Original Article

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Anatomy Section

Does the Side of Deviation of Nasal Septum have Concomitant Predictive Relation with Side of Sphenoid Septum Deviation?

G VENKATESH[1], TS GUGAPRIYA[2], N VINAY KUMAR[3], SD NALINA KUMARI[4]

ABSTRACT

Introduction: The asymmetric hidden sphenoid sinuses get separated by a bony septum which rarely lies in the median plane. Deviated Nasal Septum (DNS) formed by bony and cartilaginous parts can be identified by clinical examination. Paucity of literature about the concomitant side deviation of both the septum, has been found.

Aim: To find the predictive relation between the side deviation of nasal and sphenoid septum.

Materials and Methods: A cross-sectional study was undertaken with coronal CT image sets of paranasal air sinuses at Chennai Medical College Hospital and Research Centre, Trichy, Tamil Nadu. Images of subjects above 18 years of age without chronic sinusitis blocking Infundibulo-osteal complex, space occupying lesion, previous sinonasal surgeries, and inflammatory polyps were included from December 2016 to January 2017. In 130 source image sets, side deviation of the nasal septum and sphenoid septum were observed and categorised. The data were analysed using IBM SPSS Statistics for Windows, version 26 and a p-value of <0.05 was considered as statistically significant. The agreement of corresponding side deviation of nasal and sphenoid septum was tested using chi-square and Kappa test.

Results: The DNS was noted in 94.6% (123 of 130) of images. The right, left and median deviations were observed in 50.8% (66 of 130), 43.8% (57 of 130) and 5.4% (7 of 130), respectively. The sphenoid septum deviations of right, left and median was noted in 43.1% (56 of 130), 36.9% (48 of 130), and 19.2% (25 of 130), respectively. The right deviated sphenoid septum was seen in 39 out of 66 right DNS images and left deviated in 29 out of 57 left DNS images. Chi-square showed statistical significance (p-value = 0.0031) and kappa [0.231 (SE of kappa = 0.064, 95% confidence interval: from 0.104 to 0.357)] was assessed as a fair agreement between the observed values.

Conclusion: The fair agreement between sides of DNS with position of sphenoid septum concludes that DNS could be a probable predictor of position of sphenoid septum.

Keywords: Nasal septum deviation, Sphenoid sinus, Tomography, Paranasal sinus, Trans-sphenoid surgery

INTRODUCTION

The sphenoid sinuses are asymmetric air cavities located within the body of sphenoid bone and are separated by a bony septum [1]. The sphenoid sinuses present with varying degrees of pneumatisation and are also related to vital structures near the sellar region [2]. The sphenoid septum lies rarely on the median plane but very often deviated laterally to one side or the other [3-5].

Minimal traumatisation of nasal structures enabling quick recovery postoperatively with less complications in addition to providing panoramic view of operating field have made endoscopic endonasal trans-sphenoidal approach as the preferred surgical route to pituitary tumours now a days [6,7].

The sphenoid sinus is a hidden sinus and examination of it could be only possible by image analysis. There is a paucity of literature proposing any anatomical structure as predictor for sphenoid septal deviation by physical examination itself. An insignificant association between sides of nasal septal deviation and position of sphenoid septum in Mediterranean ethnicity was reported [8].

Nasal septum having bony and cartilaginous nasal components also occurs rarely in midline, causing DNS with a reported incidence of 62% that can be identified by clinical examination itself [8-13]. By mid-sixth week of development, the developing sphenoid bone cartilage contributes to the nasal septum formation [14]. This developmental sequence forms the basis for consideration that the side of deviation in sphenoid septum might result in concomitant side deviation of nasal septum [14].

Therefore, this study was done to test the hypothesis that the clinically observed side of deviation of nasal septum could act as a predictor for side of sphenoid septum deviation.

MATERIALS AND METHODS

A cross-sectional computerised tomographic study was undertaken with coronal CT image sets of paranasal air sinuses from archives of Department of Radiology, Chennai Medical College Hospital and Research Centre, Trichy, Tamil Nadu collected over a period of two months from December 2016 to January 2017. Without subject to any further sampling, universally we have included all the clinical records applicable during reference period. The study was initiated with approval from the Institutional Ethics Committee (IEC no. CMCH&RC/IEC NO- 34, dated 20/09/2016) and after obtaining informed consent from the study participants. The CT scan images were taken using GE Healthcare Lightspeed Ultra CT Scan Machine 8 slice with 3 mm thickness. The age of the subjects ranged from 18 to 60 years.

