"RADIOGRAPHIC STUDY OF NASAL SEPTAL BODY IN PATIENTS WITH CHRONIC RHINOSINUSITIS AND DEVIATED NASAL SEPTUM" A 1 YEAR OBSERVATIONAL STUDY.

BY

DR. DHIVYA BHARATHI. N

REG. NO: BE0119002

Dissertation

Submitted to the

KLE Academy of Higher Education and Research, Belagavi, Karnataka

In partial fulfilment

Of the requirements of the degree of

MASTER OF SURGERY

IN

OTORHINOLARYNGOLOGY AND

HEAD AND NECK SURGERY

UNDER THE GUIDANCE OF

Dr. PRASHANT. H. PATIL M.S. ENT

Professor

DEPARTMENT OF OTORHINOLARYNGOLOGY AND HEAD AND NECK SURGERY,

JAWAHARLAL NEHRU MEDICAL COLLEGE,

BELAGAVI, KARNATAKA

APRIL - 2022

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

BELAGAVI, KARNATAKA

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "**RADIOGRAPHIC STUDY OF NASAL SEPTAL BODY IN PATIENTS WITH CHRONIC RHINOSINUSITIS AND DEVIATED NASAL SEPTUM" A 1 YEAR OBSERVATIONAL STUDY** is a bonafide and genuine research work carried out by me, under the guidance of **Dr. PRASHANT. H. PATIL** M.S., Professor, Department of Otorhinolaryngology and Head and Neck Surgery, J. N. Medical College, Belagavi.

Date:

Place: Belagavi **DR DHIVYA BHARATHI.N**

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

BELAGAVI, KARNATAKA

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled "**RADIOGRAPHIC STUDY OF NASAL SEPTAL BODY IN PATIENTS WITH CHRONIC RHINOSINUSITIS AND DEVIATED NASAL SEPTUM" A 1 YEAR OBSERVATIONAL STUDY** is a bonafide research work done by **DR DHIVYA BHARATHI. N** in partial fulfilment of the requirement for the degree of M.S., Otorhinolaryngology and Head & Neck Surgery.

Date:

Place: Belagavi

Dr. PRASHANT. H. PATIL M.S. E.N.T
Professor
Department of Otorhinolaryngology and Head & Neck Surgery,
J.N. Medical College,
Belagavi – 590010

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

BELAGAVI, KARNATAKA

ENDORSEMENT BY THE HOD, PRINCIPAL/HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled "**RADIOGRAPHIC STUDY OF NASAL SEPTAL BODY IN PATIENTS WITH CHRONIC RHINOSINUSITIS AND DEVIATED NASAL SEPTUM" A 1 YEAR OBSERVATIONAL STUDY** is a bonafide and genuine research work carried out by **DR DHIVYA BHARATHI. N** under the guidance of **Dr. PRASHANT. H. PATIL** M.S., Professor, in partial fulfillment of the requirement for the degree of M.S., Otorhinolaryngology and Head & Neck Surgery.

Dr. ANIL. S. HARUGOP M.S., Ph.D.
Professor & Head of department
Department of Otorhinolaryngology
and Head & Neck Surgery,
J.N.Medical College,
Nehru Nagar,
Belagavi -590010

Date:
Place: Belagavi

Dr. (Mrs) N.S. MAHANTSHETTI M.D.
Principal
J.N.Medical College,
Nehru Nagar,
Belagavi -590010

Date:
Place: Belagavi

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

BELAGAVI, KARNATAKA

COPYRIGHT

DECLARATION BY THE CANDIDATE

I hereby declare that the KLE Academy of Higher Education and Research Belagavi, Karnataka shall have the rights to preserve, use and disseminate this dissertation in print or electronic format for academic/research purpose.

Date:

Place: Belagavi **DR DHIVYA BHARATHI.N**

PLAGIARISM CERTIFICATE

JAWAHARLAL NEHRU MEDICAL COLLEGE

(Recognized by Medical Council of India, New Delhi)

Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

Nehru Nagar, Belagavi- 590 010, Karnataka, INDIA

0831 - 2473350 0831 - 2470759

Ref No: MDC/PG/

Date: 17-11-2021

ACCEPTANCE LETTER

The softcopy of thesis entitled: "RADIOGRAPHIC STUDY OF NASAL SEPTAL BODY IN PATIENTS WITH CHRONIC RHINOSINUSITIS AND DEVIATED NASAL SEPTUM" A 1-YEAR OBSERVATIONAL STUDY" has been submitted for Anti-Plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of 05% which is within the acceptable limits of 10% as per the guidelines given by UGC.

Guide.

Dr. Prashant H. Patil
Consultant Department of ENT
KMC Reg. No. 42734
KLES Dr. Prabhakar Kore Hospital &
MRC, Belagavi

KAHER J. N. MEDICAL COLLEGE BELAGAVI

Dr. (Mrs.) N.S. Mahantashetti.
Chairperson-Antiplagiarism Committee &
Principal,
J. N. Medical College, Belagavi.

To,
Reg. No. BE0119002,
Postgraduate Student,
2019-20 Batch,
Department of ENT,
J. N. Medical College, Belagavi.

ACKNOWLEDGEMENT

Completion of study and dissertation as a part of the MDS curriculum is one of the most important milestones in the life of a post graduate. I owe my gratitude to all those people who have made this dissertation possible and because of whom my post-graduate experience has been one that I will cherish forever.

At the outset, I would like to express my deep sense of gratitude to my guide ***Dr. Prashant. H. Patil*** *M.S, Professor Department of Otorhinolaryngology, to whom I am really grateful and indebted in many ways. His personal interest and enthusiasm towards this study as well as the subject of otorhinolaryngology has been instrumental in my academic life. He has been extremely critical and analytical and had paid great attention to relevant details. He had boosted my morale and for his constant willingness and amenability, I am truly grateful. He has been extremely warm and encouraging and has been the source of my inspiration throughout my years of post-graduate study.*

I am truly thankful to ***Dr. Anil. S. Harugop*** *M.S, Ph.D, Professor and Head of Department, Otorhinolaryngology and Head and Neck Surgery, J.N. Medical College, who always encourages his students in research work, inter departmental activities, workshop and conferences. His wealth of knowledge and the wide range of surgeries he performed are truly worth a mention.*

I am thankful to ***Dr. B.P. Belaldavar*** *M.S, Ph.D, Professor and Unit Head, Department of Otorhinolaryngology and Head and Neck Surgery, J.N. Medical College, for his high-ranking advice not only in dissertation work but also in my overall performance in the field of otorhinolaryngology and as a strong disciplinarian.*

I thank ***Dr. P. S. Hajare,*** *D.N.B., D.L.O., Professor, in the Department of Otorhinolaryngology for her constant encouragement and guidance. She has always been amenable to long discussions on the subject of Otorhinolaryngology and Head and Neck Surgery, and showed me immeasurable guidance, patience and her work sparkles me to the best.*

My sincere appreciation to ***Dr. R.B. Metgudmath****, MS, Professor,* ***Dr. N.R. Ankle****, M.S, Professor,* ***Dr. V.V. Metgudmath****, MS, Associate Professor and* ***Dr. Shama Bellad*** *M.S, DNB, Associate Professor Department of Otorhinolaryngology and Head and Neck Surgery, J.N. Medical college, for their help, constant encouragement and valuable guidance.*

I wish to express my sincere and humble gratitude to ***Dr. Puneeth S Nayak*** *M.S, Assistant Professor,* ***Dr.Preeti S Shetti****, MS, Assistant Professor, and* ***Senior*** *Resident Dr* ***Rajesh Havaldar,*** *M.S, DNB,* ***Dr.Izhak Mehadi,*** *M.S,* ***Dr. Apoorva****, M.S, Department of Otorhinolaryngology and Head and Neck surgery, J.N. Medical college. for their help and guidance*

I thank most of all ***Dr. (Mrs) N.S. Mahantshetti****, M.D., Principal, J.N. Medical College and* ***Dr. M.V. Jali,*** *MD, CEO, KLEs Hospital and MRC Belgaum for their unfailing support and help throughout my course.*

I would like to thank ***Dr. Javali****, M.Sc, M.Phil, P.hD. Assistant Professor, Department of Community Medicine, for helping me with the statistics all throughout.*

A special note of thanks to my beloved parents ***Mr. N. Narasimman and Mrs. N. Vijayalakshmi*** *who have always been my confidant and source of encouragement and undying support throughout. A very special thanks to my loving sisters Mrs. Kavitha Ganesh and Mrs. Priya Praveen for her constant encouragement and positive*

criticism and for constantly helping me with my research works and my nephew Darshan and niece Nityasree for the immeasurable love and support.

I would like to thank my dear seniors ***Dr.Shivani, Dr.Samanvya, Dr.Manasi, Dr. Paramita, Dr. Sweta, Dr. Prasad and special thanks to Dr. O.Padmavathy*** *for their constant support throughout the entire period, their criticism and encouragement to pursue our goals together in this field*

I would like to thank my dear friends ***Dr. Reshma, Dr. Prasheetha, Dr. Aarathi, and my beloved co- pgs Dr. Lavanya Reddy, Dr. Lakshmi goswami, Dr. Umang aggarwal*** *for their constant support throughout the entire period, their criticism and encouragement to pursue our goals together in this field*

I thank my ***post graduate colleagues, fellowship seniors and clerical and non-clerical staffs*** *from the department of Otorhinolaryngology and Head and Neck Surgery for their help during my tenure.*

Date:

Place: Belagavi **DR DHIVYA BHARATHI.N**

LIST OF ABBREVIATIONS

NBS	Nasal Septal Body
SB	Septal Body
CRS	Chronic Rhino Sinusitis
DNS	Deviated Nasal Septum
NVA	Nasal Valve Area
INV	Internal Nasal Valve
MM	Medial Mucosa
LM	Lateral Mucosa
OMU	Osteo Meatal Unit
AR	Allergic Rhinitis
IT	Inferior Turbinate
ITH	Inferior Turbinate Hypertrophy
MT	Middle Turbinate
ST	Superior Turbinate
SS	Sphenoid Sinus
CT	Computed Tomography
EP	Ethmoidal Polyposis
PNS	Paranasal Sinus

ABSTRACT

Background :

The Nasal Septal Body or Nasal Swell Body (NSB) is present in the anterior part of the septum situated superior to the level of inferior turbinare and anterior to middle turbinate. When compared to the rest of the septum, it contains thicker cartilage and mucosa.

The structural features of septal body and its location may allow it to influence and regulate nasal airflow. The NSB effect on nasal physiology is similar to that of the inferior turbinate, hence few authors refer septal body as the septal turbinate.

Various terminologies are used in the literature to describe this distinct structure as nasal septal body, nasal swell body, septal turbinate, intumescentia nasi anterior, anterior septal tubercle, and Kisselbach's body.

In case of long-standing inflammation the hypertrophied turbinate mucosa undergoes fibrosis, once fibrosis starts it is hard to inverse, hence conservative modality of treatment like corticosteroids and decongestants are less likely to benefit. In the same way, the nasal septal body can develop hypertrophic change and affect the nasal airflow in longstanding inflammation of the nasal cavity.

Objective :

Aim of our study is to compare the radiographic changes in Nasal Septal Body (NSB) in patients with Chronic Rhinosinusitis (CRS) and Septal deviation (DNS).

Materials and Methods:

This is a retrospective observational study, where total of 60 CT-PNS were studied to observe the nasal septal body changes in patients with Deviated Nasal

Septum (DNS) and Chronic Rhinosinusitis (CRS) in ENT & HNS department, KAHER Belgaum, for a period of 1year from January 2019 to December 2019. The RadiAnt DICOM viewer was used to view CT scans and evaluate CT images. Each side was evaluated for Septal body thickness, Inferior turbinate, Internal Nasal valve area, Septal deviation, Sinusitis The thickness of the septal body was measured from the lateral aspect of the septal body to the midline, length was measured as the antero-posterior length of the protruding parts in the axial view and height was measured as the height of the protruding area of the septum in the coronal view. The internal nasal valve was measured in the coronal view as the gap between the septal body and the lateral nasal wall as the horizontal distance from the most protruding part on each side to the lateral wall. The measurements were performed separately on the both sides. Inferior turbinate measurements were made from CT PNS coronal view on both sides separately, IT medial and lateral mucosa length were measured horizontally. Measurements were taken using computer-generated scales and the values were recorded.

Result:

A total of 60 CT-PNS were retrospectively studied, the results were categorized into three groups. Group 1- DNS, group 2 - CRS, group 3 - CRS+DNS, of which 30 were DNS group, 16 were CRS, 14 were CRS+DNS. The septal body thickness in right and left nasal cavity, septal body height and length, IT medial and lateral mucosa, Internal nasal valve area were measured in right and left nasal cavity separately in all 3 groups.

In group 1 (DNS) in patients with right deviation the mean septal body thickness on right nasal cavity was 3.76mm the mean septal body thickness in left

nasal cavity was 4.58mm. In case of left deviation the mean thickness on right cavity was 4.48mm left cavity was 3.62mm.

Similarly in right and left deviation the contralateral septal body thickness was positively correlated with inferior turbinate medial and lateral mucosa thickness and the values were statistically significant. In group-2 (CRS) all patients had bilateral disease though the disease severity varied between the right and left nasal cavity, we observed that septal body thickness and inferior turbinate thickness were increased on the side with more disease severity.

In group-3 (CRS+DNS) when compared to patient with only CRS where septal body thickness showed variation based on disease severity, in CRS with DNS the septal body thickness is increased in both right and left cavity.

Conclusion:

It is found that in patient with deviated nasal septum (DNS) in addition to contralateral inferior turbinate hypertrophy septal body thickness is also increased. This is found to be similar in case of CRS with DNS. In CRS patients it is found that along with inferior turbinate hypertrophy, the septal body thickness is also increased on the diseased side and values are found to be statistically significant. Thus, concluding that in both DNS and CRS + DNS, septal deviation cause contralateral septal body hypertrophy. In CRS along with inferior turbinate hypertrophy the septal body thickness is also increased in the diseased side.

Key Words: Nasal Septal Body, Deviated Nasal Septum, Chronic Rhinosinusitis, Inferior turbinate hypertrophy

TABLE OF CONTENTS

SL.NO	CONTENTS	PAGE NO.
1	INTRODUCTION	1-2
2	OBJECTIVE	3
3	REVIEW OF LITERATURE	4-21
4	MATERIALS AND METHODS	22-24
5	RESULTS	25-48
6	DISCUSSION	49-52
7	CONCLUSION	52
8	SUMMARY	54
8	BIBLIOGRAPHY	55-58
9	ANNEXURES	
	Annexure I: Ethical Clearance Letter	59
	Annexure II: Proforma	60-61
	Annexure III: Photographs	62-68
	Annexure IV: Key to Master Chart	69
	Annexure V: Master Chart	70-71

LIST OF FIGURES

Sl.No	FIGURE	Pg. No.
1	Diagram showing the 5-week embryo—formation of facial processes	4
2	Diagram showing 6-week embryo	4
3	Diagram showing 6th week embryo, "Primitive nasal cavity which is separated from the oral cavity by oronasal membrane"	5
4	Diagram showing 9-week embryo—formation of secondary palate and definitive choana.	6
5	Diagram showing the cartilaginous and bony components of nasal septum	7
6	Diagram showing vomer left lateral view	8
7	Diagram showing vascular supply of nasal septum	10
8	**A-** External nasal valve angle and area. **B-** Internal nasal valve.	12
9	CT PNS coronal view showing septal spur with inferior turbinate hypertrophy	17
10	CT PNS - Coronal view showing nasal septal swell body	18

LIST OF TABLES

Sl.No	TABLE	Pg. No.
1	Structures contributive to development of face	5
2	Innervation of nose	11
3	Naso septal deviation angle	13
4	Lund mackey scoring system (CT grading of Rhinosinusitis)	19
5	Age wise distribution among three groups	25
6	Comparison of three groups (DNS, CRS and CRS+DNS) with mean age by one way ANOVA	27
7	Comparison of three groups (DNS, CRS and CRS+DNS) with gender	28
8	Comparison of two groups (DNS and CRS+DNS) with septal deviation	29
9	Comparison of two groups (DNS and CRS+DNS) with degree	30
10	Comparison of two groups (DNS and CRS+DNS) with mean Naso septal angle (in degree) by t test	31
11	Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group** by independent test	33
12	Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group** by Karl Pearson's correlation coefficient	35

13	Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS group** by Karl Pearsons correlation coefficient	37
14	Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group** by independent test	39
15	Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group** by Karl Pearsons correlation coefficient	41
16	Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in combined group (**DNS and CRS+DNS group)** by independent test	43
17	Comparison of three groups (DNS, CRS and CRS+DNS) with all parameters by one way ANOVA	45
18	Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **all samples of three groups** by Karl Pearsons correlation coefficient	47

LIST OF GRAPHS

Sl.No	GRAPHS	Pg.no
1	Graph showing age wise distribution among three groups	26
2	Comparison of three groups (DNS, CRS and CRS+DNS) with mean age	27
3	Comparison of three groups (DNS, CRS and CRS+DNS) with gender	28
4	Comparison of two groups (DNS and CRS+DNS) with septal deviation	29
5	Comparison of two groups (DNS and CRS+DNS) with degree	30
6	Comparison of two groups (DNS and CRS+DNS) with mean Naso Septal angle (in degree)	31
7	Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group**	34
8	Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group**	36
9	Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group**	36
10	Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS group**	38
11	Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS group**	38

