CT Assessment of Nasal Septal Deviations

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Abstract

Background: The nasal cavities represent complex anatomical structures characterized by significant variability in their functional roles. Nasal septal deviation (NSD) is a prevalent condition observed in both clinical assessments and radiological evaluations. The deviation exhibits a range of shapes, directions, and levels of significance, which can influence patient complaints and management strategies, alongside other associated pathologies involving the paranasal sinuses. Although the initial assessment is conducted through an ENT clinical examination, computed tomography (CT) is recognized as the principal diagnostic tool for evaluating NSD.

Objectives: To assess variants of nasal septum deviation by computed tomography.

Patients and methods: a retrospective study involving 50 patients (33 males and 17 females) who underwent non-enhanced CT scans of the paranasal sinuses and were diagnosed with various forms and degrees of NSD, all without a documented history of nasal trauma. The study focused on aspects such as type, direction, maximum distance of deviation from the midline, and associated pathologies.

Results: CT scanning is the predominant imaging modality for diagnosing a deviated nasal septum. This study concluded that NSD occurs more frequently in males than in females. The analysis identified three primary types of NSD: Curve, Spur, and Z shape, with Spur being the most frequently observed type. Generally, the maximum distance of deviation was found to be less than 1.5 cm.

Conclusion: CT imaging is the optimal approach for a comprehensive assessment of deviated nasal septum, crucial for both accurate diagnosis and effective treatment planning.

Keywords: Computed Tomography; Nasal Septum Deviation; Paranasal Sinuses.

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Introduction

The nasal cavity is a complex anatomical structure with high variability between different persons that relates to different nasal functions. Different anatomic variants may be noticed at this site, mainly belonging to the nasal septum and turbinates. Nasal septal deviation (NSD) is a frequent finding in both clinical and radiological examinations, a prevalence of it up to 89.2% in the general population. A deviated nasal septum is a common cause of nasal obstruction symptoms. The nasal septum is a bony cartilaginous midline structure of the nasal cavity. It has both functional and cosmetic roles, which have important support to the structure of the nose, keeping its shape, and regulating the airflow of respiration. The straight nasal septum facilitates airflow and helps optimize it for gas exchange through optimizing the temperature and humidity of the inspired air. A deviated nasal septum may lead to turbulent airflow, symptoms as nasal obstruction, and snoring **(Alshaikh and Aldhurais 2018)**.

Previous research reported 80 % of humans having some degree of septal deviation; more recent numbers in adults range around 65 %. The rough prevalence range of NSD in neonates has been reported between 1 and 20 %. In school-aged children (6–15 years), it was documented as 20 % when assessed on occipitomental projection X-rays, whereas the clinical diagnosis of NSD was made in approximately 10 % of the same group of children (**Periyasamy et al., 2019).** Patients with nasal obstruction related to NSD often need surgical correction, "septoplasty". Deviated nasal septum surgical correction is the most frequent procedure performed by otorhinolaryngologists in adult patients (**Janovic et al., 2021)**.

CT is considered a method of choice to inspect detailed insight into the septum morphology and to provide one or more parameters that could significantly predict nasal obstruction severity. However, the few studies that correlated CT images and subjective nasal obstruction symptoms reported conflicting results about which CT characteristics of the NSD correlated with the symptom severity. CT is also important for 3D assessment of the nasal area or for reformatting of virtual models of the nasal septum (**Ardeshirpour et al., 2016).**

An advantage of the CT is that it explains the detailed morphology of the deviated septum, which was not fully utilized. It is still unclear whether the complex morphology of NSD (e.g., spurs, S-shaped, ‘‘gutter" form) may have any influence on the subjective sensation of the nasal obstruction severity. In clinical practice, there are multiple classifications of NSD, but Mladina's classification is considered the most detailed one. This classification includes multiple anatomical variants of the nasal septum, usually replaced by other simplified classifications, and divides NSD into seven types. Our study will consider the three main 3 morphological types, which are Curve, Spur, and Z shape **(Janovic et al., 2022).**

Our study aimed to investigate variants of nasal septum deviation (NSD) by computed tomography of paranasal sinuses.

Patients and methods

Ethical considerations

This retrospective study was conducted in accordance with the Declaration of the scientific research morals committee, faculty of medicine, Sohag University, Egypt, and received approval from the ethics committee under the number Soh-Med-24-04—05PD on 15 April 2024. The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Subjects

This retrospective study involved 50 cases of non-contrast CT paranasal sinuses suffering from a deviated nasal septum of any degree, in the study of any age & sex groups, with no history of nasal trauma. No exclusion criteria. The CT machine **Siemens Somatom go now – 16 slice** was used in scanning the cases of the study. All scans were without the use of contrast (non-enhanced). Axial scans with coronal reformats were done in every case. Evaluation of all cases was done at coronal scans. The deviated nasal septum has to be assessed regarding morphology, direction of the deviation, and the distance of the most distant point of deviation from the Medline.

Statistical analysis

Data of all included cases in the study were recorded in an Excel sheet and analyzed to form the acquired results. The data involved patient gender, age, type of deviated nasal septum, direction of deviation, maximal distance of deviation from midline, and any associated findings.