Images of subjects above 18 years of age were included in the study. The subjects with chronic sinusitis blocking Infundibulo-osteal complex, space occupying lesions, previous sinonasal surgeries, and inflammatory polyps were excluded from the study.

The 130 coronal CT source image sets obtained without subjecting to any further sampling, universally we have included all the image sets available during the reference period and after applying exclusion and inclusion criteria. They were analysed by RadiAnt DICOM Viewer (Medixant co., version – 2020.1.1). The reference line for determining DNS was marked by two points. The first point

was made at the superior attachment of nasal septum at the base of crista galli and the second point was made at the inferior attachment of septum at maxillary crest/anterior nasal spine. The bony part of the nasal septum was assessed for deviation in coronal images. The side of nasal septum convexity/deviation was determined posterior to the reference line and was classified into right, left or median (no deviation) [15].

The deviation direction of sphenoid septum was observed from anterior to posterior plane. In images with more than one septum, a complete median or paramedian oriented septum extending from anterior to posterior was confirmed as the main septum. The deviation direction of sphenoid septum was determined as right, left and median with reference to posterior wall of the sphenoid sinus [8]. The number of images that showed corresponding side deviation of both nasal and sphenoid septum was also noted.

STATISTICAL ANALYSIS

The data collected were statistically analysed using IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA). The p-value of <0.05 was considered statistically significant for all tests. Statistical agreement of two variables, corresponding side deviation of nasal and sphenoid septum was done using Chi-square and Kappa test.

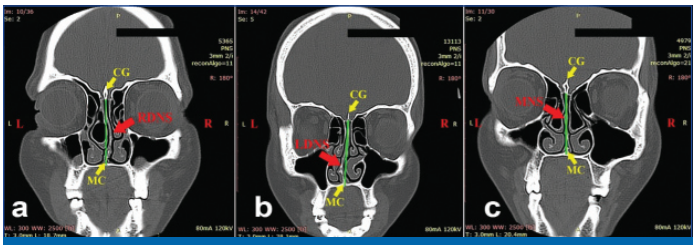
RESULTS

The computerised tomographic analysis of 130 coronal image sets of paranasal air sinuses with a mean±SD age of 40.3±1.63 years were analysed for deviation direction of nasal septum and sphenoid septum. In the study, male to female distribution was 64 and 66, respectively.

The DNS was noted in 94.6% of images (123 of 130) and the deviation direction of nasal septum was determined to be on right, left and median [Table/Fig-1,2].

Deviation direction	Number of images	Percentage
Right	66	50.8%
Left	57	43.8%
Median	7	5.4%
Total	130	100%

[Table/Fig-1]: Incidence of deviation direction of nasal septum.



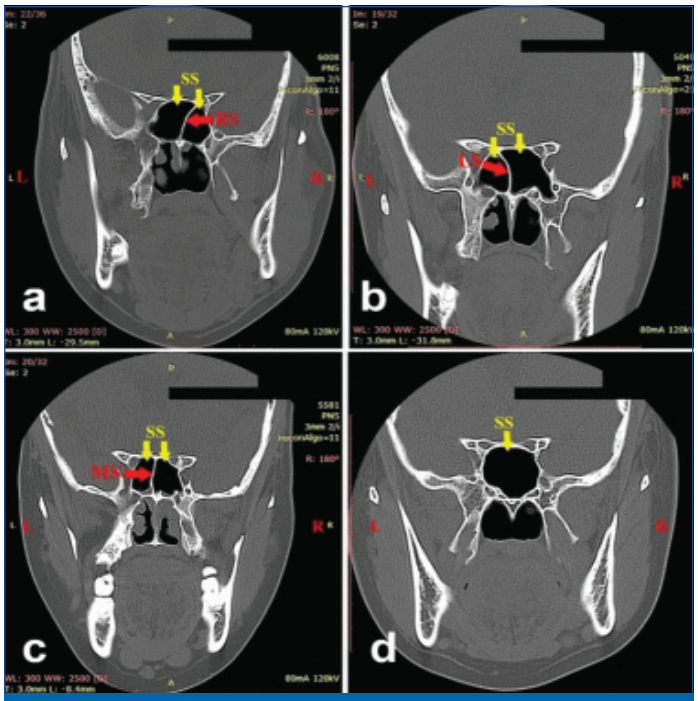
[Table/Fig-2]: Showing direction of deviation of nasal septum. a) Right Deviated Nasal Septum (RDNS)-red arrow; b) Left Deviated Nasal Septum (LDNS)-red arrow; c) Median Nasal Septum (MNS)-red arrow. CG- Crista galli, MC- Maxillary crest.