12	Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group**	40
13	Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group**	42
14	Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group**	42
15	Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in combined group (**DNS and CRS+DNS group)**	44
16	Comparison of three groups (DNS, CRS and CRS+DNS) with all parameters	46
17	Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **all samples of three groups**	48
18	Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **all samples of three groups**	48

LIST OF PHOTOGRAPHS

Sl.No.	IMAGE	Pg.no
1.	CT-PNS coronal view showing (a) DNS and (b) CRS	62
2.	CT-PNS (a) axial view showing septal body length and (b) coronal view showing septal body height	62
3.	CT-PNS coronal view showing septal body thickness in (a) right and (b) left nasal cavity in right septal deviation	63
4.	CT-PNS coronal view showing left inferior turbinate (a) medial and (b) lateral mucosa thickness in right septal deviation	63
5.	CT-PNS coronal view showing showing the internal nasal valve area in (a) right and (b) left nasal cavity in right septal deviation	64
6.	CT-PNS coronal view showing showing the septal body thickness in (a) right and (b) left nasal cavity in CRS with right DNS	65
7.	CT-PNS coronal view showing the inferior turbinate (a) medial and (b) lateral mucosa thickness in right and left nasal cavity in CRS with right DNS	65
8.	CT-PNS coronal view showing the internal nasal valve area in (a) right and (b) left nasal cavity in CRS with right DNS	66
9.	CT-PNS coronal view showing the septal body thickness in (a) right and (b) left nasal cavity in CRS	67
10.	CT-PNS coronal view showing the inferior turbinate (a) medial and (b) lateral mucosa thickness in right and left nasal cavity in CRS	67
11.	CT-PNS coronal view showing the internal nasal valve area in (a) right and (b) left nasal cavity in CRS	68

INTRODUCTION

"The Nasal Septal Body or Nasal Swell Body (NSB) is present in the anterior part of the septum situated superior to the level of inferior turbinare and anterior to middle turbinate. When compared to the rest of the septum, it contains thicker cartilage and mucosa".[1]

Various terminologies are used in the literature to describe this distinct structure as "Nasal septal body, nasal swell body, septal turbinate, intumescentia nasi anterior, anterior septal tubercle, and Kisselbach's body".[2]

Multiple factors contribute to the nasal airflow like valve area, septum and inferior concha.[3] As "Septal body is present in the region of the nasal valve area congestion of the septal body can result in changes to the nasal cross-sectional area and create resistance to the airflow".[4]

The structural features of septal body and its location may allow it to influence and regulate nasal airflow. "The NSB effect on nasal physiology is similar to that of the inferior turbinate, hence few authors refer septal body as the septal turbinate".[5]

"It contains expansile tissue that behave in a similar manner to the inferior concha, the septal body hypertrophy when combined with inferior concha hypertrophy can result in changes to cross-sectional area of nose and airflow resistance".[6]

Histology of "Septal body" is similar to that of inferior concha, recent studies have shown that in case of septal deviation in addition to the contralateral

compensatory inferior turbinate hypertrophy, septal body is also prominent in such patients.[5]

In case of chronic sinonasal diseases, It is said “NSB undergoes similar mucosal changes as seen in hypertrophy of the inferior concha”.

In cases of long standing inflammation the hypertrophied turbinate mucosa undergoes fibrosis, once fibrosis starts it is hard to inverse, hence conservative modality of treatment like corticosteroids and decongestants are less likely to benefit. In the same way, “The nasal septal body can develop hypertrophic change and affect the nasal airflow in cases of long standing inflammation of the nasal cavity”. [1]

There are very few studies in literature about NSB and its changes in chronic sino-nasal disease, the objective of the current study is to focus on the “NSB changes in chronic rhino sinusitis and septal deviation”.

OBJECTIVE

"Aim of our study is to compare the radiographic changes in Nasal Septal Body (NSB) in patients with Chronic Rhinosinusitis (CRS) and Septal deviation (DNS)".

REVIEW OF LITERATURE

EMBRYOLOGY OF NOSE:

"The nasal airway development starts at 4th week of gestation. The collection of neural crest cells undergoes proliferation to form the nasal placodes".[7,8]

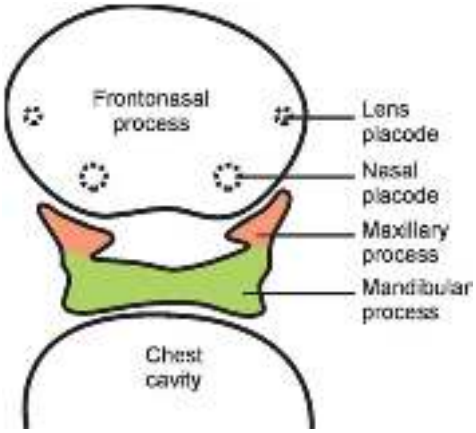


Figure 1: Diagram showing the 5-week embryo—formation of facial processes.[9]

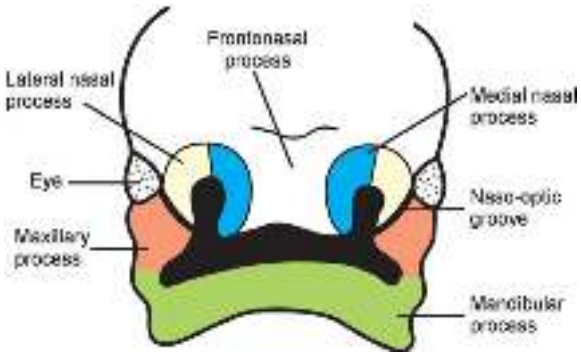


Figure 2: Diagram showing 6-week embryo.[9]

The surrounding cells multiply and fuse to give "medial and lateral nasal processes"on foetal face. Maxillary and frontal processes joins to give the "lateral two thirds of the upper lip, superior alveolar ridges, and palatal shelves". Maxillary processe joins with medial nasal processe to give columella and philtrum , it fuses with frontal prominence to form frontonasal process, which incorporates the frontal, ethmoid and nasal bones, cartilage of nose, central incisors, and hard palate.

Table 1: Structures contributive to development of face:

Processes	Structures
Frontonasal	Forehead, bridge of nose, medial and lateral nasal prominences
Maxillary	Cheeks, lateral portion of upper lip
Medial nasal	Philtrum of upper lip, most and tip of nose, septum
Lateral nasal	Ala of nose, lateral nasal wall
Mandibular	Lower lip and jaw

Until nasobuccal membrane remains, "the medial and lateral nasal processes grows and invaginate to form two nasal pits". By tenth week the membrane eventually ruptures, allowing contact between nose and the nasopharynx.[10]

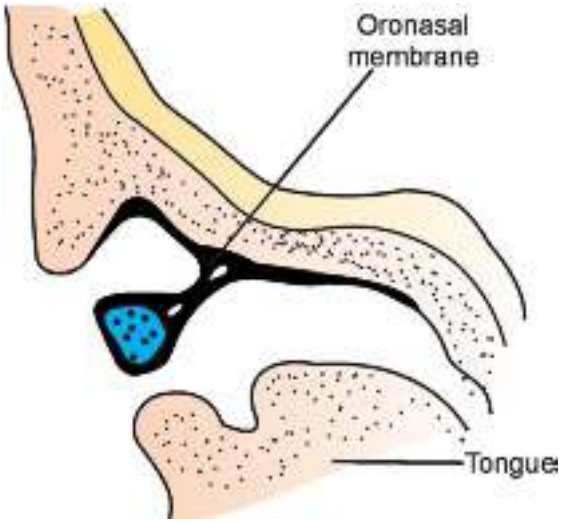


Figure 3: Diagram showing 6th week embryo, "primitive nasal cavity which is separated from the oral cavity by oronasal membrane".[9]

Fused medial nasal processes and frontonasal process grows downwards to form nasal septum and thus defines the two separate nasal cavities. "Fusion of nasal septum and the palatine processes begins anteriorly during the 9th week, and its fusion is completed posteriorly by the 12th week".[7,10]

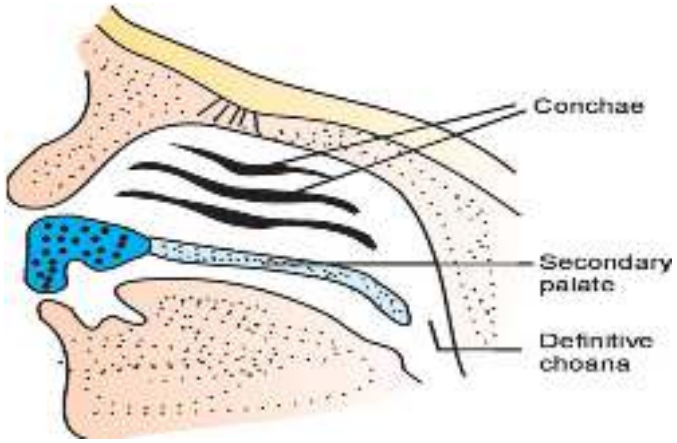


Figure 4: Diagram showing 9-week embryo—formation of secondary palate and definitive choana.[9]

The cartilaginous framework of nose develops jointly from "the medial and lateral nasal swellings". Part of the cartilage starts to ossify, forming the" membranous bone that covers the vomer and the cartilaginous perpendicular plates". until puberty "the perpendicular plates of ethmoid and nasal bones do not completely ossify".[11] "Trauma to nose in young child or teenager might not elicit a true fracture, instead they generate a growth changes in the transitioning tissue that might ultimately result in a posterior deviated bony septum or spur formation". Septum contributes to both functional and aesthetic significance. "Nasal septum is the main structure that support the external nose".[12]

NASAL CAVITY:

"Nasal cavity extends from external nares to the posterior choanae, and becomes continuous posteriorly with the nasopharynx". Anteriorly "it is narrower than posteriorly, it extends vertically from cribriform plate to the palate, it is broader at base than superiorly, where it narrows to the olfactory cleft". "The septum divides the nose into two halves each half has a roof, floor, lateral wall and a medial wall".

The floor is antero-posteriorly flat, almost horizontal and concave from side to side. Anterior 3/4th contains maxillary palatine process, posterior 1/3rd by palatine bone horizontal process.

"The roof is narrow from side to side, except posteriorly, it is divided into frontonasal, ethmoidal and sphenoidal parts, related to the respective bones. Frontonasal and sphenoidal parts of the roof slopes downwards, the highest part of the nasal cavity relates to the cribriform plate of the ethmoid which is horizontal. This area is covered by olfactory epithelium which spreads down a little distance onto the upper lateral and medial walls of the nasal cavity".

"The nasal cavity is lined by respiratory mucous membrane (with the exception of the nasal vestibule) it is adherent to the underlying periosteum and perichondrium and continuous with the paranasal sinuses, nasolacrimal duct and nasopharynx".[13]

Septum of nose:

"It is composed of a anterior small membranous portion, the cartilage and the bones namely perpendicular plate of the ethmoid, the vomer and crests of the maxilla and crest of palatine.

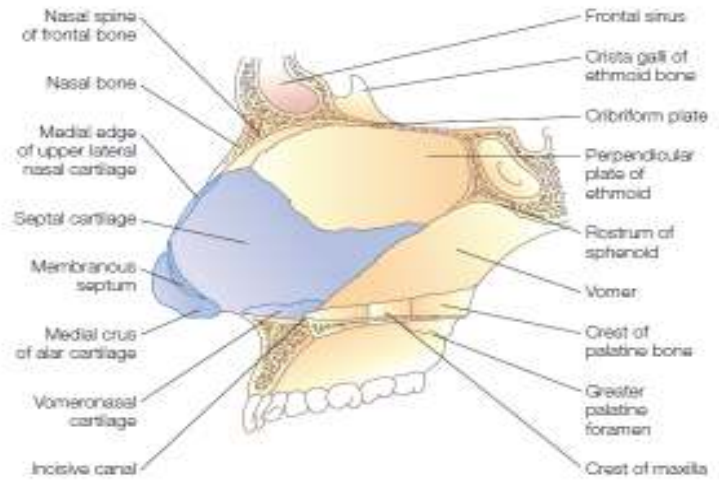


Figure 5: Diagram showing the cartilaginous and bony components of nasal septum [14]

Cartilaginous portion of septum is comprise of quadrilateral cartilage with contribution from the upper and lower lateral alar cartilages forming the anterior nasal septum".

"The perpendicular plate forms the anterior and superior bony septum, it is continuous above with the crista galli and cribriform plate. The vomer forms the inferior and posterior nasal septum and articulates by its two alae with the rostrum of the sphenoid, thus creating the vomero vaginal canals which transmits the pharyngeal branch of the maxillary artery".

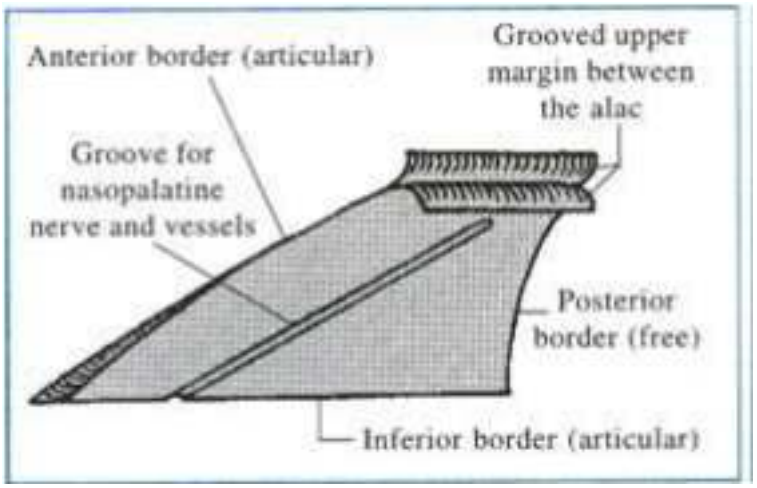


Figure 6: Diagram showing vomer left lateral view [13]

"Vomer articulates inferiorly with the nasal crest formed by the maxilla and palatine bones. The anterior border articulates with quadrilateral cartilage inferiorly and perpendicular plate above, posterior edge of vomer forms the posterior free edge of the septum".

The quadrilateral cartilage of sptum, has "Vital importance in the development of the mid third of the face".

- Rostrum of sphenoid far posteriorly.
- Nasal crest of the maxilla inferiorly.
- Frontal bone - nasal spine.

- Medial crus of greater alar cartilage

"The surface area of septum measures about 30 to 35 cm^2 in adults".

"Deflections can develop at any part of septal articulations and spurs can also form where the quadrilateral cartilage gives small processes between the ethmoid and vomer. These septal deviations were common on the left than the right. These deflections are more common in males than females, and most likely to be obtained due to trauma than congenital causes".[13]

HISTOLOGY OF NASAL SEPTUM

"The mucous membrane lining the nose is chiefly respiratory with a small area of olfactory epithelium superiorly adjacent to the cribriform plate. Pavement or respiratory epithelium is composed of ciliated and nonciliated pseudostratified columnar cells, goblet cells and basal pluripotential stem cells".

Like inferior turbinate, anterior nasal septum also has sinusoidal system in the submucosal layer under autonomic control called "anterior septal tubercle or intumescence". It was first described by "Morgagni and related to control of airflow into olfactory cleft".[12]

VASCULAR SUPPLY OF SEPTUM

"The internal and external carotid artery contributes to rich blood supply of nose". Branches of maxillary artery, sphenopalatine artery supply posteroinferior part of septum. Greater palatine artery supply the anteroinferior part. "Facial artery superior labial branch supply anteriorly, mainly to Kiesselbach's plexus, situated in Little's area, which is a common source for epistaxis". "The anterior and posterior ethmoidal arteries from internal carotid artery supplies the septum superiorly and also contributes to formation of plexus of Kiesselbach".