Results

The ages of the patients involved in the study were between 13 and 67 years (mean=40 years) (**Fig.1**). Of which 34% (17 cases) were females and 66% (33 cases) males (**Fig.2**). Assessment of the direction of nasal septal deviations generally, revealed 52% of cases (26 cases) show deviation to the left side, while 42% (21 cases) to the right, while only 6 % (3 cases) of Z shape type (**Fig3**).

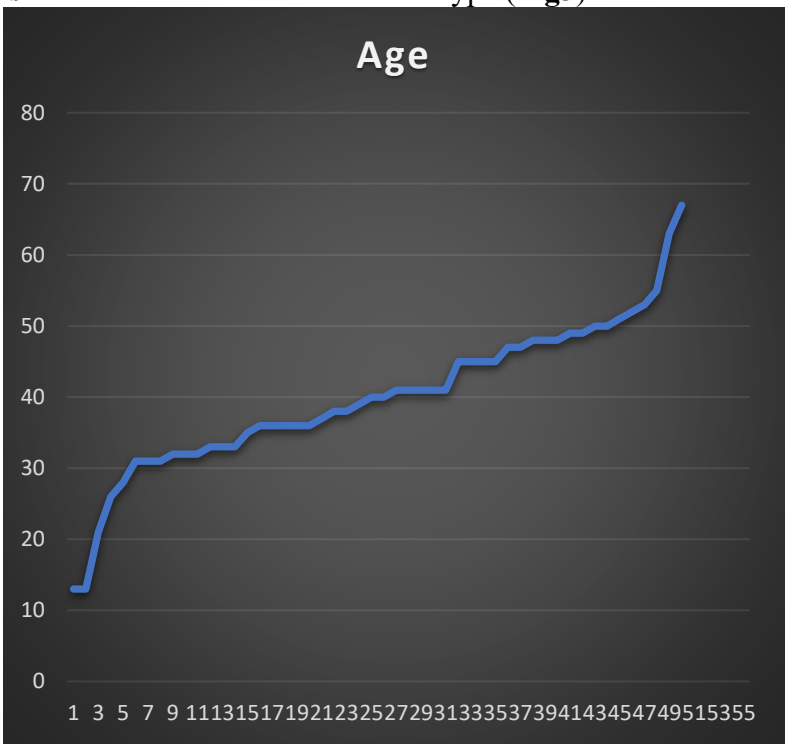

Fig.1. Age distribution of the study cases

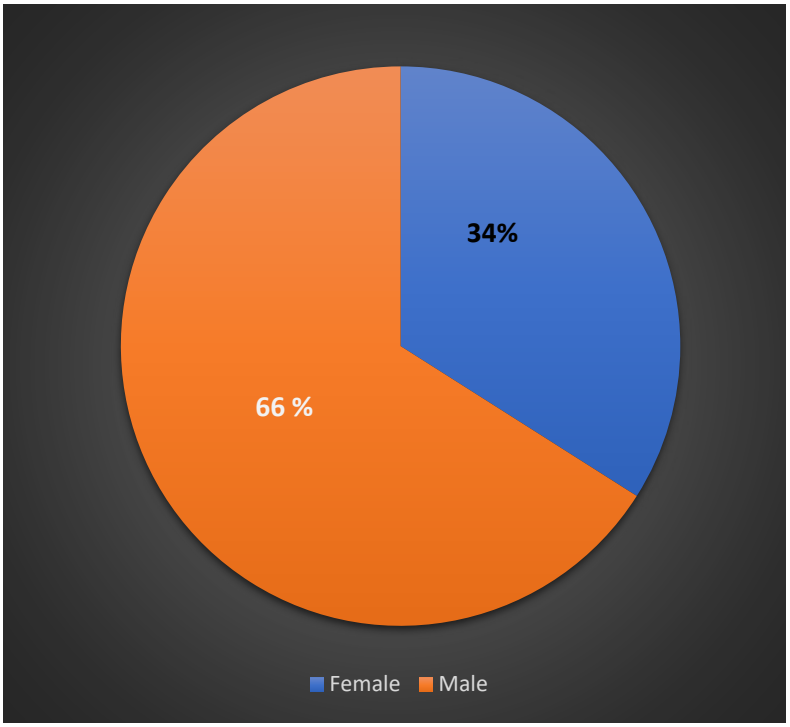

Fig.2. Sex distribution of the study cases

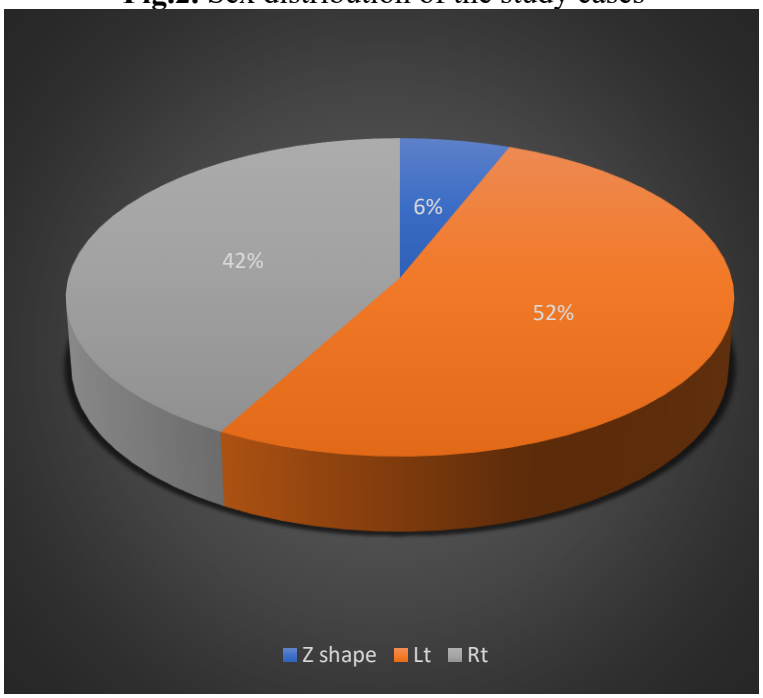

