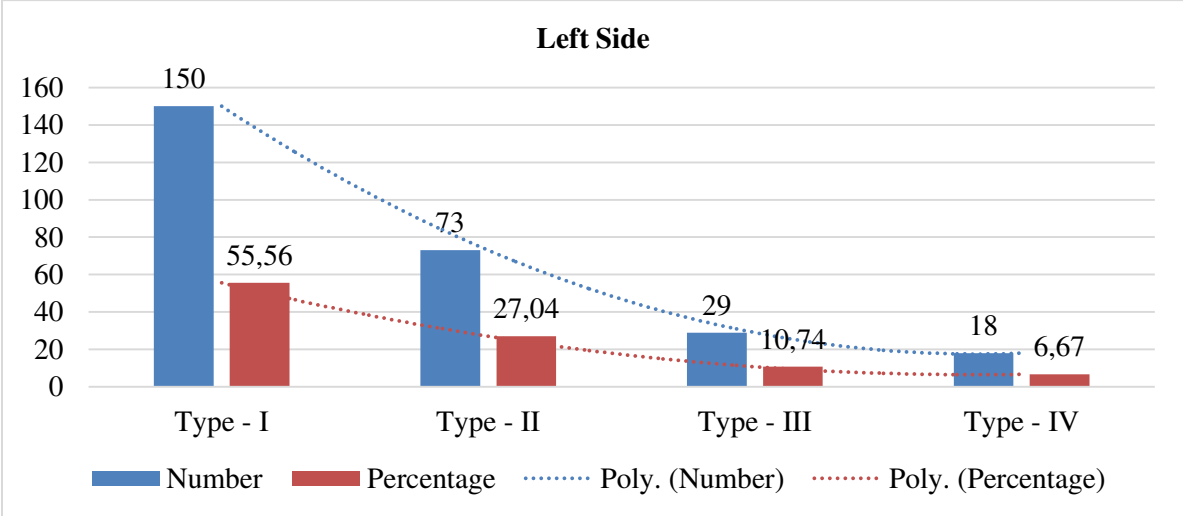


Table – IV: Types of optic nerve (ON) according to DeLano's classification

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

DISCUSSION:

To make endoscopic sinus surgeries successful and to prevent potential intra-operative surgical complications, profound knowledge about the anatomical correlations of sphenoid sinus is vital. To ensure maximum benefit of treatment, the communication between radiologist and surgeon is paramount about CT PNS scans interpretation. Since there was dearth of studies conducted on the topic internationally owing to smaller sample sizes, we are quite sure that this is the first ever study conducted in Pakistan of its own nature. Cranial nerve II superolateral location in connection with sphenoid sinus makes it susceptible to iatrogenic injury in the course of trans sphenoidal pituitary and endoscopic sinus surgery. The most devastating complication of ESS is thought to be the blindness because of direct cranial nerve II injury. The most common type of optic nerve was found to be Type 1 ON which is consistent with the findings of earlier researches [11, 23-28]. In the year 2014 a study conducted on sixty-four adults by Bra et al, had different results in which type 1 ON was found to be second commonest type with the percentage of 25.8 [18]. It may be due to the fact that a changed DeLano classification was employed for cadaveric analysis of his study. type 2 with the percentage of 26.85 was the second most frequent type of optic nerve. Most of the earlier researches are again consistent with our results in this regard [1, 23, 24, 26, 28, 29]. Despite this, Heskova et al presented contrasting results with the type 3 to be the second frequent of optic nerve with the frequency percentage of 14.7. Batra et al indicated that type 2 optic nerve was the commonest amongst the population of Korea with the frequency of 39.8 percent [18]. Type 3 was 11.1 percent being the less frequent in our study. Other researchers observed the same pattern [23, 26 – 28]. However, some researches showed contrasting findings. A study carried out in the year of 2009 on the population of Europe, by Heskova et al had indicated that Type 3 optic nerve was found with the frequency of 23.5 percent being the second highest. On the contrary, other researches had verified the presence of type 3 with the minimum frequencies of 1.8 percent, 5.4 percent and 9.4 percent correspondingly [11, 24, 29]. Type 4 of optic nerve was 6.11 percent being the less frequent in our study. Other studies had indicated the similar findings too [23, 25, 27, 28]. In the year 2014, a study carried out by Pra et al in Thailand, had confirmed the type 4 to be second most frequent with the frequency of 9.3 percent. Pra et al had reported in his sample combined overall percentage of type 2, 3 and 4 as twenty four percent. Various other studies have indicated type 4 optic nerve stands at third position with the percentages in sequence as 2.6, 12 and 7 [11, 26, 29]. Optic nerve assessment was done on both sides i.e. left and right one by one to monitor whether there was any alteration in the distribution of various kinds of optic nerve on right and left-hand sides. It was revealed that ON types pattern was as same as in the other conducted studies [18, 23, 24]. These changes should be in the best knowledge of the radiologist in the Preoperative stage in order to establish dissection limits. Before proceeding for any surgery in the sphenoid sinus location, coronal and axial CT sections must be collected.

CONCLUSION:

In the year 1996, DeLano et al recorded a very likely injury risk with optic nerve type II and type III [22]. During the course of ESS, optic nerve type II and type III indicated combined frequency of 37.96 percent with the greater risks associated with ON injury. CT tests are effective means to ensure the identification of bony variations of paranasal sinuses. They ensure the efficacy and safety of paranasal sinus surgery during pre-operative strategies.

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