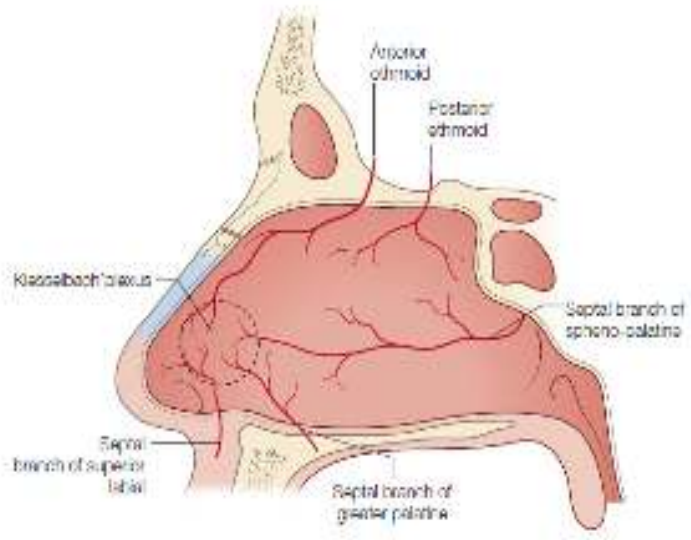


Figure 7: Diagram showing vascular supply of nasal septum[12]

NERVE SUPPLY OF SEPTUM

SENSORY INNERVATION:

"The sensory innervation to the most of the septum is given by maxillary division of trigeminal nerve". Nasopalatine nerve mainly supplies the bony septum. Nasociliary nerve branch of anterior ethmoids supply anterosuperior part of the septum and a small portion of anteroinferior also receives a branch from anterior superior alveolar nerve. Nerve to pterygoid canal and anterior palatine nerve posterior inferior nasal branch supply posterior inferior part of septum.[12]

SYMPATEHETIC AND PARASYMPATHETIC

Table 2: Innervation of nose

SYMPATHETIC	PARASYMPATHETIC
T1 & T2 SEGMENTS	SUPERIOR SALIVATORY NUCLEUS
SUPERIOR CERVICAL GANGLION	NERVUS INTERMEDIUS
DEEP PETROSAL NERVE	CIRCULATORY GANGLION
VIDIAN NERVE	VIDIAN NERVE
PTERYGOPALATINE GANGLION (without synapse)	PTERYGOPALATINE GANGLION (synapse)
NASAL MUCOSA (posterior superior lateral and medial nasal branches of the maxillary nerve) vis, noradrenaline, neuropeptide	NASAL GLAND (posterior superior lateral and medial nasal branches of the maxillary nerve) vis, Ach, VIP
Vasoconstriction reduces secretion	Vasodilation Stimulation of secretion

LATERAL WALL OF NOSE:

Lateral wall of nose includes “lamina papyracea of the lacrimal bone, portions of the ethmoid bone, and the inferior and middle nasal conchae”. Concha develop during the fifth intrauterine month from a cartilage ossification center.

“Superior, middle and inferior concha are composed of a thin bone for structural support and are covered by an mucoperiosteum”. The anterior tip of the inferior turbinate is lined by stratified squamous epithelium, whereas all other surfaces are covered by pseudostratified ciliated columnar respiratory epithelium. “The concha maximize the effective intranasal surface area and rapidly warm and humidify inspired air”. [12]

NASAL VALVE AREA AND VALVE ANGLE

"The narrowest portion of the nasal cavity is the internal nasal valve, therefore, any compromise of the valve area components results in nasal obstruction". The angle is bound "laterally by the inferior edge of the upper lateral cartilages, medially by septum and the anterior aspect of the inferior turbinate, forming a trapezoidal configuration".

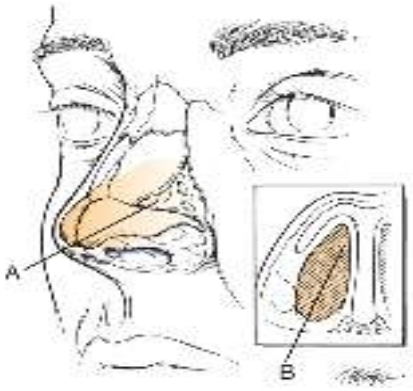


Figure 8: A- External nasal valve angle and area. **B -**Internal nasal valve.

This angle widens with muscular contraction and narrows with negative pressure on inspiration. "The nasal valve area is around 10 to 15 degrees in white patients and wider in nonwhites".[15,16] Loss of anatomic support of structures and deformities of the adjacent nasal septum can "predispose the valve area to collapse and narrowing, resulting in nasal airway obstruction".

Exterior nasal valve is a laterally based soft tissue area bounded by the piriform aperture, the upper and lower lateral cartilage attachments and septum. Compromise of external valve can result in obstruction from weakened or lacking cartilage from dislocation, trauma, rhinoplasty, caudal septal or lax connective tissue as a part of aging process.[17]

Deviation of septum:

"Septum is fundamental for the development of nose and the paranasal sinuses". Septal deviation is mostly congenital but in few patients it can be post traumatic. "Malalignment of the parts of the nasal septum like septal cartilage, perpendicular ethmoidal plate, and vomer can cause deviation of the septum, septal spur or deformity of the chondro vomerine articulation".

Asymptomatic deviation is seen in 20 to 31 percent of the population. However significant septal deviation, mainly at the chondro vomerine articulation, can result in sinusitis symptoms.[18,19]

Obstruction, infection of the middle meatus, secondary inflammation, swollen membranes all have been observed as a result of severe nasal septal deviation. "Severe deviations can compress over middle turbinate laterally cause narrowing of middle meatus, and combined bony spurs can further compromise osteomeatal unit".[20]

The septal deviations are "classified into four categories according to the degree of its deviation".[21-24]

Type I (normal)— Naso septal angle less than 5◦

Type II (mild)— Naso septal angle from 5◦ to 10◦

Type III (moderate)— Naso septal angle from 10◦ to 15◦

Type IV (severe)—naso septal angle more than 15◦

Table 3: Naso septal deviation angle [21 - 24]

PARANASAL SINUSES - ANATOMY.[25,26]

Paranasal sinuses are present on either side of the nasal cavity and lies near vital structures. The sinuses are maxillary, frontal and ethmoids which are paired and sphenoid which is a single sinus.

MAXILLARY SINUS:

It is pyramidal in shape and situated within maxillary bone. The largest sinus group which appears by 7-10 weeks. Bounded superiorly by floor of orbit , inferiorly by maxillary alveolar process, laterally by zygomatic process and posteriorly by the infra temporal and pterygo palatine fossa. The main ostium of maxillary sinus is on medial wall and drains through the hiatus semilunaris. Once anterior ethmoids are cleared basal lamella is visualised. The anterior ethmoids empty into middle meatus.

ETHMOIDAL SINUS:

Ethmoidal sinus is a group of cavities within the ethmoid bone. Frontal bone and lamina cribriosa forms the roof which is called “fovea ethmoidalis and it slops posterior. The area where the frontalis and lamina cribriosa meets is a fragile region. The lateral wall lies in relation to papyracea lamina of orbit. Ethmoids are separated into two groups namely - posterior and anterior. The volume is around fifteen ml. The basal lamella is posterior to anterior ethmoids.

SPHENOID SINUS:

It lies within the sphenoidal bone which starts apperaring on 3rd intrauterine month and minimally develops till three years. Sphenoid sinus is highly pneumatized and extend laterally. Intersinus septum splits it into two ostium which are usually seen

in spheno ethmoidal recesss. Two bulges are formed by "Carotid artery and optic nerve on lateral wall of the sinus and it should be kept in mind while operating".

FRONTAL SINUS:

"The right and left frontal sinuses are located between inner and outer tables of frontal bone, posterior to superciliary arches and the root of the nose. They are usually detectable in children by seven years of age". These sinuses drain into ethmoidal infundibulum through frontonasal duct, which opens into the semilunar hiatus of the middle nasal meatus. The supra-orbital nerves (CN V1) branches supply the frontal sinus.

Paranasal sinus- Functional anatomy:

"Sinuses are paired structures lined by pseudostratified ciliated columnar respiratory epithelium similar to lower airway". They are classified into anterior, posterior and sphenoid compartments that serve as functional units based on their "drainage pathways".

"Anterior functional unit" is composed of the anterior ethmoid, frontal & maxillary sinuses. These sinuses drain into middle meatus. "The posterior functional unit" composed of the posterior ethmoid sinus which drains into nose via the superior meatus. "The sphenoid functional unit" is contains sphenoid sinus which drains into spheno-ethmoidal recess situated medial and posterior to superior concha. "Though anterior and posterior ethmoidal cavities share the common name", they have different embryologic origin and drainage pathways with separate functional entities.[12]

Rhinosinusitis:

They are classified "As acute or chronic based on the duration of symptoms". Less than 12 weeks of duration of symptoms is classified as acute and more than 12 weeks is classified as chronic.

Chronic Rhino Sinusitis (CRS):

"Based on the presence of polyps, and endoscopic findingds CRS is divided into those cases with polyps as (CRSwNPs) and those without polyps as (CRSsNPs)".

European guidelines define (CRSwNP) as

Clinically:

"The inflammation of nose and the paranasal sinuses connected with two or more symptoms, among which one should be nasal obstruction/ blockage /nasal discharge or congestion:

- With or without facial pain / pressure
- Loss of smell or reduction and either

Endoscopic evidence of

- Polyps and/or
- Mucopurulent discharge from the middle meatus / mucosal oedema / mucosal obstruction primarily in the middle meatus and/or

Computed tomography (CT) changes:

- Mucosal changes within the sinuses and/or osteomeatal complex".[12]

Computed Tomography

"CT is the gold standard investigation", has it provides the detailed bony anatomy and serves as a "road map" for the surgeon during surgery. "It is the investigation of choice in the evaluation of the paranasal sinuses and adjacent structures, it has the

ability to optimally display air, soft tissue, and bone it provides an accurate depiction of anatomy and the extent of disease in and around the paranasal sinuses".

- CT coronal cuts serves as a primary image for the evaluation of sinonasal tract in patients with inflammatory disease of the sinsus, who are candidates for endoscopic surgeries.

The coronal cuts provide details of the osteomeatal unit (OMU), the relation of ethmoidal roof to the brain, and correlates with surgical orientation.

-The axial cuts add on details to the coronal study, particularly in severe disease leading to opacification of the paranasal sinuses and surgical treatment is advised,

They are of importance in visualizing the fronto-ethmoid junction and the spheno-ethmoid recess.[26]

Septal Deviations

Septal deviations may occur in an anteroposterior direction in which case they are better appreciated in the axial scans. Deviations may also present as sharp spurs at vomero-cartilaginous junction. These are better seen in coronal scans.

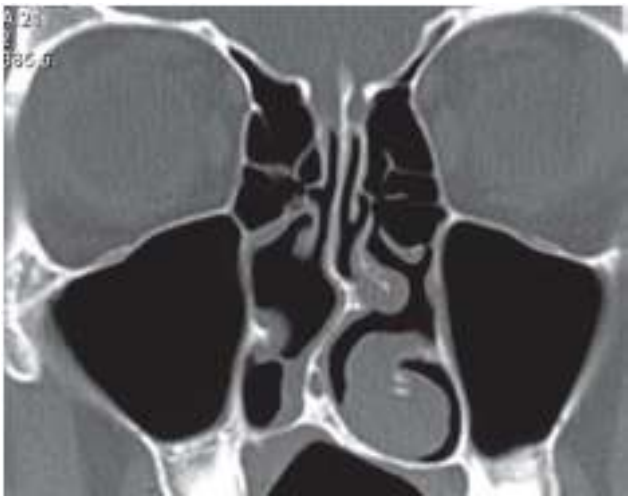


Figure 9: CT PNS coronal view showing septal spur with inferior turbinate hypertrophy [28]

Septal deviations can also compromise the key areas like osteomeatal unit leading to impaired to the impairment of sinus drainage. Deviations may also be associated with a hypertrophied turbinates or concha bullosa on the roomy side. These variations in turn may compromise the osteomeatal unit.[28]

Nasal septal body

"It is the widened region of the anterior nasal septum, it is located anterior to the middle turbinate and superior to the inferior turbinate at the level of the internal nasal valve". Histological analysis of this tissue when compared to the adjacent septal mucosa contains "large amount of venous sinusoids and fewer glandular elements". The high proportion of venous sinusoids suggests capacity to alter the nasal airflow in a comparable manner to the inferior turbinates.

Figure 10: CT PNS - Coronal view showing nasal septal swell body [29]

It shares similar histological morphology as inferior turbinate and can undergo "mucosal changes as seen in the hypertrophy of the inferior turbinates in cases of long standing sinonasal diseases". Chronic inflammation results in fibrosis which is difficult to reverse with conservative treatment like nasal decongestants and corticosteroids. "It interupts nasal airflow in chronic inflammation of the nasal cavity".[29]

Staging in rhinosinusitis [30]

CT grading of rhinosinusitis - Lund and Mackay scoring system

"Each sinus group is graded from 0 to 2, where 0 suggests no abnormality, 1 is partial opacification, 2 is total opacification. The osteomeatal complex is graded as 0 not obstructed or 2 has obstructed. A total score of 0-24 possible and each side can be graded separately from 0-12".

Table 4: Lund mackey scoring system (CT grading of Rhinosinusitis) [30]

Lund–Mackey system.

Sinus	Right sinus	Left sinus
Frontal	0–2	0–2
Anterior ethmoids	0–2	0–2
Posterior ethmoids	0–2	0–2
Maxillary	0–2	0–2
Sphenoid	0–2	0–2
Ostiomeatal complex	0 or 2	0 or 2

- January E. Gelera et al [1], in 2017 compared the radiographic anatomical changes occurring in the "Nasal septal body (NSB) among patients with sinonasal disease and without sinonasal disease. NSB thickness were significantly larger among the diseased group and is statistically significant". The study also concluded that with aging nasal mucosa atrophy in normal subjects but with sinonasal disease the mucosa appears to be thickened.

- Jennifer Setlur et al [5], in 2011 conducted a retrospective study, where 100 computarized tomographic sinus scans were retrospectively studied, they compared "the size of septal body to laterality of the septal deviation, and concluded that the septal body was larger on side opposite to nasal septal deviation, and was statistically

significant". Thus "hypertrophy of septal body may contribute to nasal obstruction and play a role in regulating nasal airflow"

-In a retrospective study by Myeong Sang Yu [6] in 2018 on "radiological analysis of correlation between septal body size and inferior turbinate hypertrophy on Computed Tomography- Para nasal sinus (CT-PNS)" scans in fifty patients concluded that "SB size is significantly associated with IT size and narrowed internal nasal valve area. These results indicate that clinicians should check for concomitant SB hypertrophy in patients with IT hypertrophy".

-In a retrospective study by Dary J. Costa et al [30] in 2010, they analysed "the radiographic, anatomic, and histologic characteristics of the nasal septal swell body" and concluded that, "the swell body is a conserved region of the septum located anterior to the middle turbinate approximately 2.5 cm above the nasal floor. The high proportion of venous sinusoids within the swell body suggests the capacity to alter nasal airflow".

-In a randomized study by Myeong Sang Yu et al [3] in the year 2015, evaluated "the efficacy of septal body volume reduction (SBVR) for the treatment of septal body hypertrophy in patients with nasal obstruction". The study concluded that "the combined SBVR and turbinoplasty was more effective than turbinoplasty alone for nasal obstruction in patients with inferior turbinate and septal body hypertrophy".[31]

-Omer Hizli in his study in 2020, were 106 CT-PNS scans with Inferior turbinate hypertrophy (ITH) were retrospectively studied, they were divided into two group ITH with Allergic Rhinitis (AR), ITH without AR, and concluded that " patients with ITH had a greater nasal septal body area, length, and width, compared to the patients without ITH and AR had an additional increasing effect on the area and width of the nasal septal body ".

- S Elwany [32] in his study in 2008 on "histological characteristics of the septal body mucosa and the morphometric differences between it and the adjacent septal mucosa", concluded that "histological characteristics of the septal body mucosa included thick (more than 60 mm), pseudostratified, ciliated respiratory epithelium with goblet cells, abundant seromucinous glands and many blood sinusoids. Morphometric analysis showed that the septal body mucosa had thicker epithelium and more glandular acini and blood sinusoids than the rest of the septal mucosa".

MATERIALS AND METHODS

All CT-PNS scans done in "KLES Dr. Prabhakar Kore Hospital & MRC, Belgaum" during January 2019 - December 2019 period.

Study design: Retrospective observational study.

Study period: 1year

Sample Size: All CT-PNS scans done in "KLES Dr. Prabhakar Kore Hospital & MRC, Belgaum" during Jan 2019- Dec 2019 period where included based on inclusion and exclusion criteria.

n=60

Study population: All CT- PNS scans done in "KLES Dr. Prabhakar Kore Hospital & MRC, Belgaum" during the study period.

Study setting: Hospital Based study

Ethical Clearance– Obtained

Selection criteria

Inclusion criteria:

1.All patients undergoing CT - PNS in Department of ENT&HNS in KLE Dr. Prabhakar Kore hospital & MRC.

Exclusion criteria:

1. Massive polyposis where septum cannot be delineated.
2. Previous history of nasal surgery
3. Sinonasal malignancy
4. Faciomaxillary fracture

Methodology:

- After obtaining clearance and approval from the institutional ethics committee CT-PNS of patients who fulfill the inclusion and exclusion criteria was studied.

-The RadiAnt DICOM viewer was used to view CT scans and evaluate CT images. Each side was evaluated for Septal body thickness, Inferior turbinate, Internal Nasal valve area, Septal deviation, Sinusitis.

-The sinusitis on CT scan was graded by Lund and Mackay scoring system

- Septal deviation was measured by drawing a line from crista galli to maxillary crest and another line to the maximum deviation of nasal septum. Deviation angles was calculated according to the angle between crista galli and the most prominent point of the deviation.

-The nasal septal deviation angle was classified into four categories according to the degree of its deviation.

Type I (normal)— less than 5^{o}

Type II (mild)— 5^{o} to 10^{o}

Type III (moderate)— 10^{o} to 15^{o}

Type IV (severe)—more than 15^{o}.

- The thickness of the septal body was measured from the lateral aspect of the septal body to the midline, length was measured as the antero-posterior length of the protruding parts in the axial view and height was measured as the height of the protruding area of the septum in the coronal view.