Fig.3. Laterality of the nasal septum deviation in between cases of our study.

Our study is considering the classification of types of NSD into the following types: Curve, Spur, and Z shape. The spur type is like a sided V shape, the curve type deviated nasal septum is like a C shape, while the Z shape is considered the more complex form of deviation in two directions **(Fig. 4).**

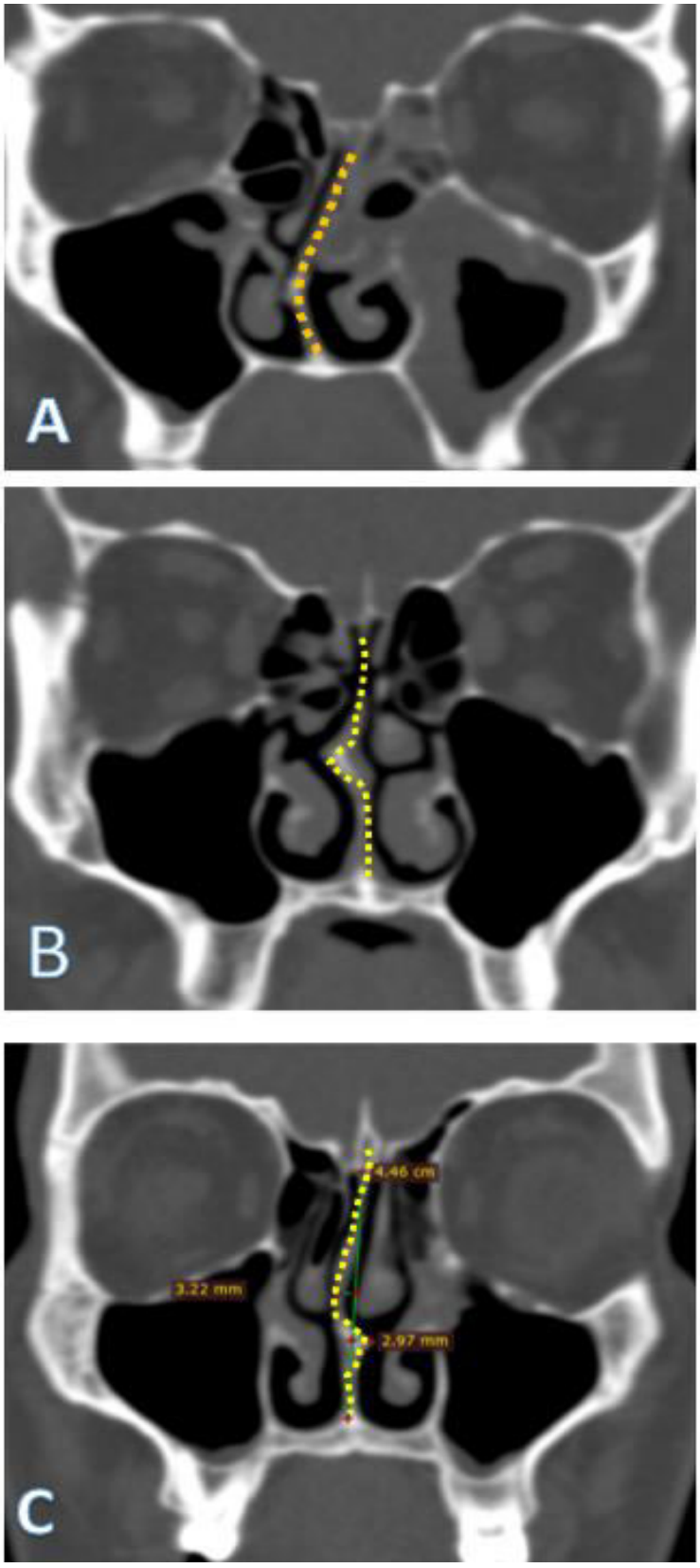

Fig. 4. Types of NSD: (A) Curve type, (B) Spur & (C) Z shape type.

The most frequent NSD type in our study was spur type to the left (34 %), while Z shape was the least frequent (6%) as explained in (**Fig.5**).