The sphenoid septum was observed in 99.2% of images (129 of 130) and was absent in 0.8% of images (1 of 130). The incidence of deviation direction of sphenoid septum was observed to be on the right, left or median (no deviation) as tabulated [Table/Fig-3,4].

Deviation direction	Number of images	Percentage
Right	56	43.1%
Left	48	36.9%
Median	25	19.2%
Absent	1	0.8%
Total	130	100%

[Table/Fig-3]: Incidence of deviation direction of sphenoid septum.

The sphenoid septum was deviated to right side in 39 out of 66 images that belonged to right sided DNS. The sphenoid septum was deviated to left side in 29 out of 57 images with left sided DNS. This association between the side of DNS and sphenoid septal deviation proved to be statistically significant with p-value = 0.0031 after applying chi-square test [Table/Fig-5].



[Table/Fig-4]: Showing direction of deviation of sphenoid septum: a) Right deviated sphenoid septum (RS)-red arrow; b) Left deviated sphenoid septum (LS)-red arrow; c) Median Sphenoid septum (MS)-red arrow; d) Absent sphenoid septum. SS: Sphenoid sinus

Deviation direction of nasal septum		Deviation direction of sphenoid septum			
Side	No. of images	Right	Left	Median	Total
Right	66	39 (28.65) [3.74]	15 (24.56) [3.72]	12 (12.79) [0.05]	66
Left	57	16 (24.74) [3.09]	29 (21.21) [2.86]	12 (11.05) [0.08]	57
Median	7	1 (2.60) [0.99]	4 (2.23) [1.40]	1 (1.16) [0.02]	6*
Total	130	56	48	25	129

[Table/Fig-5]: Statistical analysis of association between the side of DNS and sphenoid septal deviation.
The chi-square statistic is 15.9516. *The p-value is 0.0031; The result is considered significant at p<0.05; Sphenoid septum was absent in one case†

The Kappa test was applied to know the intergroup agreements between the deviation direction of nasal and sphenoid septa. The value of kappa = 0.231 (SE of kappa = 0.064, 95% confidence interval: From 0.104 to 0.357) was assessed as a fair agreement between the observed values of direction deviations of nasal and sphenoid septa (kappa between 0.21 and 0.40: fair agreement).

The proposed null hypothesis was that there is no statistically significant association between the side of DNS and sphenoid septal deviation has been rejected as the association was shown to be statistically significant by applying chi-square test (p-value=0.0031).

DISCUSSION

A common phenomenon that occurs in the nasal septum is its deviation to either side. Previous literature shows references of such deviation of DNS with either right or left side predominance [Table/Fig-6] [8-19].

Right-sided dominance was observed in the present study and was reported by some previous studies as well [9,17,18-19]. Such deviations were proposed to be as a result of trauma either during intrauterine life or postnatal life [20]. A developmental theory was

Study	Right	Left	Median
Battal B et al., [8]	41%	44.6%	14.3%
Keles B et al., [9]	51.1%	42.2%	6.7%
Tsai TL et al., [10]	21.2%	21.2%	57.7%
Moorthy PNS et al., [11]	36.5%	54%	9.5%
Orhan I et al., [16]	49.5%	50.5%	--
Sistani SS et al., [17]	65.3%	34.7%	--
Wojas O et al., [18]	60.5%	39.4%	--
Ahmmed SU et al., [19]	47.8%	41.3%	10.9%
Present Study	50.8%	43.8 %	5.4 %

[Table/Fig-6]: Comparing incidence of deviation direction of nasal septum.

also put forth as the probable cause for such deviation in the nasal septum with sphenoidal process playing the pivotal role [21,22]. The sphenoidal process of cartilaginous septum in cases of DNS was observed to be significantly longer and prominent with distinct histology [21]. A study on role of sphenoidal process in DNS showed that increasing angle of deviation noted in cases with long sphenoid process [22]. These observations could be explained as due to developmental delay in ossification of septum. The delayed septal ossification contributed to increased deviation of septum [21,22].

The present study's incidence of the positional deviation of sphenoid septum and absence of septum falls within the same range when compared to previous studies [23-25]. But the commonest side of deviation stands inconclusive [Table/Fig-7] [5,8,23-25].

Study	Right	Left	Median	Absent
Vidya CS and Raichurkar K [5]	63.75%	28.75%	--	--
Battal B et al., [8]	43.3%	38.9%	17.7%	1.3%
Kapur E et al., [23]	64.4%	35.6%	--	2%
Sirikci A et al., [24]	20.6%	21.7%	38%	--
Fasunla AJ et al., [25]	26.4%	43.6%	18.2%	2.7%
Present study	43.1%	36.9%	19.2%	0.8%

[Table/Fig-7]: Comparing incidence of deviation direction of sphenoid septum [5,8,23-25].