- The internal nasal valve was measured in the coronal view as the gap between the septal body and the lateral nasal wall as the horizontal distance from the most protruding part on each side to the lateral wall. The reduction of its measurements reflects the narrowing of the nasal valve area. The measurements were performed separately on the both sides".

- Inferior turbinate measurements were made from CT PNS coronal view on both sides separately. The inferior turbinate medial and lateral mucosa length were measured horizontally.

- Measurements was taken using computer-generated scales and the values were recorded.

ETHICAL CONSIDERATIONS:

Ethical clearance for the study was obtained from the JNMC Institutional Ethics Committee on Human Subjects Research and the reference number was MDC/DOME/437.

RESULTS

A total of 60 CT-PNS were studied, the results are categorized into 3 groups.

"Group 1- DNS,

Group 2 - CRS,

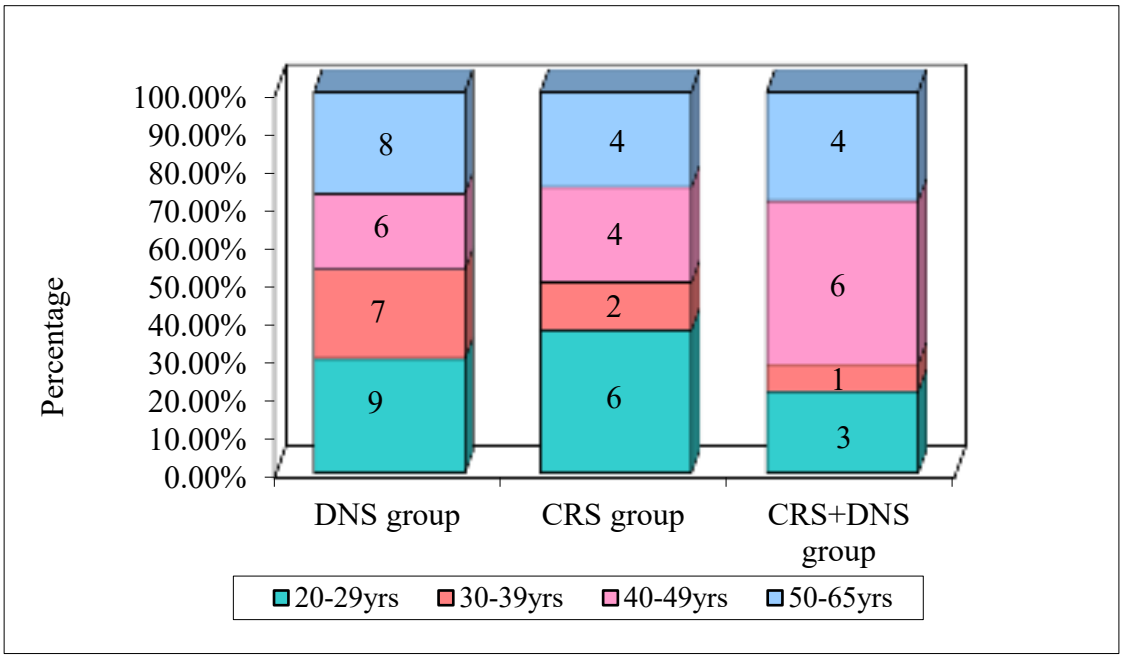
Group 3 - CRS+DNS" of which 30 were DNS group, 16 were CRS, 14 were CRS+DNS.

The age wise distribution of three groups were given in the below table-5 and graph-1.

Table 5: Age wise distribution among three groups:

Age group	DNS group	%	CRS group	%	CRS+DNS group	%	Total	%
20-29yrs	9	30.00	6	37.50	3	21.43	18	30.00
30-39yrs	7	23.33	2	12.50	1	7.14	10	16.67
40-49yrs	6	20.00	4	25.00	6	42.86	16	26.67
50-65yrs	8	26.67	4	25.00	4	28.57	16	26.67
Total	30	100.00	16	100.00	14	100.00	60	100.00
Chi-square=4.300, p=0.6360								

Graph 1: Age wise distribution among three groups:

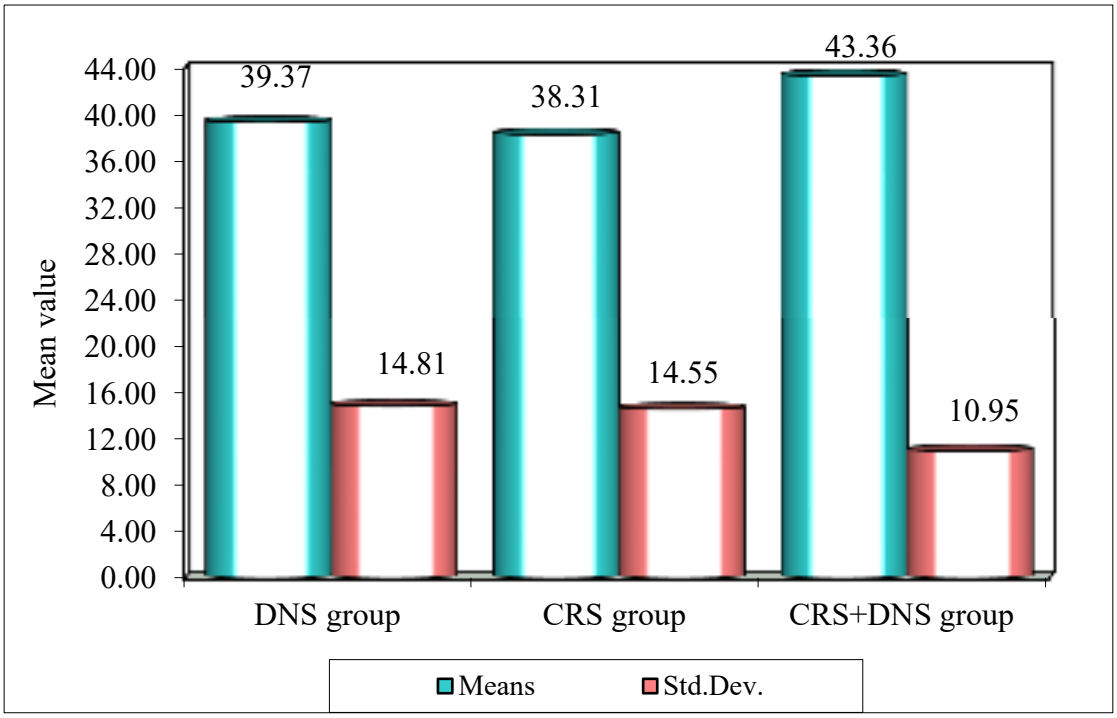


The mean age of DNS group was 39.37, CRS group was 38.31, CRS+DNS group was 43.36 as shown in the Table-6 & graph-2,

Table 6: Comparison of three groups (DNS, CRS and CRS+DNS) with mean age by one way ANOVA

Groups	Means	Std.Dev.
DNS group	39.37	14.81
CRS group	38.31	14.55
CRS+DNS group	43.36	10.95
Total	40.02	13.85
F-value	0.5529	
p-value	0.5783	

Graph 2: Comparison of three groups (DNS, CRS and CRS+DNS) with mean age



GENDER WISE DISTRIBUTION OF PATIENTS

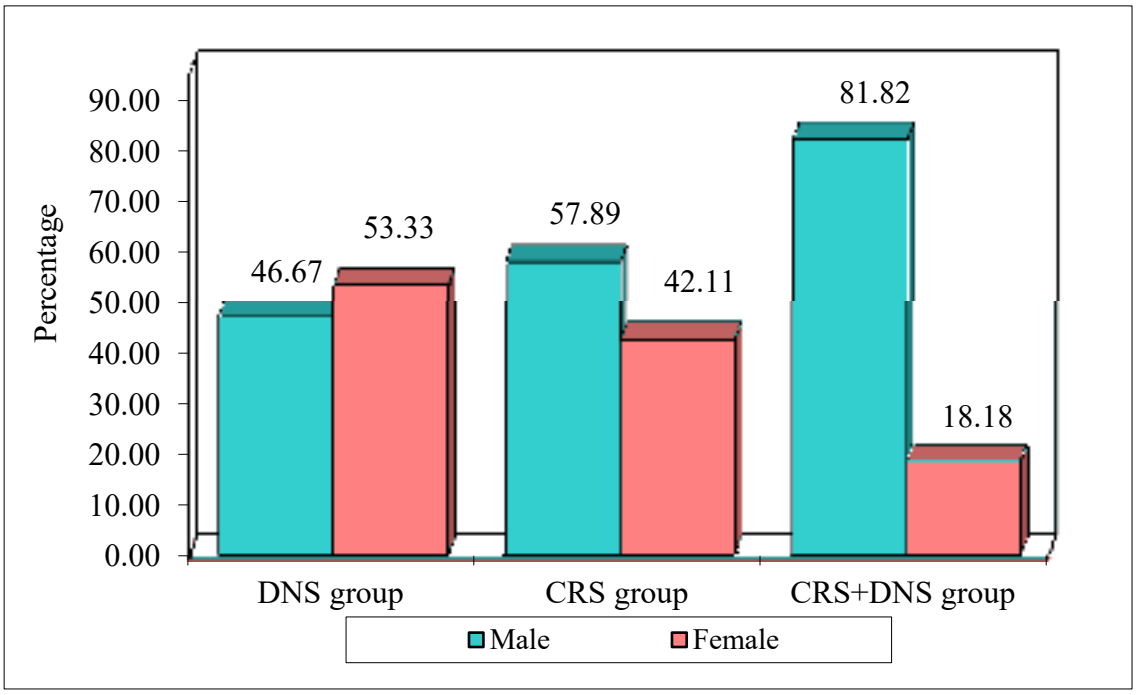
The gender wise distribution of the three groups was given in the below Table-7 & graph-3.

In group-1 30 patients with DNS, 14 were male (46.67%) and 16 were female (53.33%). In group-2 16 patients with CRS, 8 were male (50%), 8 were female (50%). In group-3, 14 patients with CRS + DNS, 12 were male (85.71%) and 2 were female (14.29%).

Table 7: Comparison of three groups (DNS, CRS and CRS+DNS) with gender

Gender	DNS group	%	CRS group	%	CRS+DNS group	%	Total	%
Male	14	46.67	8	50.00	12	85.71	34	14
Female	16	53.33	8	50.00	2	14.29	26	16
Total	30	100.00	16	100.00	14	100.00	60	30
Chi-square=6.3220, p=0.0420, S								

Graph 3: Comparison of three groups (DNS, CRS and CRS+DNS) with gender

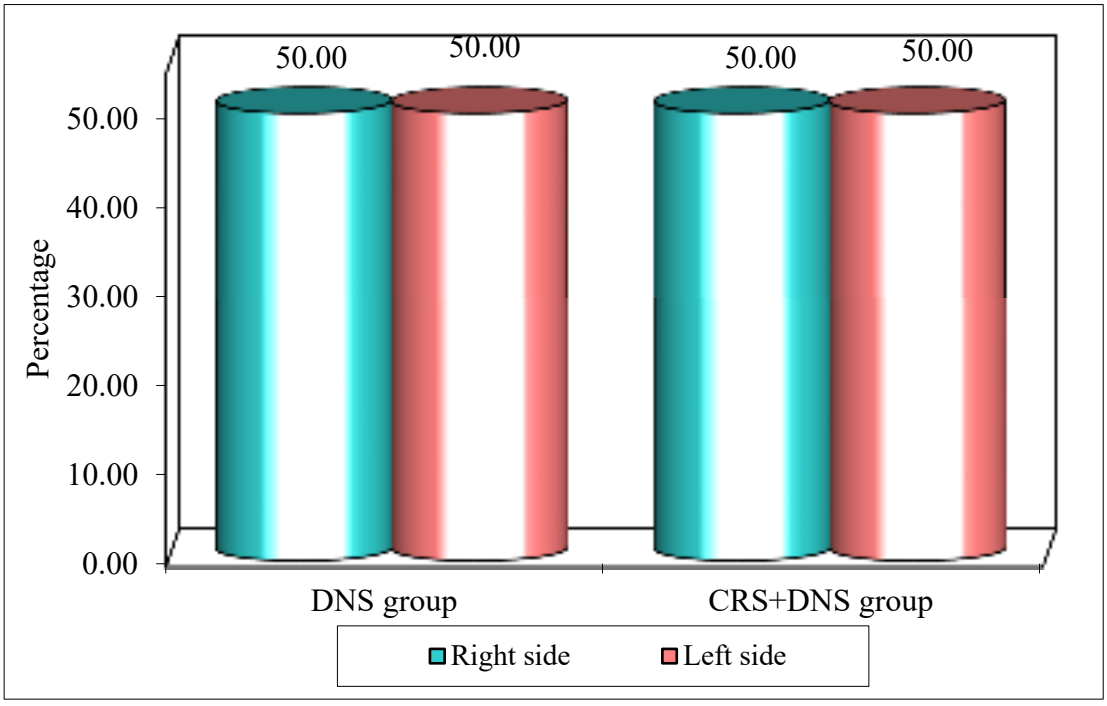


Of the three groups, the DNS and CRS+DNS group were compared in terms of septal deviation. In DNS group 15 patients had right deviation and 15 had left septal deviation, in CRS+DNS group, 7 had right deviation and 7 had left septal deviation, as shown in the below Table- 8 and Figure-14

Table 8: Comparison of two groups (DNS and CRS+DNS) with septal deviation

Septal deviation	DNS group	%	CRS+DNS group	%	Total	%
Right side	15	50.00	7	50.00	22	15
Left side	15	50.00	7	50.00	22	15

Graph 4: Comparison of two groups (DNS and CRS+DNS) with septal deviation

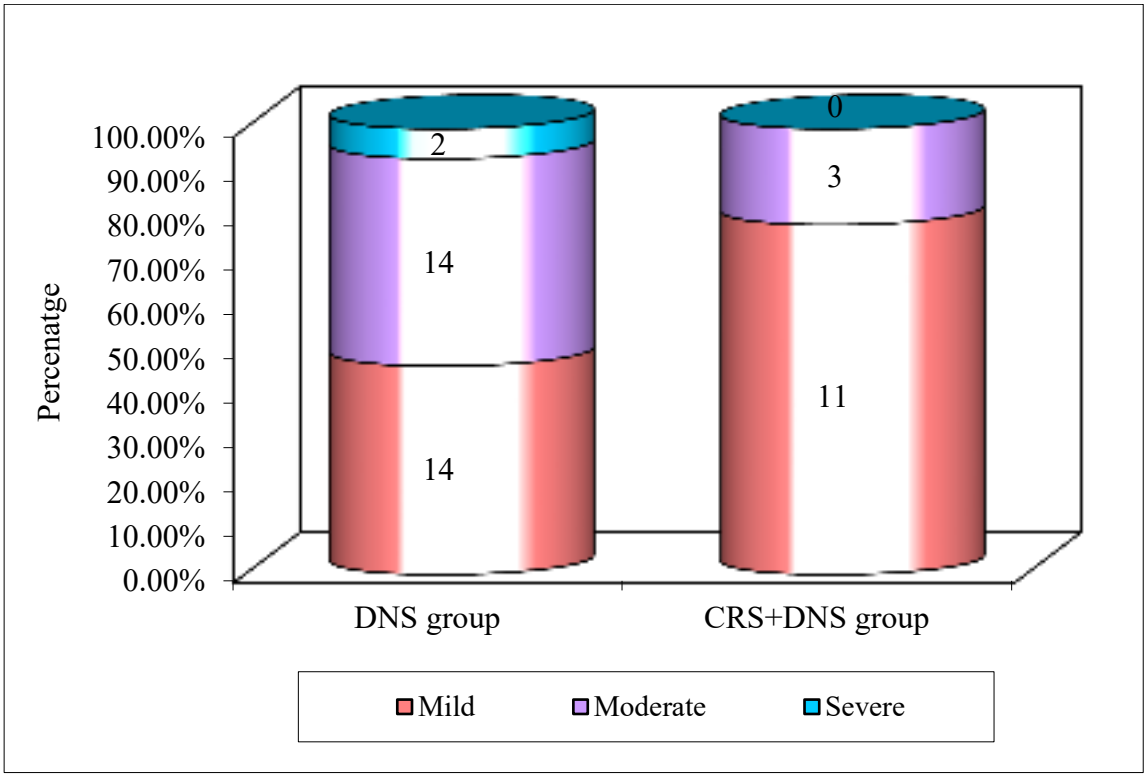


The two groups (DNS & CRS+DNS) were further compared in terms of degree of septal deviation. In DNS group 14 patients had mild DNS, 14 had moderate, 2 had severe DNS. In CRS+ DNS group 11 had mild, 3 had moderate degree as shown in the below Table-9 and Graph-5.