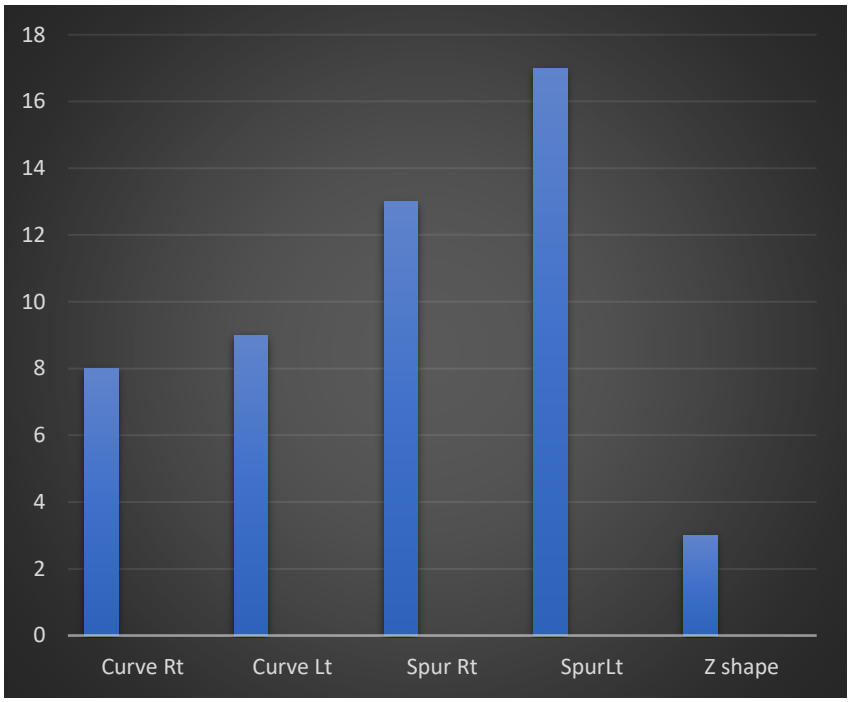

Fig.5. Frequency of different types of deviated nasal septum in the study.

As there were no exclusion criteria in our study, some cases showed other associated pathologies mentioned in (**Table.1)**.

Table.1. Other associated pathologies discovered in CT scan of the study cases.

Associated pathologies	Number of Cases	Percentage N=50
• Rt Maxillary chronic Sinusitis	1	2%
• Rt Max minimal Chronic	1	2%
• Sino nasal Polyposis	1	2%
• Lt Maxillary Chronic Sinusitis	2	4%
• Fungal Pansinusitis	1	2%
• Pan chronic sinusitis	1	2%
• Rt Maxillary Retention Cyst	1	2%
• Chronic Sinusitis	1	2%
• Middle concha bullosa	1	2%
TOTAL	**10**	**20%**

The distance of deviation ranged from 2 mm minimum and up to 13.4 mm maximally. The most frequent distance of deviation (72 % - 36 cases were from 3.9 mm: 7.7 mm (**Fig. 6**).. Our study noticed a relation between unilateral hypertrophied lower concha and contralateral deviation of nasal septum in 28% of cases as explained in **Table 2** While 3 cases in the study are showing NSD to the ipsilateral side.

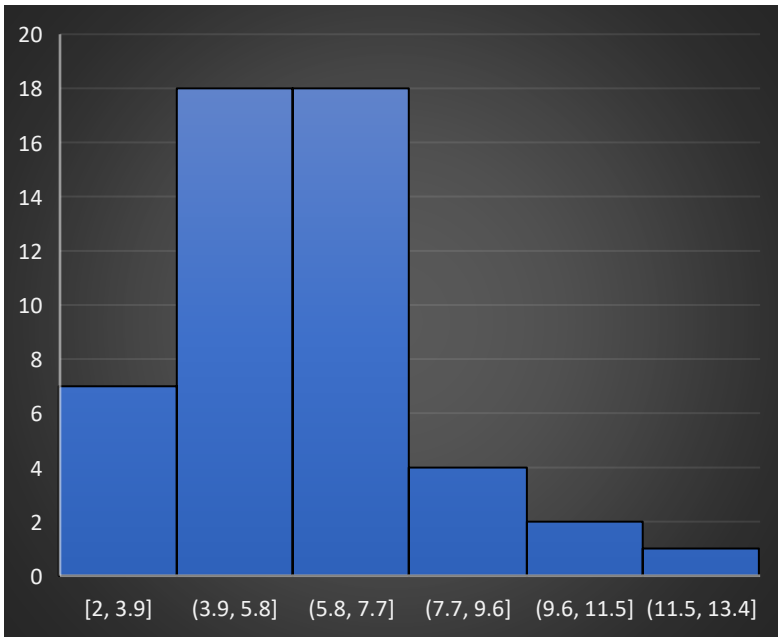

Fig.6. Maximal distances of nasal septum deviation ranges

Table 2. Different types of NSD cases correlated to conceal hypertrophy.

Number of cases	NSD	Hypertrophied concha	The percentage N=50
5 cases	Rt Spur	Lt lower	10%
5 cases	Lt Spur	Rt lower	10%
1 case	Rt Curve	Lt Lower	2%
2 cases	Lt Curve	Rt lower	4%
1 Case	Rt Curve	Lt middle	2%

Cases presentations (**Figs. 7-14**).