The endoscopic endonasal trans-sphenoidal approach has wide application and recommended in treatment of pituitary tumours, craniopharyngiomas, germinomas of sellar and parasellar region in adult as well as paediatrics, due to its minimal invasiveness, less trauma and for maintaining anatomical integrity [26,27]. During this procedure, the excision of sphenoid septum is a necessity for adequate exposure of sella and the surgeon must have orientation to deviated direction of sphenoid septum pre operatively [6,7,26,27]. The anatomical variations of deviated sphenoid septum and its relationship to nearby vital structures like internal carotid artery, optic nerve, pituitary gland delineates the determination of its position for safety during surgery [1,2].

In concordance with present study's finding of same side deviation of DNS and sphenoid septum to either right side (59.09% i.e., 39 out of 66) or left side (50.87% i.e., 29 out of 57), another study also had reported concomitant deviation of both septa to right or left sides in 21.8% and 18.8% cases, respectively [8]. The possible predictive relation of side of deviation of DNS in determining the sphenoid septal position in this study stands in fair agreement statistically by kappa analysis of 0.231 and significant by Chi-square with p=0.0031.

Limitation(s)

In spite of this statistical agreement, the limited sample size and the cross-sectional study design limited the generalisability of the relation between sides of DNS to the side of sphenoid septum position.

CONCLUSION(S)

The present study findings shows a fair statistical agreement between sides of deviation of nasal septum with position of sphenoid septum, thus we conclude that the direction of DNS could be a probable predictor of side deviation of sphenoid septum. These relational findings would aid the surgeon to preoperatively plan upon the side of main access during endoscopic endonasal trans-sphenoidal approaches. Further prospective studies are recommended with more sample size of endoscopic endonasal trans-sphenoidal approach regarding this relation between the septa are needed to confirm the relationship.

REFERENCES

[1] Budu V, Mogoanta CA, Fanuta B, Bulescu I. The anatomical relations of the sphenoid sinus and their implications in sphenoid endoscopic surgery. Rom J Morphol Embryol. 2013;54(1):13-16.

[2] EL Kammash TH, Enaba MM, Awadalla AM. Variability in sphenoid sinus pneumatization and its impact upon reduction of complications following sellar region surgeries. Egypt J Radiol Nucl Med. 2014;45(3):705-14.

[3] Seddighi A, Seddighi AS, Mellati O, Ghorbani J, Raad N, Soleimani MM. Sphenoid Sinus: Anatomic Variations and Their Importance in Trans-sphenoid Surgery. Int Clin Neurosci J. 2014;1(1):31-34.

[4] Dundar R, Kulduk E, Soy FK, Aslan M, Kilavuz AE, Sakarya EU, et al. Radiological evaluation of septal bone variations in the sphenoid sinus. ENT Updates. 2014;4(1):6-10.

[5] Vidya CS, Raichurkar K. Anatomic variation of sphenoid sinus in Mysore based population: CT scan study. Int J Anat Res. 2015;3(4):16114.

[6] Tataranu L, Gorgan MR, Ciubotaru V, Dediu A, Ene B, Paunescu D, et al. Endoscopic Endonasal Transsphenoidal Approach in the Management of Sellar and Parasellar Lesions. Rom Neurosurg. 2010;5:52-63. doi: 10.4103/2152-7806.130901.

[7] Cavallo LM, Messina A, Cappabianca P, Esposito F, de Divitiis E, Gardner P, et al. Endoscopic endonasal surgery of the midline skull base: anatomical study and clinical considerations. Neurosurg Focus. 2005;19(1):1-14.

[8] Battal B, Akay S, Karaman B, Hamcan S, Akgün V, Sari S, et al. The relationship between the variations of sphenoid sinus and nasal septum. Gulhane Med J. 2014;56(4):232-237.

[9] Keleş B, Ozturk K, Unaldı D, Arbag H, Ozer B. Is there any relationship between nasal septal deviation and concha bullosa. Eur J Gen Med. 2010;7(4):359-64.

[10] Tsai TL, Lan MY, Ho CY. There is no structural relationship between nasal septal deviation, concha bullosa, and paranasal sinus fungus balls. Sci World J. 2012;181-246. DOI: 10.1100/2012/181246.

[11] Moorthy PNS, Kolloju S, Madhira S, Jowkar AB. Clinical study on deviated nasal septum and its associated pathology. Int J Otorhinolaryngol Head Neck Surg. 2014;3(2):75-81.