Table-9: Comparison of two groups (DNS and CRS+DNS) with degree

Degree	DNS group	%	CRS group	%	CRS+DNS group	%	Total	%
Mild	14	46.67	0	0.00	11	78.57	25	41.67
Moderate	14	46.67	0	0.00	3	21.43	17	28.33
Severe	2	6.67	0	0.00	0	0.00	2	3.33
Chi-square = 4.2170 P = 0.1210								

Graph 5: Comparison of two groups (DNS and CRS+DNS) with degree



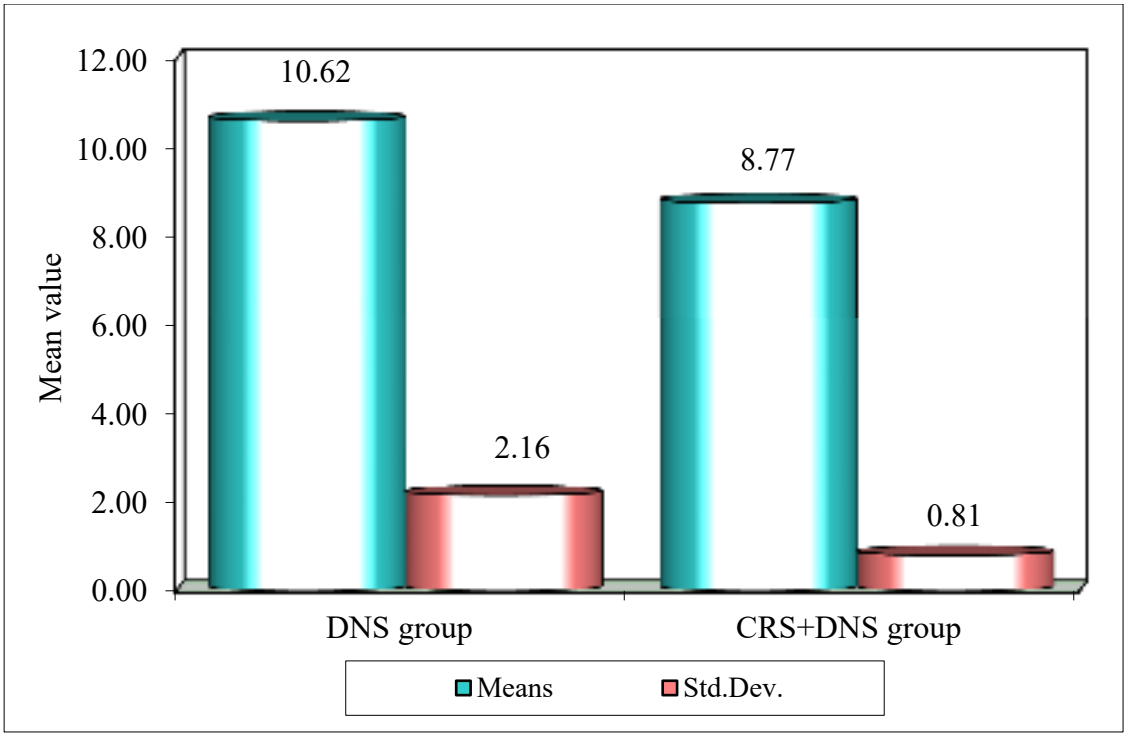
The mean degree of septal deviation in DNS group were 10.62 and CRS+DNS group were 8.77 as shown in the below Table-10 & Graph-6

Table-10: Comparison of two groups (DNS and CRS+DNS) with mean Naso septal angle (in degree) by t test

Groups	Means	Std.Dev.
DNS group	10.62	2.16
CRS+DNS group	8.77	0.81
Total	10.03	2.02
t-value	3.0962	
p-value	0.0035*	

*p<0.05

Graph 6: Comparison of two groups (DNS and CRS+DNS) with mean Naso Septal angle (in degree)



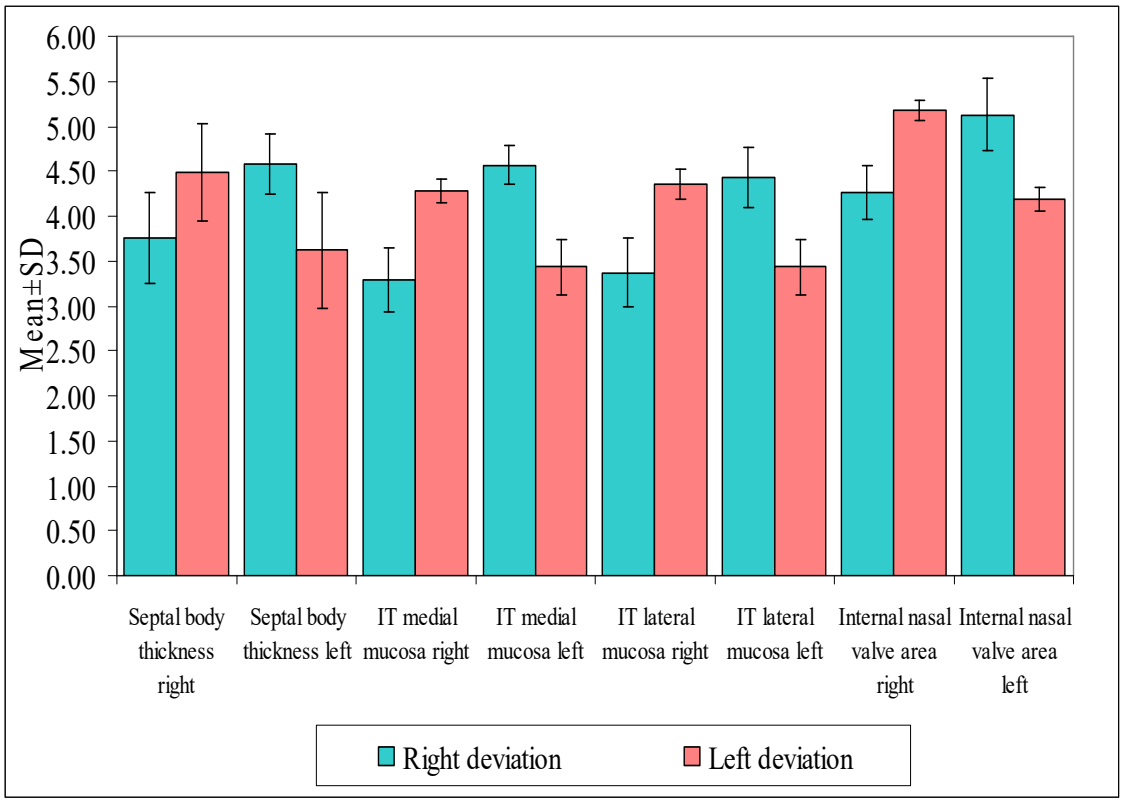
In group-1 – (DNS group) 30 patients, among which 15 had right and 15 had left septal deviation. The septal body thickness, IT medial and lateral mucosa, Internal nasal valve area were measured in right and left nasal cavity separately. The mean and standard deviation values of right and left deviation are mentioned in the below Table-11 and Graph-7. In patients with right septal deviation the measurements of left nasal cavity septal thickness, IT medial and lateral mucosa and internal nasal valve area were increased compared to the right nasal cavity and the values were statistically significant. Similarly in case of left septal deviation the measurements on the right nasal cavity are increased and the values are statistically significant.

Table -11: Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group** by independent test

Variables	Right deviation		Left deviation		Mean Diff.	t-value	p-value
	Mean	SD	Mean	SD			
Septal body thickness right	3.76	0.51	4.48	0.54	-0.73	-3.7964	0.0007*
Septal body thickness left	4.58	0.33	3.62	0.64	0.96	5.1602	0.0001*
IT medial mucosa right	3.29	0.35	4.28	0.13	-0.98	-10.1267	0.0001*
IT medial mucosa left	4.57	0.22	3.43	0.31	1.14	11.6349	0.0001*
IT lateral mucosa right	3.37	0.38	4.36	0.17	-0.98	-9.0599	0.0001*
IT lateral mucosa left	4.43	0.34	3.43	0.31	1.00	8.4671	0.0001*
Internal nasal valve area right	4.27	0.30	5.18	0.11	-0.90	-11.1270	0.0001*
Internal nasal valve area left	5.13	0.41	4.19	0.13	0.94	8.4020	0.0001*

*p<0.05

Graph 7: Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group**



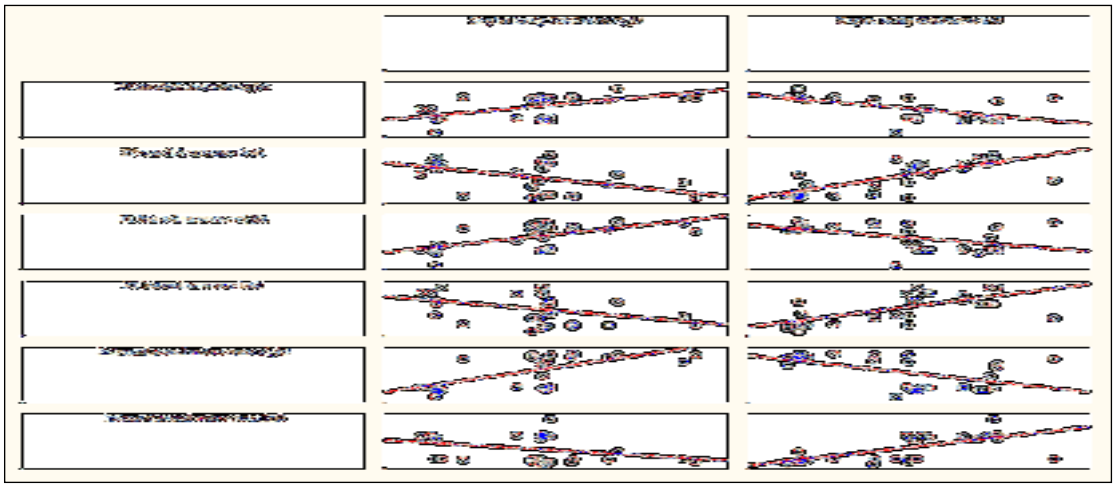
Further in group-1, the relation between septal body thickness, height and length is compared to IT medial and lateral mucosa and internal nasal valve area in right and left nasal cavity by Karl Pearson's correlation coefficient in the below Table-12 and Graph- 8&9.

Table-12: Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group** by Karl Pearson's correlation coefficient

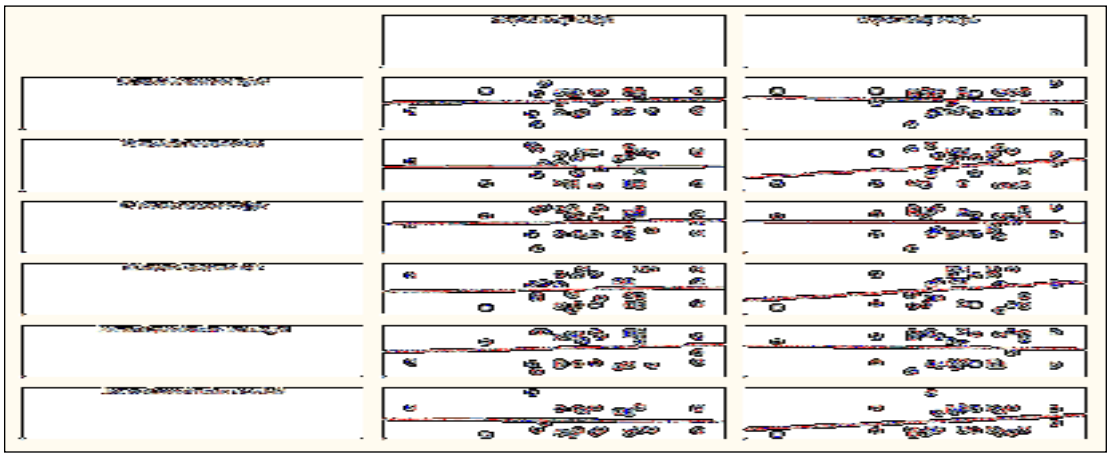
Variables	Summery	Septal body thickness right	Septal body thickness left	Septal body height	Septal body length
IT medial mucosa right	r-value	0.5370	-0.6090	0.0730	-0.0820
	p-value	0.0020*	0.0001*	0.7000	0.6650
IT medial mucosa left	r-value	-0.4470	0.7610	0.0160	0.2090
	p-value	0.0130*	0.0001*	0.9330	0.2680
IT lateral mucosa right	r-value	0.6110	-0.4950	0.0720	-0.0070
	p-value	0.0001*	0.0050*	0.7040	0.9690
IT lateral mucosa left	r-value	-0.3970	0.6760	0.0610	0.2380
	p-value	0.0300*	0.0001*	0.7470	0.2050
Internal nasal valve area right	r-value	0.6560	-0.5520	0.0930	-0.0380
	p-value	0.0001*	0.0020*	0.6230	0.8420
Internal nasal valve area left	r-value	-0.3220	0.6960	-0.0420	0.1940
	p-value	0.0830	0.0001*	0.8250	0.3050

*$p<0.05$

Graph 8: Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group**



Graph 9: Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **DNS group**



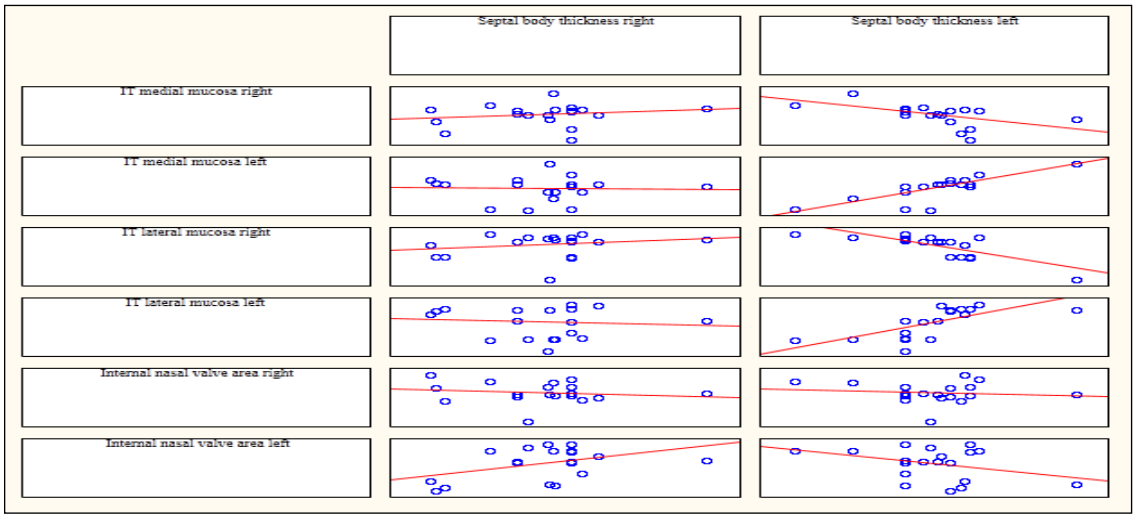
In group-2, (CRS group), the septal body thickness, height and length is compared to IT medial and lateral mucosa, internal nasal valve area in right and left nasal cavity by Karl Pearsons correlation coefficient as given in the below Table-13 and Graph- 10&11. It is found that when the septal body thickness is increased the IT medial and lateral mucosa is also increased on the same side and values are found to be statistically significant.