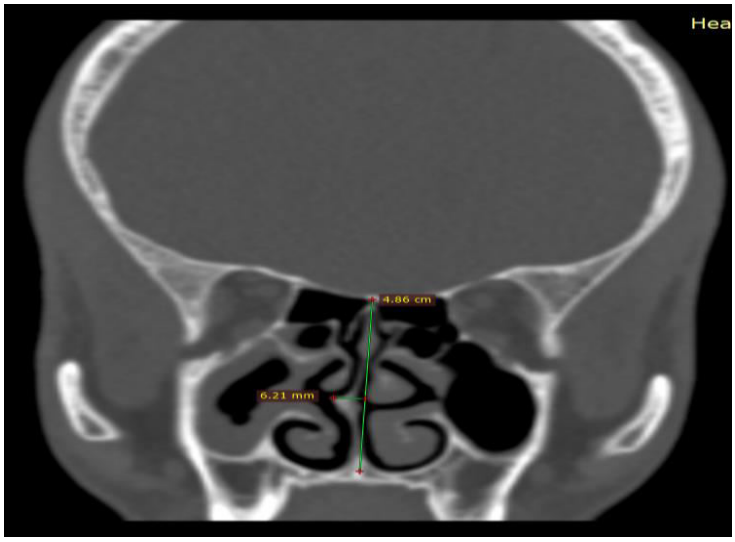

Fig.7. Case 1 Male patient, 50 y, Coronal reformate non-enhanced CT scan is showing spur NSD to the right of the maximal distance of deviation 6.2 mm from Medline. Notice the associated Rt maxillary circumferential mucosal thickening denoting chronic sinusitis

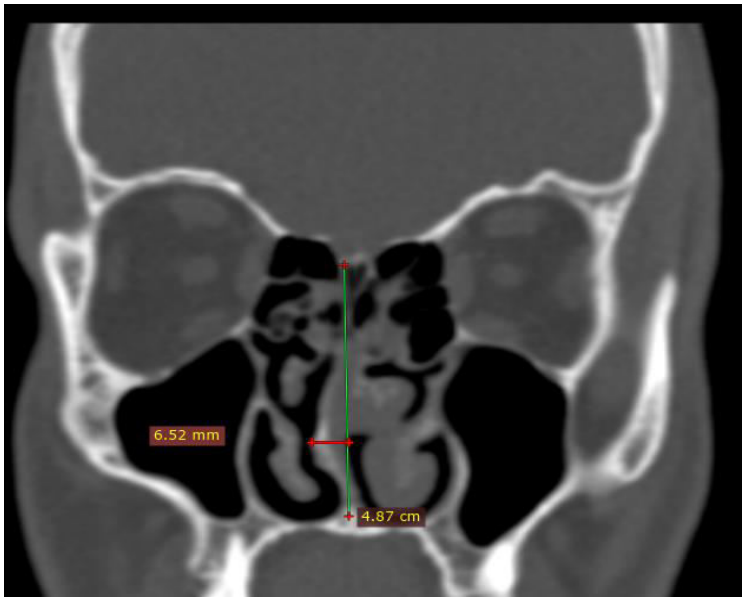

Fig. 8. Case 2 Coronal reformate non-enhanced CT scan is showing Curve type NSD to the right, with a maximal distance of deviation 6.5 mm from Medline. Notice the associated LT lower turbinate hypertrophy.