[12] Blaugrund SM. Nasal obstruction. The nasal septum and concha bullosa. Otolaryng Clin N Am. 1989;22(2):291-306.

[13] Aktas D, Kalcioglu MT, Kutlu R, Ozturan O, Oncel S. The relationship between the concha bullosa, nasal septal deviation and sinusitis. Rhinol. 2003;41(2):103-06.

[14] Som PM, Naidich TP. Illustrated Review of the Embryology and Development of the Facial Region, Part 1: Early Face and Lateral Nasal Cavities. Am J Neuroradiol. 2013;34(12):2233-40.

[15] Lee DH, Jin KS. Effect of nasal septal deviation on pneumatization of the mastoid air cell system: 3D morphometric analysis of computed tomographic images in a pediatric population. J Int Adv Otol. 2014;10(3):251-55.

[16] Orhan I, Ormeci T, Bilal N, Sagiroglu S, Doganer A. Morphometric analysis of sphenoid sinus in patients with nasal septum deviation. J Craniofac Surg. 2019;30(5):1605-08.

[17] Sistani SS, Dashipour A, Jafari L, Ghahderijani BH. The Possible Associations of Nasal Septal Deviation with Mastoid Pneumatization and Chronic Otitis. Open Access Maced J Med Sci. 2019;7(15):2452-56.

[18] Wojas O, Szczęsnowicz-Dąbrowska P, Grzanka A, Krzych-Fałta E, Samolinski B. Nasal septum deviation by age and sex in a study population of poles. Journal of Rhinolaryngo-Otologies. 2019;7:1-6.

[19] Ahmmed SU, Khan MN, Hossain MZ, Mridha MK, Bhuiyan AP, Ahmed KS. Study of prevalence of concha bullosa, nasal septal deviation and sinusitis based on CT findings. Bangladesh J. otorhinolaryngol. 2020;26(1):18-23.

[20] Beekhuis GJ. Nasal fractures. In: Paparrella, Chumrick, Gluckman, Meyerhoff (eds): Otolaryngology, Vol. III (3rd Ed). WB Sanders Co, Harcourt Brace Jovanovich Inc, Philadelphia. 1991;1823-30.

[21] Kim J, Han SH, Kim SW, Cho JH, Park YJ, Kim SW. Clinical significance of the sphenoidal process of the cartilaginous nasal septum: A preliminary morphological evaluation. Clin Anat. 2010;23(3):265-69.

[22] Kim J, Kim SW, Kim SW, Cho JH, Park YJ. Role of the sphenoidal process of the septal cartilage in the development of septal deviation. J Otolaryngol Head N Surg. 2012;146(1):151-55.
[23] Kapur E, Kapidi A, Kulenovi A, Sarajli L. Septation of the sphenoid sinus and its clinical significance. Int J Collab Res Intern Med Public Health. 2012;4(10):1793-802.
[24] Şirikci A, Bayazıt YA, Bayram M, Mumbuc S, Gungor K, Kanlikama M. Variations of sphenoid and related structures. Eur Radiol. 2000;10(5):844-48.
[25] Fasunla AJ, Ameye SA, Adebola OS, Ogbole G, Adeleye AO, Adekanmi AJ. Anatomical variations of the sphenoid sinus and nearby neurovascular structures seen on computed tomography of black Africans. East Cent Afr J Surg. 2012;17(1):57-64.
[26] Cappabianca P, Alfieri A, Colao A, Cavallo LM, Fusco M, Peca C, et al. Endoscopic endonasal transsphenoidal surgery in recurrent and residual pituitary adenomas. Minim Invas Neurosur. 2000;43(1):38-43.
[27] deDivitiis E, Cappabianca P, Gangemi M, Cavallo LM, The role of the endoscopic transsphenoidal approach in pediatric neurosurgery. Child Nerv Syst. 2000;16(10-11):692-96.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Anatomy, K. A. P. Vishwanatham Government Medical College, Trichy, Tamil Nadu, India.
2. Additional Professor, Department of Anatomy, All India Institute of Medical Sciences, Nagpur, Maharashtra, India.
3. Associate Professor, Department of Anatomy, Government Medical College, Palakkad, Kerala, India.
4. Professor, Department of Anatomy, SRM Trichy Medical College Hospital and Research Centre, Trichy, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
N Vinay Kumar,
Associate Professor, Department of Anatomy, Government Medical College, NH-47, East Yakkara, Palakkad-678013, Kerala, India.
E-mail: vinaydr1981@gmail.com

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