Table-13: Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS group** by Karl Pearsons correlation coefficient

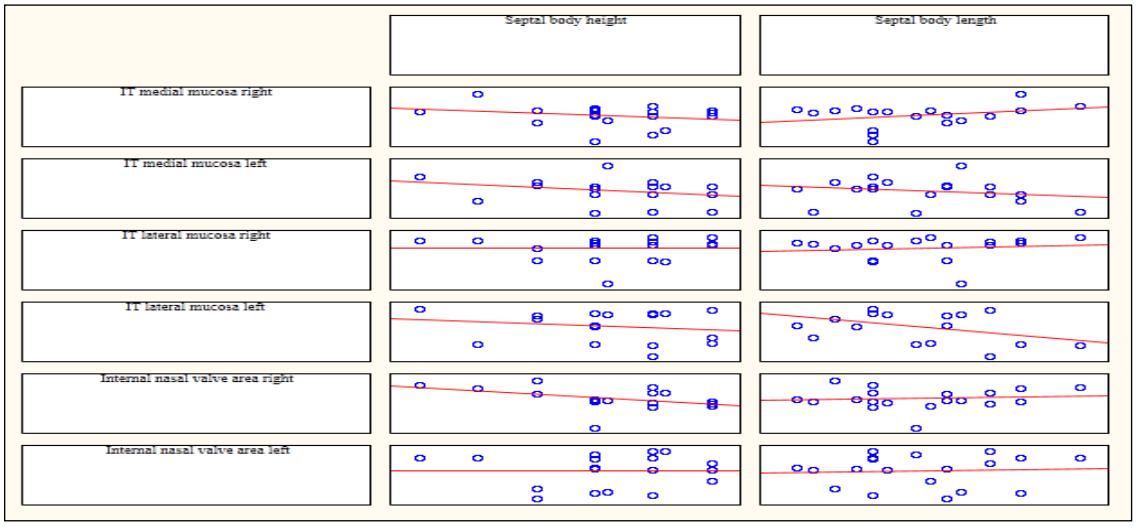
Variables	Summery	Septal body thickness right	Septal body thickness left	Septal body height	Septal body length
It medial mucosa right	r-value	0.1820	-0.5490	-0.2400	0.3020
	p-value	0.4560	0.0150*	0.3230	0.2090
It medial mucosa left	r-value	-0.0240	0.8030	-0.2710	-0.2170
	p-value	0.9240	0.0001*	0.2610	0.3730
It lateral mucosa right	r-value	0.2100	-0.7770	-0.0120	0.1370
	p-value	0.3880	0.0001*	0.9630	0.5760
It lateral mucosa left	r-value	-0.0870	0.7000	-0.1760	-0.4460
	p-value	0.7240	0.0010*	0.4710	0.0550
Internal nasal valve area right	r-value	-0.1630	-0.1210	-0.4230	0.0930
	p-value	0.5050	0.6220	0.0710	0.7050
Internal nasal valve area left	r-value	0.4400	-0.3500	0.0100	0.0590
	p-value	0.0590	0.1420	0.9670	0.8100

*$p<0.05$

Graph 10: Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS group**



Graph 11: Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS group**



In group-3– (CRS + DNS), the septal body thickness, IT medial and lateral mucosa, Internal nasal valve area were measured in right and left nasal cavity separately. The mean and standard deviation values of right and left deviation are mentioned in the below Table-14 and Graph-12. In patients with right septal deviation the

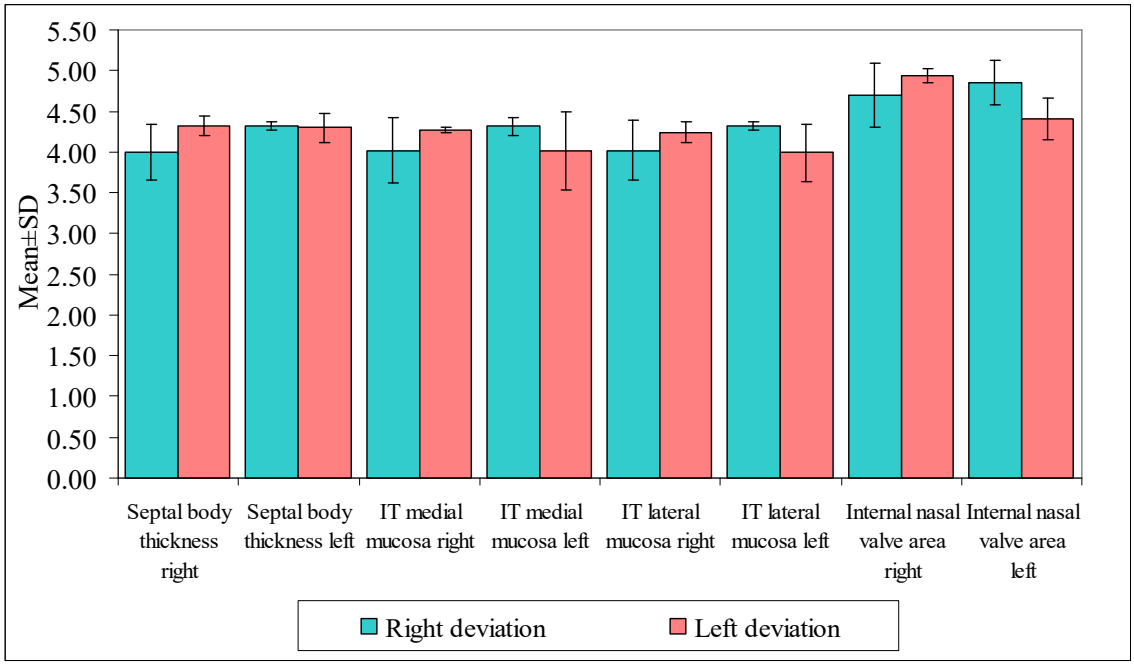
measurements of left nasal cavity septal thickness, IT medial and lateral mucosa and internal nasal valve area were increased compared to the right nasal cavity. Similarly in case of left septal deviation the measurements on the right nasal cavity are increased.

Table-14: Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group** by independent test

Variables	Right deviation		Left deviation		Mean Diff.	t-value	p-value
	Mean	SD	Mean	SD			
Septal body thickness right	3.99	0.34	4.32	0.12	-0.32	-2.3468	0.0369*
Septal body thickness left	4.32	0.05	4.30	0.18	0.01	0.1600	0.8756
IT medial mucosa right	4.02	0.40	4.27	0.04	-0.25	-1.6824	0.1183
IT medial mucosa left	4.32	0.11	4.01	0.48	0.31	1.6665	0.1215
IT lateral mucosa right	4.02	0.37	4.24	0.13	-0.22	-1.4572	0.1707
IT lateral mucosa left	4.32	0.05	3.99	0.35	0.33	2.4907	0.0284*
Internal nasal valve area right	4.70	0.39	4.94	0.09	-0.23	-1.5490	0.1473
Internal nasal valve area left	4.85	0.27	4.41	0.26	0.43	3.0451	0.0102*

*$p<0.05$

Graph 12: Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group**



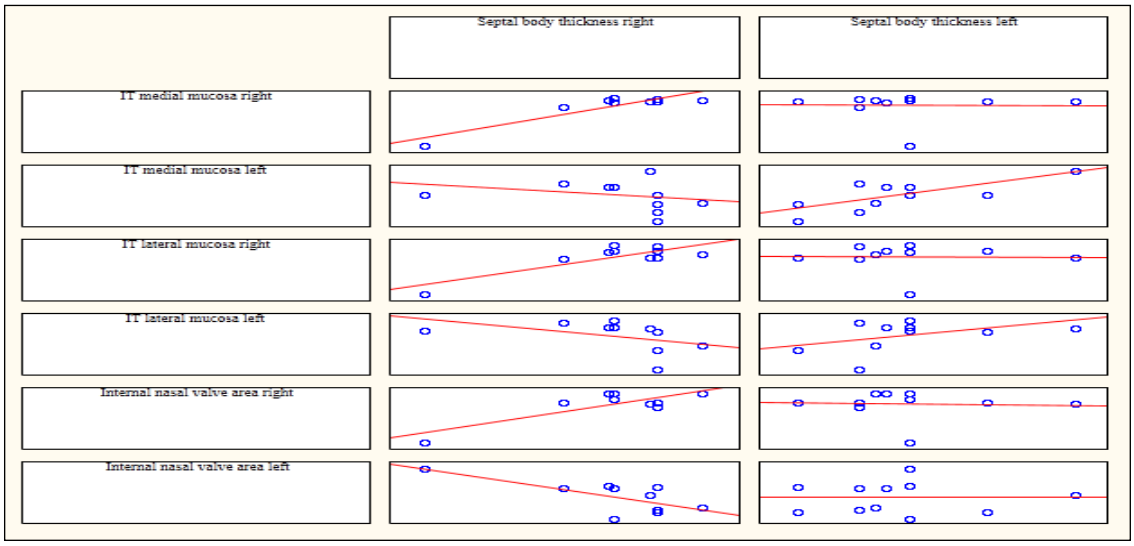
In group-3, (CRS + DNS), the septal body thickness, height and length is compared to IT medial and lateral mucosa, internal nasal valve area in right and left nasal cavity by Karl Pearsons correlation coefficient as given in the below Table-15 and Graph- 13& 14.

Table-15: Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group** by Karl Pearsons correlation coefficient

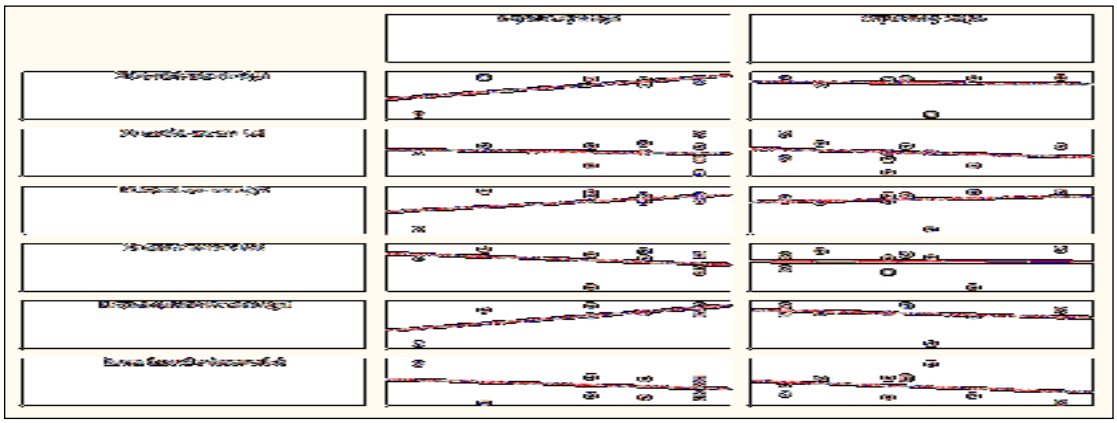
Variables	Summery	Septal body thickness right	Septal body thickness left	Septal body height	Septal body length
It medial mucosa right	r-value	0.8990	-0.0260	0.6370	-0.0620
	p-value	0.0001*	0.9390	0.0350*	0.8570
It medial mucosa left	r-value	-0.2790	0.7180	-0.1170	-0.1860
	p-value	0.4070	0.0130*	0.7320	0.5850
It lateral mucosa right	r-value	0.8110	-0.0200	0.4700	0.1370
	p-value	0.0020*	0.9540	0.1440	0.6880
It lateral mucosa left	r-value	-0.4380	0.4800	-0.2740	-0.0160
	p-value	0.1780	0.1350	0.4150	0.9630
Internal nasal valve area right	r-value	0.8040	-0.0650	0.6770	-0.1830
	p-value	0.0030*	0.8500	0.0220*	0.5900
Internal nasal valve area left	r-value	-0.7070	0.0080	-0.2200	-0.2380
	p-value	0.0150*	0.9830	0.5170	0.4810

*$p<0.05$

Graph -13: Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group**



Graph 14: Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **CRS+DNS group**



-Group1 (DNS) and group-3 (CRS+DNS) were compared in terms of right and left septal deviation with Septal body thickness, IT medial and lateral mucosa, Internal nasal valve area in right and left nasal cavity separately as given in the below Table-16 and Graph-15.. In case of right deviation the contralateral septal body, IT

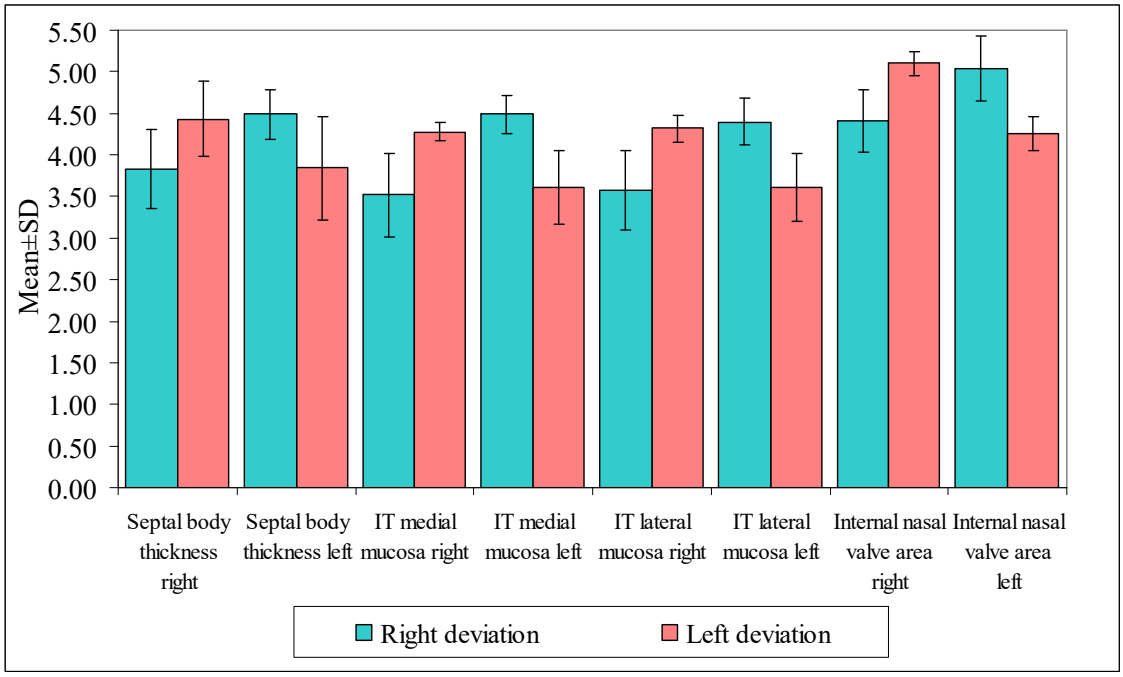
medial and lateral mucosa thickness and internal nasal valve area are increased and the values are found to be statistically significant.

Table-16: Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in combined group (**DNS and CRS+DNS group)** by independent test

Variables	Right deviation		Left deviation		Mean Diff.	t-value	p-value
	Mean	SD	Mean	SD			
Septal body thickness right	3.83	0.47	4.43	0.45	-0.60	-4.3129	0.0001*
Septal body thickness left	4.49	0.30	3.84	0.62	0.66	4.4606	0.0001*
IT medial mucosa right	3.52	0.50	4.28	0.11	-0.75	-6.9159	0.0001*
IT medial mucosa left	4.49	0.23	3.61	0.45	0.88	8.1212	0.0001*
IT lateral mucosa right	3.58	0.48	4.32	0.16	-0.74	-6.7921	0.0001*
IT lateral mucosa left	4.40	0.28	3.61	0.41	0.79	7.3988	0.0001*
Internal nasal valve area right	4.41	0.38	5.10	0.15	-0.69	-7.9388	0.0001*
Internal nasal valve area left	5.04	0.39	4.26	0.20	0.78	8.2718	0.0001*

*$p<0.05$

Graph 15: Comparison of right and left deviation with Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in combined group (**DNS and CRS+DNS group)**



The below Table-17 and graph-16 shows the comparision of three groups with all the variables by one way ANOVA test. Table-18 and graph-17 & 18 gives correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial and lateral mucosa, Internal nasal valve area in right and left nasal cavity in **all samples of three groups** by Karl Pearsons correlation coefficient

Table-17: Comparison of three groups (DNS, CRS and CRS+DNS) with all parameters by one way ANOVA

Variables	DNS group		CRS group		CRS+DNS group		F-value	p-value `
	Mean	SD	Mean	SD	Mean	SD		
Septal body thickness right	4.12	0.63	4.22	0.25	4.16	0.30	0.2089	0.8121
Septal body thickness left	4.10	0.70	4.24	0.26	4.31	0.13	0.9210	0.4039
Septal body height	21.20	1.09	24.09	1.35	24.70	1.63	45.6189	0.0001*
Septal body length	30.91	0.94	30.64	1.13	30.98	0.86	0.5344	0.5889
IT medial mucosa right	3.79	0.56	4.11	0.40	4.15	0.30	3.8998	0.0259*
IT medial mucosa left	4.00	0.64	4.03	0.47	4.17	0.37	0.4471	0.6417
IT lateral mucosa right	3.86	0.58	4.09	0.30	4.13	0.29	2.1181	0.1296
IT lateral mucosa left	3.93	0.60	4.10	0.26	4.16	0.30	1.3787	0.2602
Internal nasal valve area right	4.73	0.51	5.01	0.25	4.82	0.30	2.5354	0.0881
Internal nasal valve area left	4.66	0.56	4.82	0.41	4.63	0.34	0.7527	0.4757