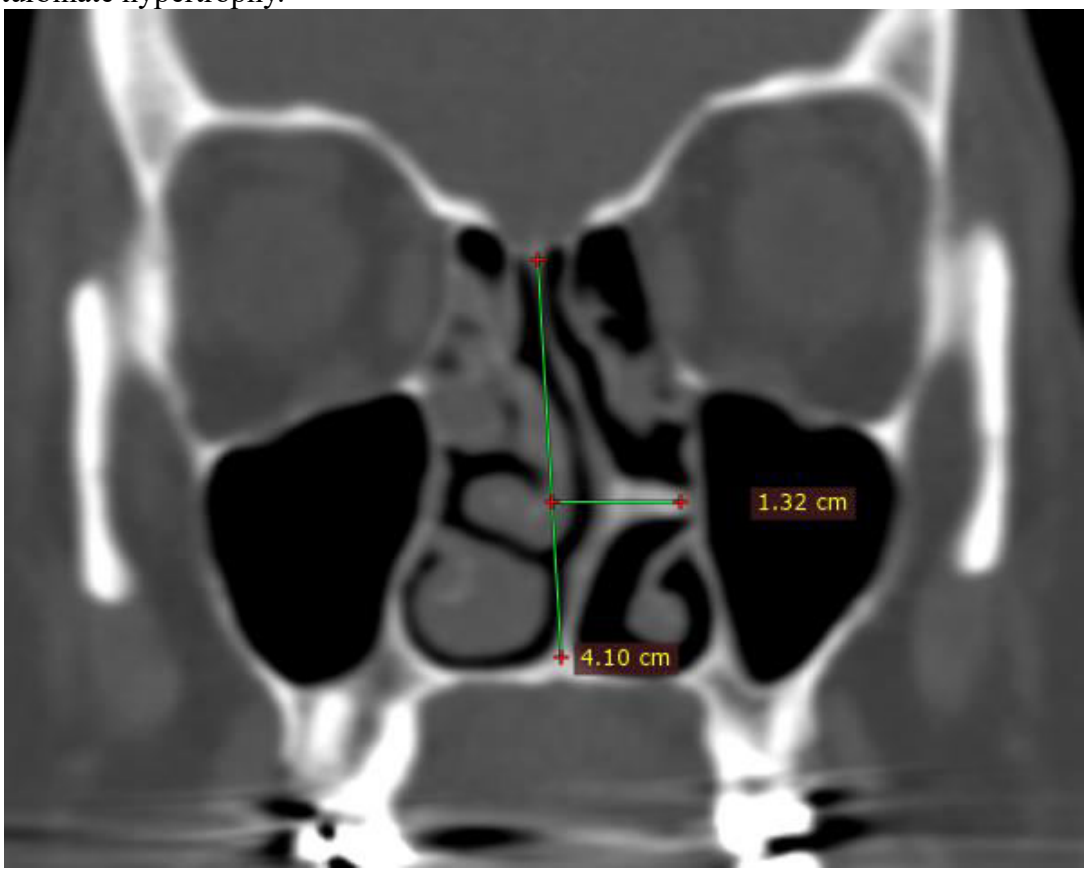

Fig. 9 . Case 3 Female patient, 39 y, CT scan is showing spur-type NSD to the left, with maximal distance of deviation (13.2 mm), which reaches the medial wall of the left maxillary sinus. associated Rt lower turbinate hypertrophy is noticed.

Fig. 10. Case 4 Male patient, 48 y, Coronal reformate non-enhanced CT scan is showing Z shape NSD of curved deviation posteriorly & spur shape Anteriorly. Notice the associated bilateral maxillary retention cysts, and the levels of deviation are not at the same coronal level.

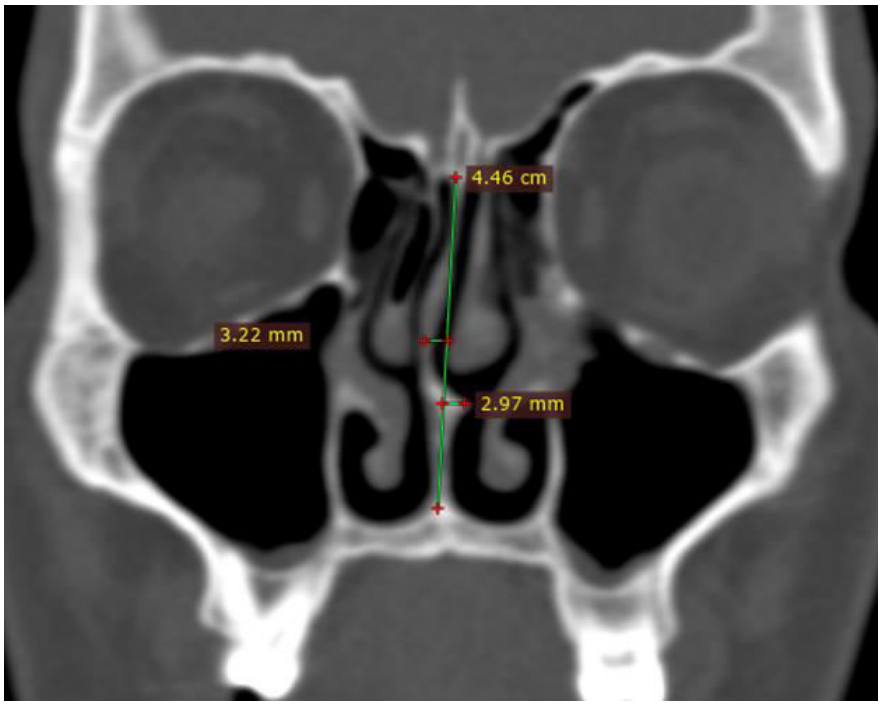

Fig. 11 . Case 5 Z shape deviated nasal septum, notice that the deviations on both sides are at the same coronal cut section level. Rt middle concha bullosa is noticed.

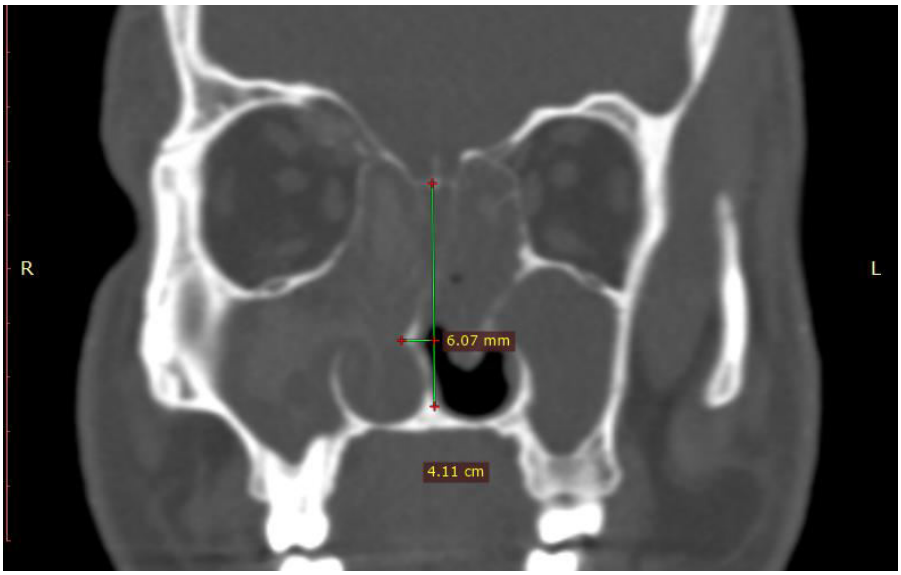

Fig. 12 . Case 6 Male patient 31 y, spur NSD to the right of the maximal distance of deviation 6.07 mm. Associated total opacification of visualized sinuses with hyperdense islands is noticed and suggestive of fungal sinusitis.

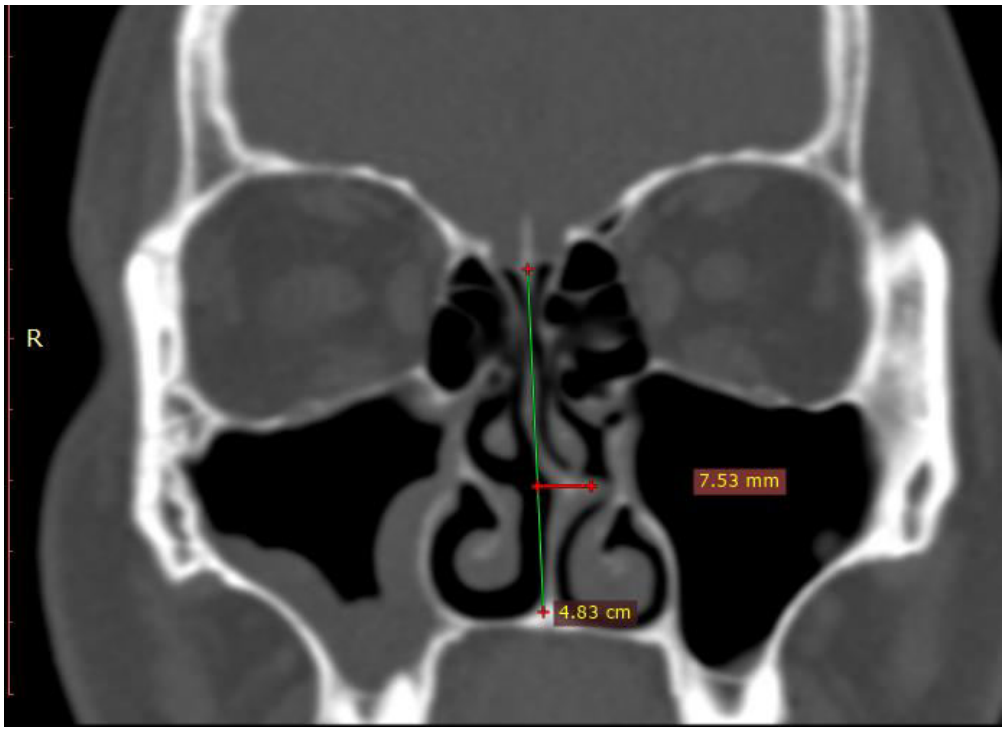

Fig. 13 . Case 7 Lt Spur type NSD with ipsilateral Lt lower concha hypertrophy. Rt maxillary basal mucosal thickening is noticed, denoting chronic sinusitis.