*p<0.05

Graph 16: Comparison of three groups (DNS, CRS and CRS+DNS) with all parameters

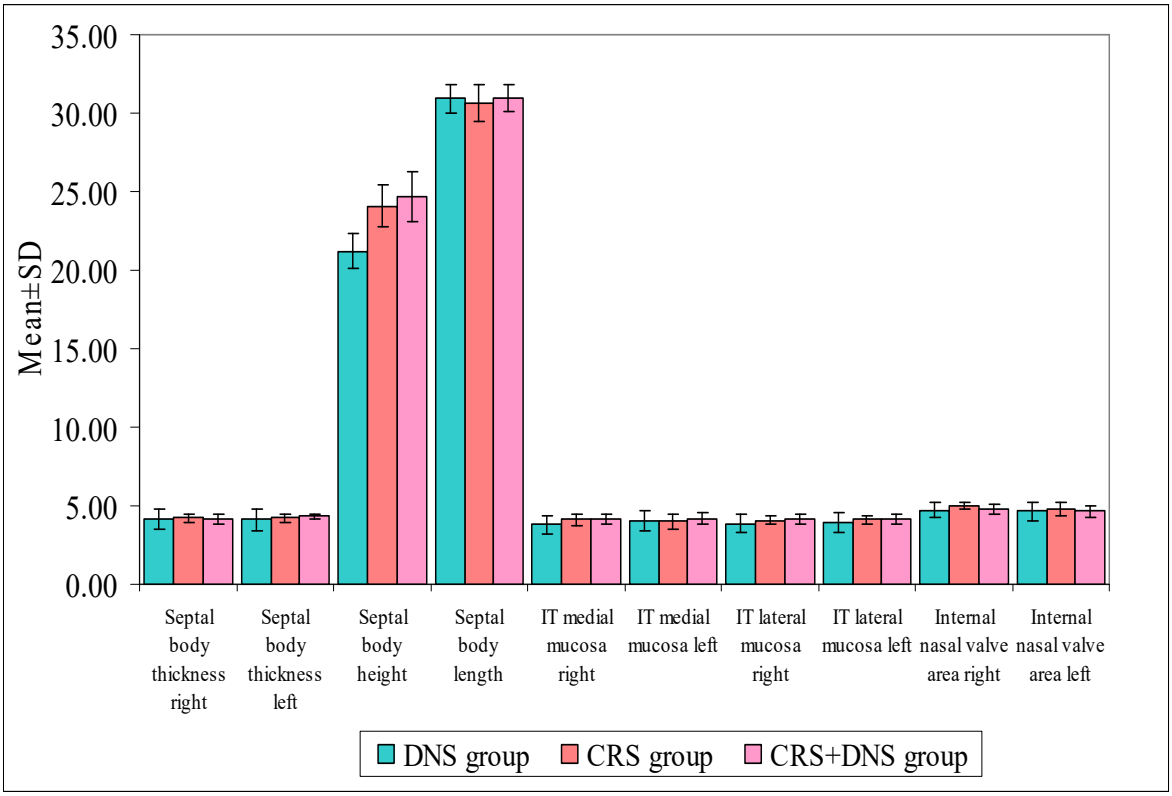
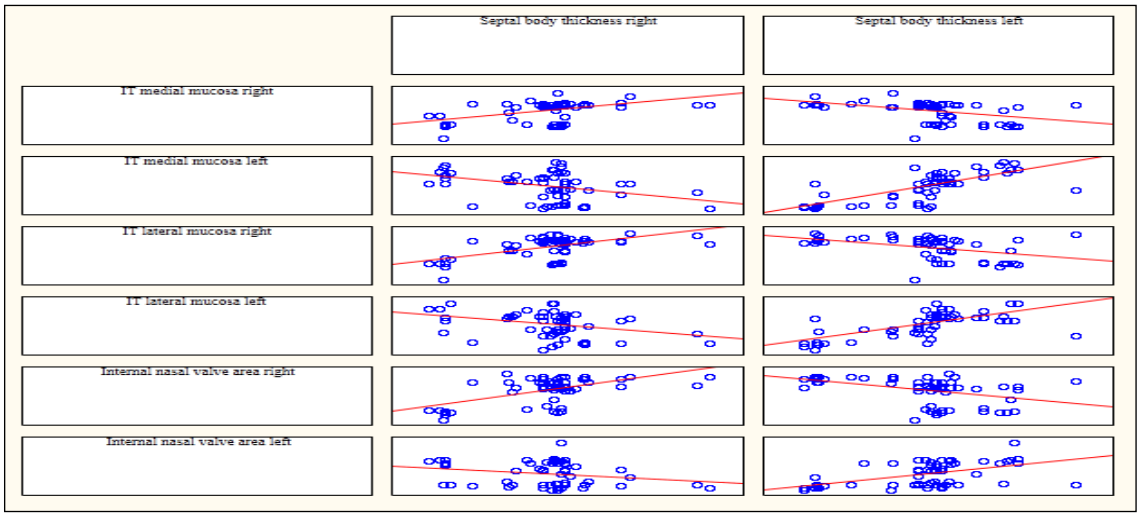


Table-18: Correlation between Septal body thickness right and left, Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **all samples of three groups** by Karl Pearsons correlation coefficient

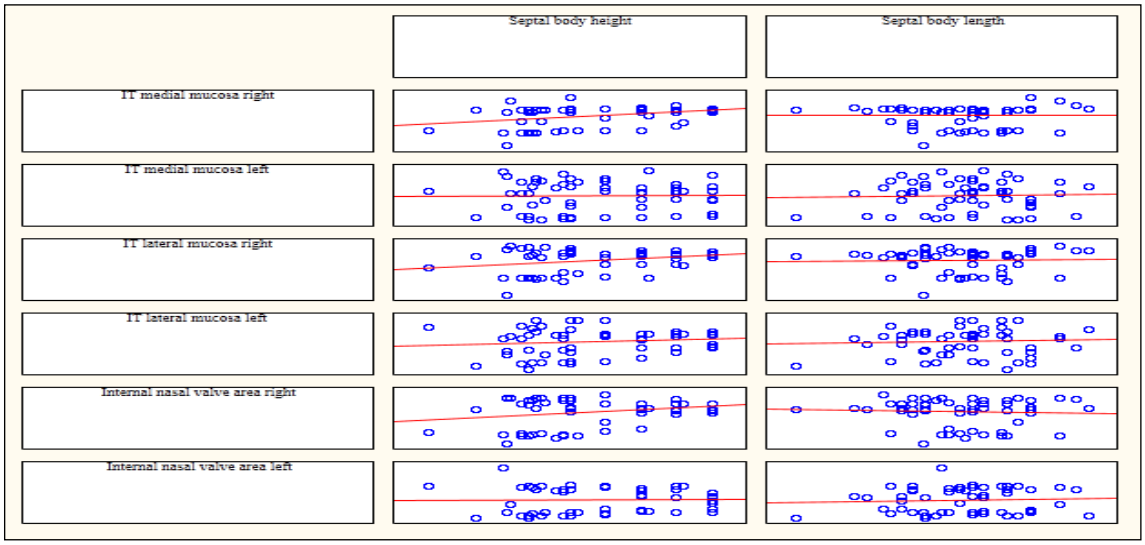
Variables	Summery	Septal body thickness right	Septal body thickness left	Septal body height	Septal body length
IT medial mucosa right	r-value	0.5060	-0.4580	0.3290	0.0040
	p-value	0.0001*	0.0001*	0.0100*	0.9770
IT medial mucosa left	r-value	-0.3650	0.7300	0.0100	0.0400
	p-value	0.0040*	0.0001*	0.9370	0.7610
IT lateral mucosa right	r-value	0.5810	-0.4240	0.2860	0.0240
	p-value	0.0001*	0.0010*	0.0270*	0.8530
IT lateral mucosa left	r-value	-0.3550	0.6710	0.1190	0.0570
	p-value	0.0050*	0.0001*	0.3650	0.6630
Internal nasal valve area right	r-value	0.5910	-0.4210	0.2600	-0.0530
	p-value	0.0001*	0.0010*	0.0450*	0.6860
Internal nasal valve area left	r-value	-0.2430	0.5140	0.0200	0.0690
	p-value	0.0610	0.0001*	0.8810	0.6020

*$p<0.05$

Graph 17: Scatter diagram showing the correlation between Septal body thickness right and left with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **all samples of three groups**



Graph 18: Scatter diagram showing the correlation between Septal body height and Septal body length with IT medial mucosa right & left, IT lateral mucosa right & left, Internal nasal valve area right & left in **all samples of three groups**



DISCUSSION

"Nasal septal body" located in the nasal valve region has tissue structure similar to that of the inferior turbinate. Its impact on nasal airway and physiology is similar to that of the inferior turbinate, and hence described as "septal turbinate".[5]

"Septal body hypertrophy combined with inferior turbinate hypertrophy may result in changes to nasal cross-sectional area and resistance to airflow".[6]

It is believed that the septal body undergoes mucosal changes similar to that of inferior turbinate hypertrophy as seen in cases of chronic sino-nasal diseases.[1]

This study was done in ENT and HNS department, J.N.M.C, KAHER from January 2020 to December 2020. The objective was to "compare the radiographic changes in Nasal Septal Body in patients with Chronic Rhinosinusitis and Septal deviation".

In our study 60 CT-PNS scans both coronal and axial cuts were retrospectively studied in patients with septal deviation and chronic rhinosinusitis to compare and observe the changes in the nasal septal body.

The analysis was done under the following headings in relation to septal body thickness.

1. Age and sex distribution:

In our study the mean age of patients in DNS group was 39.37, CRS group was 38.31, CRS+DNS group was 43.36. In DNS group 46.67% were male and 53.33% were female, in CRS group there was equal distribution of male and female. In CRS+DNS 85.71% were male and 14.29% were female.

The septal body thickness was increased in all 3 groups but no significant differences were observed in relation to age and sex distribution.

In a study done by January E Gelera in 2017 on "Radiographic changes of the nasal septal body among patients with sinonasal diseases", they concluded that in normal subjects as we age we expect nasal mucosa atrophy but in patients with sinonasal disease the mucosa is thickened.

2. Septal deviation:

Septal deviations cause contralateral inferior turbinate hypertrophy, this compensatory hypertrophy is "to counter balance the more roomy side from crusting, dryness, impaired mucociliary clearance due to excess airflow". The histological morphology of septal body is similar to that of inferior turbinate.[5]

Both in DNS group and CRS+DNS there was a equal distribution of right and left septal deviation. All the scans showed increased septal body thickness on the side opposite to deviation along with inferior turbinate hypertrophy leading to narrowing of septal valve area. The values were statistically significant. The septal body and inferior turbinate were showing positive correlation.

Degree of septal deviation:

In our study the mean degree of septal deviation in group 1 (DNS) is 10.62, in group 2 CRS+DNS is 8.77. The septal body thickness in terms of degree of devation did not show significant positive correlation.

Jennifer Setlur[5] in 2010, studied 100 computarized tomographic sinus scans retrospectively, on "relationship between the septal body size and septal deviation". They concluded that "The difference in septal body size increases as septal deviation increases and patients with severe septal deviation had the greatest difference in septal body size compared to patients with mild or moderate septal deviation".

3. Group-1 (DNS):

In group 1 (DNS) in patients with right deviation the mean septal body thickness on right nasal cavity was 3.76mm the mean septal body thickness in left nasal cavity was 4.58mm. In case of left deviation the mean thickness on right cavity was 4.48mm left cavity was 3.62mm.

Similarly in right and left deviation the contralateral septal body thickness was positively correlated with inferior turbinate medial and lateral mucosa thickness and the values were statistically significant.

It is similar to study done by Jennifer Setlur[5], in 2010, where 100 computarized tomographic sinus scans were retrospectively studied, "they compared the size of the septal body to the laterality of septal deviation". They concluded that "the septal body was larger on the side opposite the nasal septal deviation, and was statistically significant. Septal body hypertrophy may play a role in regulating nasal airflow and may contribute to nasal obstruction"

-In a retrospective study done by Myeong Sang Yu[6] in 2018 on "radiological analysis correlation between septal body size and inferior turbinate hypertrophy on Computed Tomography- Para nasal sinus (CT-PNS) scans in fifty patients" and concluded that "SB (septal body) size is significantly associated with IT size and narrowed internal nasal valve area. These results indicate that clinicians should check for concomitant SB hypertrophy in patients with IT hypertrophy".

4. Group-2 (CRS):

16 CT-PNS with CRS were studied, all patients had bilateral disease though the disease severity varied between the right and left nasal cavity, we observed that septal body thickness and inferior turbinate thickness were increased on the side with more disease severity.

January E. Gelera[1], in 2017 on "Radiographic anatomical changes occurring in the nasal septal body (NSB) among patients with sinonasal disease and the measurements obtained from patients without sinonasal disease. NSB diameter measurements were significantly larger among the diseased group" and is statistically significant.

5. Group-3 (CRS + DNS)

14 CT-PNS with combination of CRS (bilateral disease) with DNS were studied, when compared to patient with only CRS where septal body thickness showed variation based on disease severity, in CRS with DNS the septal body thickness is increased in both right and left cavity.

There is no previous studies in literature on comparision of CRS and CRS with DNS. Although studies suggest that mucosal hypertrophy is observed in septal body in relation to inferior turbinate hypertrophy in the diseased side.[1]

The current study will helps us to understand the significance of nasal septal body and its changes in DNS and CRS.

CONCLUSION

- ✓ It is found that in patient with deviated nasal septum (DNS) in addition to contralateral inferior turbinate hypertrophy septal body thickness is also increased. This is found to be similar in case of CRS with DNS.
- ✓ In CRS patients it is found that along with inferior turbinate hypertrophy, the septal body thickness is also increased on the diseased side and values are found to be statistically significant.
- ✓ Thus, concluding that in both DNS and CRS + DNS, septal deviation cause contralateral septal body hypertrophy. In CRS along with inferior turbinate hypertrophy the septal body thickness is also increased in the diseased side.
- ✓ In literature they are very few studies on septal body, the current study will enlighten us about the importance of septal body and its changes in septal deviation and chronic rhinosinusitis. It is important to address the septal body hypertrophy for the better symptomatic outcome of the patient.

SUMMARY

This study was done from the department of Otorhinolaryngology and Head and neck surgery, Jawaharlal Nehru Medical College and KAHER from January 2020 to December 2020. The objective is to compare the radiographic changes in Nasal Septal Body in patients with Chronic Rhinosinusitis and Septal deviation.

We studied a total of 60 CT-PNS, for radiographic changes occurring in nasal septal body. The parameters measured include septal body thickness in right and left nasal cavity, septal body length and height, inferior turbinate medial and lateral mucosa and internal nasal valve area in both nasal cavity.

For analysis of results, we categorized them into three groups. Group 1- DNS, group 2 - CRS, group 3 - CRS+DNS, of which 30 were DNS group, 16 were CRS, 14 were CRS+DNS. The mean age of DNS group was 39.37, CRS group was 38.31, CRS+DNS group was 43.36. In DNS group 15 patients had right deviation and 15 had left septal deviation, in CRS+DNS group, 7 had right deviation and 7 had left septal deviation The mean degree of septal deviation in DNS group were 10.62 and CRS+DNS group were 8.77

It is found in patient with deviated nasal septum (DNS) in addition to contralateral inferior turbinate hypertrophy septal body thickness is also increased. This is found to be similar in case of CRS with DNS. In CRS patients it is found that along with inferior turbinate hypertrophy, the septal body thickness is also increased on the diseased side and values are found to be statistically significant

In literature they are very few studies on septal body, the current study will enlighten us about the importance of septal body and its changes in septal deviation and chronic rhinosinusitis. Thus, it is important to address the septal body hypertrophy for the better symptomatic outcome of the patient.

BIBLIOGRAPHY

1. E Gelera J, Ojar D, Lim JH, Wee JH, Kim JW, Rhee CS. Radiographic Changes of the Nasal Septal Body Among Patients With Sinonasal Diseases. *Clin Exp Otorhinolaryngol*. 2017;10(4):338-343.
2. Wexler D, Braverman I, Amar M. Histology of the nasal septal swell body (septal turbinate). Otolaryngol Head Neck Surg. 2006 Apr;134(4):596-600.
3. Hizli O, Kayabasi S, Ozkan D. Is Nasal Septal Body Size Associated With Inferior Turbinate Hypertrophy and Allergic Rhinitis?. Journal of Craniofacial Surgery. 2020 May 1;31(3):778-81.
4. Cole P. Biophysics of nasal airflow: a review. American journal of rhinology. 2000 Jul;14(4):245-50.
5. Setlur J, Goyal P. Relationship Between Septal Body Size and Septal Deviation. The Laryngoscope. 2010;120(S4):S246-S246.
6. Yu M, Choi C, Jung M, Kim H. Correlation between septal body size and inferior turbinate hypertrophy on computerised tomography scans in fifty patients: A radiological analysis. Clinical Otolaryngology. 2018;43(3):952-955.
7. Beck JC, Sie KCY: The growth and development of the nasal airway. Facial Plast Surg Clin North Am 7:257, 1999.
8. Enlow DH: Facial growth, ed 3, Philadelphia, 1990, W.B. Saunders.
9. Bradoo, Renuka (2005). Chapter-01 Embryology. 3-1.
10. Moore KL, Persaud TVN: The developing human: clinically oriented embryology, ed 5, Philadelphia, 1993, W.B. Saunders.

11. Lebowitz RA, Brunner E, Jacobs JB. The agger nasi cell: radiological evaluation and endoscopic maagement in chronic frontal sinusitis. Operative Techniques Otolaryngol Head Neck Surg 1995;6:171–175.
12. Watkinson JC, Clarke RW, editors. Physiology of nose and paranasal sinus. Scott-Brown's otorhinolaryngology and head and neck surgery: Volume 1: Basic sciences.
13. Tardy MD: Rhinoplasty: the art and the science, Philadelphia, 1997, W.B. Saunders.
14. Faris C. Scott-Brown's Otorhinolaryngology, Head and Neck Surgery, 7th edn. Ann R Coll Surg Engl. 2011;93(7):559.
15. Constaninides MS, Miller PJ: New developments in nasal valve analysis and functional nasal surgery. *Curr Opin Otolaryngol Head Neck Surg* 6:238, 1998.
16. Kasperbauer JL, Kern EB: Nasal valve physiology: implications in nasal surgery. *Otolaryngol Clin North Am* 20:699, 1987.
17. Toriumi DM, et al: Use of alar batten grafts for correction of nasal valve collapse. *Arch Otolaryngol Head Neck Surg* 123:802, 1997.
18. Lebowitz RA, Brunner E, Jacobs JB. The agger nasi cell: radiological evaluation and endoscopic maagement in chronic frontal sinusitis. Operative Techniques Otolaryngol Head Neck Surg 1995;6:171–175.
19. Wanamaker HH. Role of Haller's cell in headache and sinus disease: a case report. Otolaryngol Head Neck Surg 1996;114:324–327.
20. Laine F, Smoker W. The ostiomeatal unit and endoscopic surgery: anatomy, variations, and imaging findings in inflammatory diseases. Am J Roentgenol 1992;159:849–857.