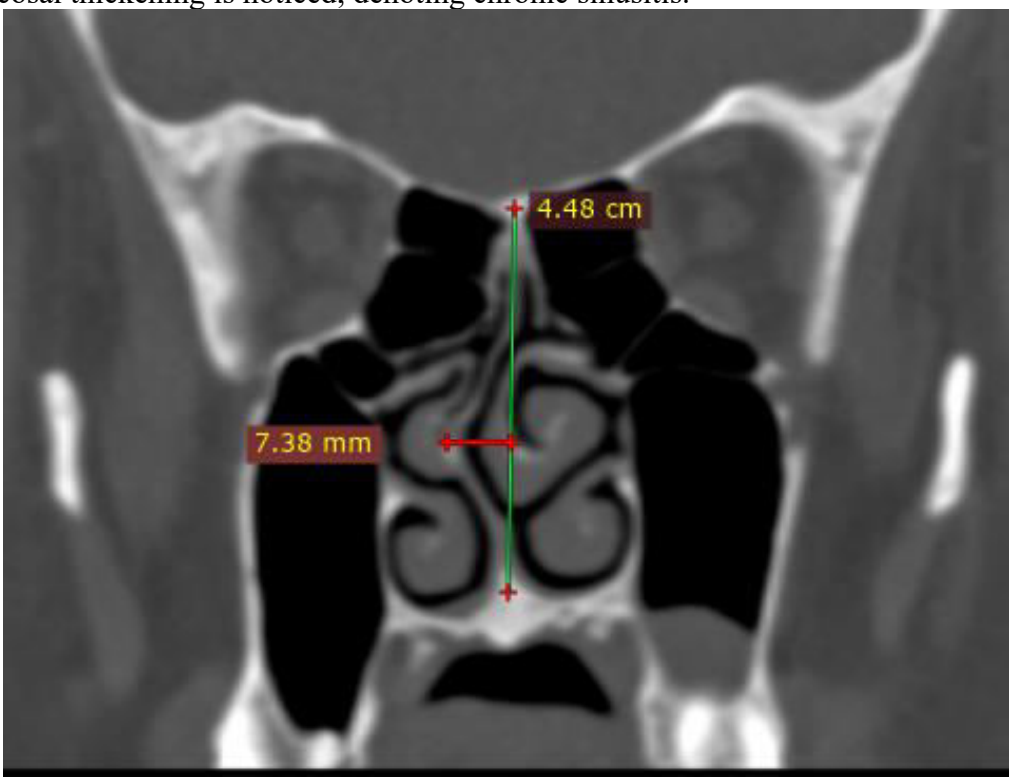

Fig. 14 .Case 8 Male patient, 67 y, coronal CT scan is showing Rt deviated nasal septum of curved type associated with hypertrophied Lt middle concha.

Discussion

Nasal septum deviation (NSD) can cause significant anatomical and clinical complications. It can alter the breathing pattern and thus change the anatomy of the airway structures. The severity of the deviation of the nasal septum is correlated with a decrease in nasopharynx volume. Aging might increase the extent of NSD. Sex is likely not related to either NSD severity or nasopharynx volume (**Sharhan et al., 2018)**. Nasal septum defects may have forensic importance as they are associated with various mechanisms, including trauma and cocaine abuse. Several classification systems have been developed for the evaluation of nasal septum deviation (**Mladina et al., 20218) . Rao et al.** and **Mladina** developed similar classification systems that accurately described the most common types of deviations seen in clinical practice. Our study has considered the 3 main types of considerable difference in morphology, which are curved (C shape), Spur (horizontal V shape), and Z or S shape. The considerable incidence of anatomical variation and congenital findings in CT images of the paranasal sinuses in patients scheduled for operations indicates that preoperative CT examination is useful in avoiding multiple or less indicated surgical operations (**Mladina 1987 ; Mladina et al., 2018 ; Rao et al., 2005)** .

Many articles consider different classifications of NSD. Guyuron et al. classification consists of 6 different types of NSD that require diverse surgical approaches. Mladina et al. classification describes the morphology of NSD and divides it into 7 categories. Liu et al.'s classification is formed of 3 groups of deviation (caudal, anterior, and media) based on the location of the most prominent point of the NSD. Another classification is based on deformed septal structure and categorizes deviation into 3 types: cartilaginous, bony, and combined cartilaginous-bony. Classification according to the maximal NSD angle grades deviation into mild, moderate, and severe (**Teixeira et al., 2016).**

Our study is considering the measurement of the maximal distance of deviation from Medline is a better in assessing the degree of deviation, which is more helpful for an ENT surgeon to assess the case. *Janovic* et al. explained that any CT grading of NSD could not specifically confirm nasal obstruction severity. Hence, CT is not recommended as the only diagnostic tool of choice for an objective selection of septal surgery candidates **(Janovic et al., 2022)**. The nasal turbinate is one of the important anatomical and physiological structures of the nasal cavity. Nasal endoscopes and paranasal sinus CT have explained many turbinate variations. MT variations in adults are common, mainly pneumatized MT, then PMT, with no apparent relation to septal deviation. Also variability in sinuses may be associated like absent frontal nasal septum (**Janovic et al., 2022 ; Abodahab 2023)**.

CT is the modality of choice for assessing inflammatory sinus disease and is routinely performed prior to functional endoscopic sinus surgery. It is important for the radiologist to understand the anatomy of the nasal sinus drainage pathways and the different anatomical variants in order to guide the surgeon. These variants may impair the functional drainage pathways, increase the risk of endoscopic surgery, and make access to sites of pathology extremely difficult. The CT study should be reviewed in all three orthogonal planes in order to accurately understand this complex region. But Rehman et al. has concluded that a preoperative CT scan is a poor tool in predicting sinus disease in patients without clinical features of sinus disease and has a limited role in patients with symptomatic

DNS and the decision of operation should be clinically correlated not only according to CT findings. Measurement of septal deviation angle and distances is useful as it can aid preoperative planning, as their increase is associated with the need for septoplasty (**Shams et al., 2022 ; El-Anwar et al., 2020**).

Conclusion

CT scan is considered the main imaging modality and main tool of diagnosis for assessment of NSD. Our study has concluded that NSD is more common in males than for females. Deviation is generally slightly more to the left than to the right. Our study considered 3 main classification types of NSD; Curve, Spur and Z shape. Spur NSD type in the commonest (to the left more than to the right), then Curve NSD type (also more to the left than to the right) and the least common type is Z NSD shape. Hypertrophied lower concha at the contralateral side of deviation was noticed but not confirmed as an etiology. The maximal distance of deviation is generally less than 1.5 cm. CT is the best way for detailed assessment of deviated nasal septum, either for diagnosis or for good planning of treatment. CT alone is not enough to correlate degree of nasal obstruction but clinical history and examination is the main way to assess it.

Abbreviation

CT Computed Tomography
MT Middle Turbinate
PMT Pneumatized Middle Turbinate
NSD Nasal Septum Deviation
PNS Para Nasal Sinuses

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Human Ethics and Consent to Participate declarations: not applicable.

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