21. Periyasamy V, Bhat S, Sree Ram MN. Classification of Naso septal deviation angle and its clinical implications: A CT scan imaging study of palakkad population, India. Indian J Otolaryngol Head Neck Surg. 2019;71(Suppl 3):2004–10.

22. Mohebbi A, Ahmadi A, Etemadi M, Safdarian M, Ghourchian S (2012) An epidemiologic study of factors associated with nasal septum deviation by computed tomography scan: a cross sectional study. BMC Ear Nose Throat Disord 12(15):1–5. https://doi.org/10.1186/1472-6815-12-15

23. Ozkurt FE, Akdag M, Keskin I, Iskenderoglu AY, Tacar O (2014) Relation between the nasal septal deviation and chronic rhinosinusitis. Int J Basic Clin Stud 3(1):25–30

24. Javadrashid R, Naderpour M, Asghari S, Fouladi DF, Ghojazadeh M (2014) Concha bullosa, nasal septal deviation and paranasal sinusitis: a computed tomographic evaluation. B-ENT 10:291–298

25. Stammberger, H. Special endoscopic anatomy of lateral wall and ethmoid sinuses. In: B.C. Decker, editor; 1991. pages 49-87.

26. H Stammberger and Valerie J lund. Anatomy of the nose and paranasal sinuses In: Gleeson M, editor Scott-Brown's Otorhinolaryngology, Head and Neck Surgery. 7th ed. Great Britain: Edward Arnold; c2008. pages 1315-1344.

27. Bradoo, Renuka (2005). Chapter-05 Radiological anatomy. 73-79.

28. Bradoo, Renuka (2005). Chapter-06 Anotomical variations. 89-99.

29. (Costa DJ, Sanford T, Janney C, et al. Radiographic and anatomic characterization of the nasal septal swell body. *ArchOtolaryngol Head Neck Surg* 2010;**136**(11): 1107–10.)

30. Lund VJ, Mackay IS. Staging in rhinosinusitus. Rhinology. 1993;31(4):183–4

31. Yu M, Kim J, Kim B, Kang S, Lim D. Feasibility of septal body volume reduction for patients with nasal obstruction. The Laryngoscope. 2015;125(7):1523-1528.

32. Elwany S, Salam S, Soliman A, Medanni A, Talaat E. The septal body revisited. The Journal of Laryngology & Otology. 2008;123(3):303-308.

ANNEXURE I. ETHICAL CLEARANCE.

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (Govt)
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
Website: http://www.jnmc.edu
E-Mail : jnmc@jnmc.edu
Phone: (+91-0831) Office : 2472550
Principal: 2471701
Fax No. +91 (0831) 2470739

Ref: MDC/DOME/ 437 Date: 23/10/2020

To
REG. NO: BE0119002
PG student in Otorhinolaryngology and Head & Neck Surgery.
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled "**RADIOGRAPHIC STUDY OF NASAL SEPTAL BODY IN PATIENTS WITH CHRONIC RHINOSINUSITIS AND DEVIATED NASAL SEPTUM" A 1 YEAR OBSERVATIONAL STUDY**", is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

ANNEXURE II

PROFORMA

"RADIOGRAPHIC STUDY OF NASAL SEPTAL BODY IN PATIENTS WITH CHRONIC RHINOSINUSITIS AND DEVIATED NASAL SEPTUM" A 1 YEAR OBSERVATIONAL STUDY.

Date: Scan no :

Name:

Age:

Sex:

CT PARANASAL SINUSES

Parameters :

Measurements	Right	Left
Septal deviation -Naso septal angle		
Nasal septal body Coronal view: a) SB thickness b) SB height Axial view: c) SB length		

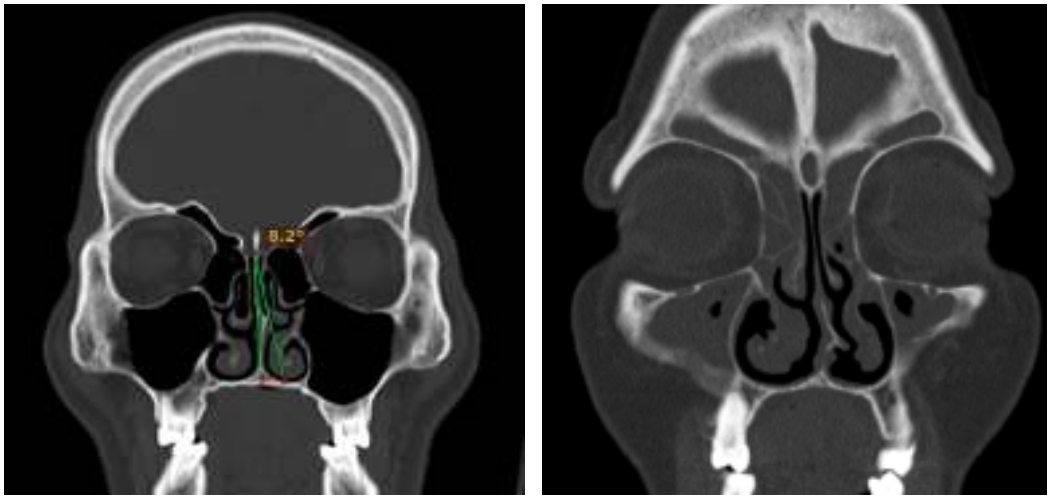
Inferior turbinate Coronal view: d) Medial mucosa e) Lateral mucosa		
Internal nasal valve area: Coronal view: h) Horizontal distance between SB and lateral nasal wall.		

Lund Mackay Scoring:

Sinus	Right	Left
Frontal		
Anterior ethmoidal		
Posterior ethmoidal		
Maxillary		
Sphenoid		
Osteomeatal complex		

ANNEXURE III

PHOTOGRAPHS



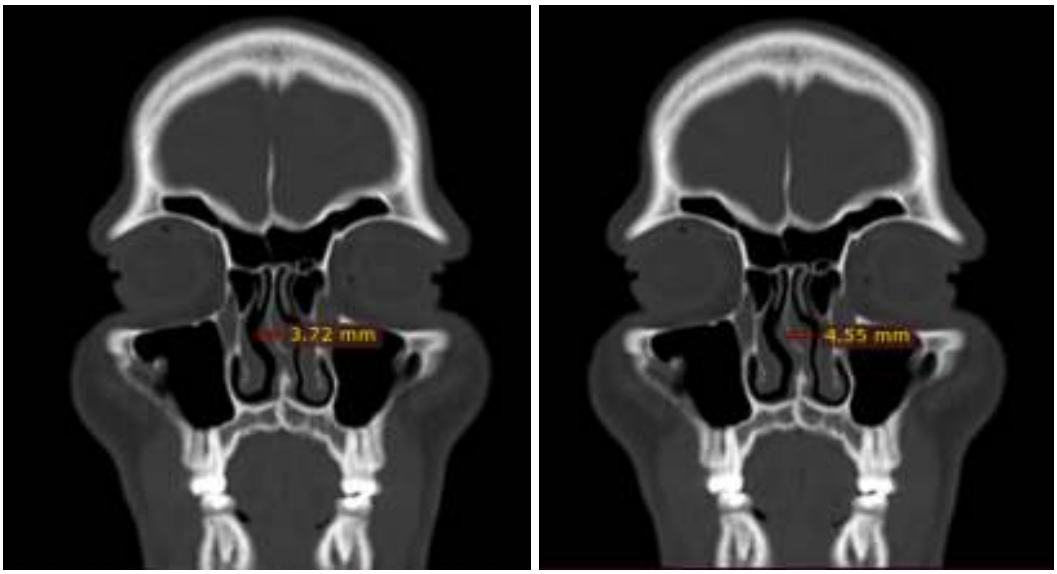
(a) (b)

Image 1: CT-PNS coronal view showing (a) DNS and (b) CRS

(a) (b)

Image 2: CT-PNS (a) axial view showing septal body length, (b) coronal view showing septal body height

DNS

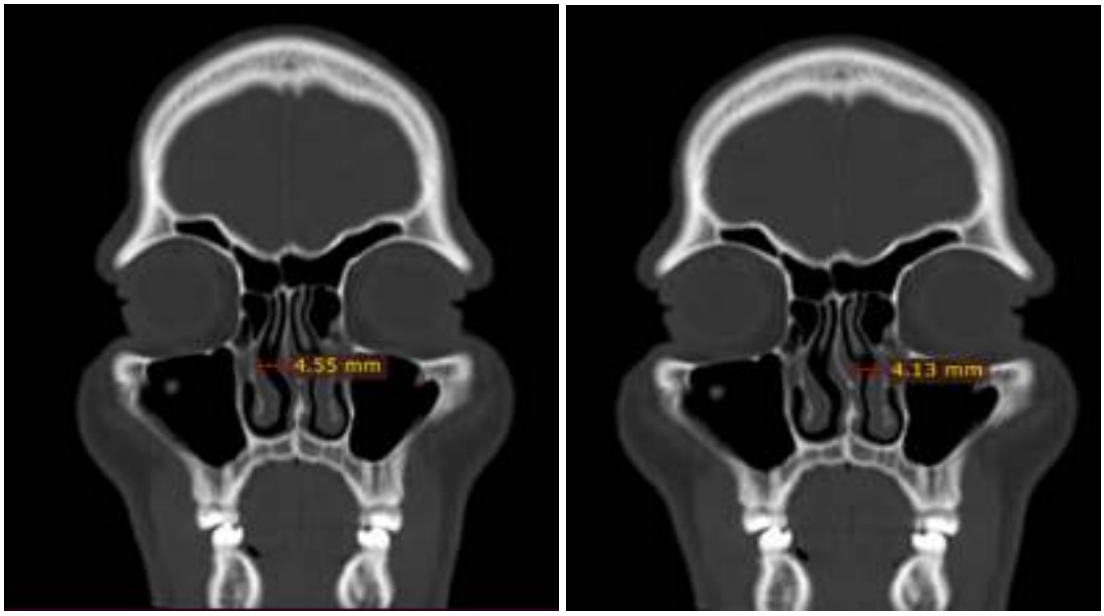


(a) (b)

Image 3: CT-PNS coronal view showing septal body thickness in (a) right and (b) left nasal cavity in right septal deviation

(a) (b)

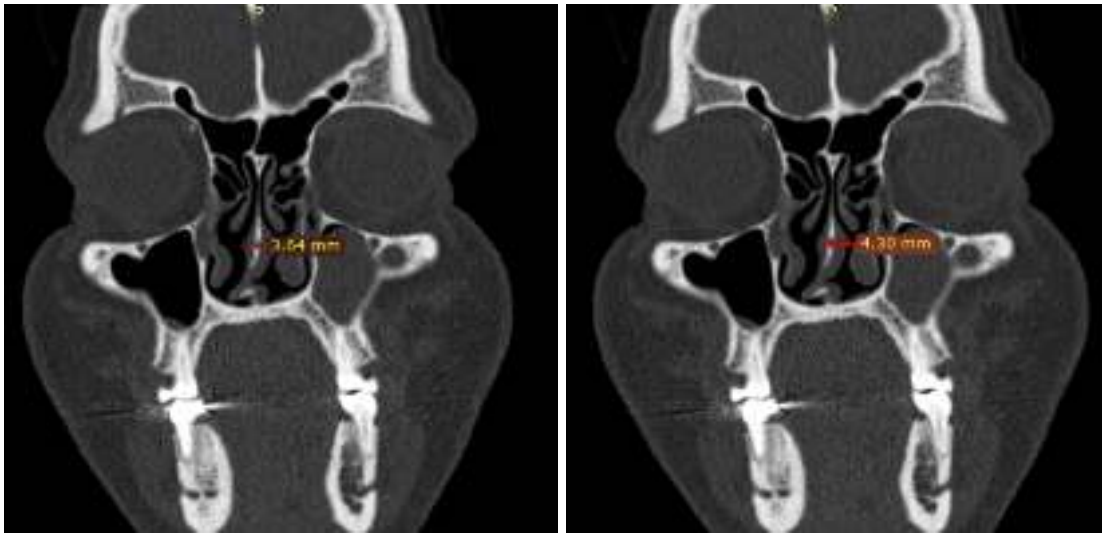
Image 4: CT-PNS coronal view showing left inferior turbinate (a) medial and (b) lateral mucosa thickness in right septal deviation



(a) (b)

Image 5: CT-PNS coronal view showing showing the internal nasal valve area in (a) right and (b) left nasal cavity in right septal deviation

CRS WITH DNS



(a) (b)

Image 6: CT-PNS coronal view showing showing the septal body thickness in (a) right and (b) left nasal cavity in CRS with right DNS

(a) (b)

Image 7: CT-PNS coronal view showing the inferior turbinate (a) medial and (b) lateral mucosa thickness in right and left nasal cavity in CRS with right DNS

(a) (b)

Image 8: CT-PNS coronal view showing the internal nasal valve area in (a) right and (b) left nasal cavity in CRS with right DNS

CRS

(a) (b)

Image 9: CT-PNS coronal view showing the septal body thickness in (a) right and (b) left

(a) (b)

Image 10: CT-PNS coronal view showing the inferior turbinate (a) medial and (b) lateral mucosa thickness in right and left nasal cavity in CRS

(a) (b)

Image 11: CT-PNS coronal view showing the internal nasal valve area in (a) right and (b) left nasal cavity in CRS

ANNEXURE IV - KEY TO MASTERCHART

Groups	1- DNS 2- CRS 3- CRS+DNS
Age groups	1- 20-29 2- 30-39 3- 40-49 4- 50-65
Sex	1- Male 2- Female
Septal deviation	1- Left 2- Right
Degree of septal deviation	1- Mild 2- Moderate 3- Severe

S.NO	Groups	Groups	AGE	Age group	SEX	SEPTAL DEVIATION	NASO SEPTAL ANGLE (in degree)	DEGREE	Groups	SEPTAL BODY THICKNESS RIGHT	SEPTAL BODY THICKNESS LEFT	SEPTAL BODY HEIGHT	SEPTAL BODY LENGTH	IT MEDIAL MUCOSA RIGHT	IT MEDIAL MUCOSA LEFT	IT LATERAL MUCOSA RIGHT	IT LATERAL MUCOSA LEFT	INTERNAL NASAL VALVE AREA RIGHT	INTERNAL NASAL VALVE AREA LEFT	LUND MACKAY SCORING RIGHT	LUND MACKAY SCORING LEFT		
1	DNS	1	40	3	1	2	12	2	1	4.26	4.89	20.6	32.5	3.16	4.55	3.26	4.15	4.13	5.21				Comparison of three grps with all
2	DNS	1	60	4	1	1	8.4	1	1	4.26	3.89	20.8	30.2	4.15	3.27	4.55	3.72	5.08	4.02				
3	DNS	1	65	4	2	2	8	1	1	3.98	4.18	18	31.5	3.26	4.23	3.68	4.56	4.23	5.25				Correlation b/w SB length/ height with others in each group
4	DNS	1	46	3	2	1	16	3	1	4.26	3.26	20.6	30.2	4.26	3.27	4.52	3.22	5.1	4.13				
5	DNS	1	21	1	1	1	9.7	1	1	4.2	3.15	19.3	28	4.28	3.26	4.18	3.12	4.95	4.02				
6	DNS	1	36	2	2	2	12	2	1	3.31	4.28	22.2	31.5	3.27	4.55	3.48	4.82	4.13	4.26				
7	DNS	1	58	4	2	1	12	2	1	5.6	4.2	21.2	31.8	4.25	3.16	4.15	3.26	5.28	4.13				
8	DNS	1	21	1	1	1	8.6	1	1	4.13	3.23	20.8	31.6	4.25	3.16	4.16	3.01	5.2	4.13				
9	DNS	1	35	2	1	2	10	1	1	3.21	4.32	21.2	29.6	3.7	4.62	3.28	4.59	4.21	5.29				
10	DNS	1	62	4	1	2	9.2	1	1	3.12	4.38	20.6	30.8	3.72	4.15	3.27	4.59	4.2	5.21				
11	DNS	1	60	4	1	2	16	3	1	4.29	4.95	20.1	30.5	3.12	4.94	3.26	4.15	4.16	5.98				
12	DNS	1	34	2	2	2	9.2	1	1	4.2	4.98	21	30.8	3.16	4.68	3.23	4.82	4.98	5.13				
13	DNS	1	39	2	2	1	9.3	1	1	4.13	3.9	20.2	30.5	4.15	3.64	4.45	3.56	5.28	4.23				
14	DNS	1	35	2	2	2	11	2	1	4.28	4.68	23	31	3.28	4.62	3.3	4.28	4.25	5.23				
15	DNS	1	21	1	2	2	10	2	1	4.23	4.92	23	31.8	3.26	4.69	3.83	4.82	4.56	5.28				
16	DNS	1	21	1	1	1	8.6	1	1	4.19	5.48	21.3	30.6	4.25	3.87	4.56	3.56	5.15	4.25				
17	DNS	1	58	4	2	1	12	2	1	5.48	4.2	22	32	4.26	3.78	4.54	3.65	5.02	4.25				
18	DNS	1	35	2	2	2	10	2	1	4.22	4.98	22	31	4.12	4.68	4.32	4.82	4.86	5.32				
19	DNS	1	20	1	2	2	9.2	1	1	3.26	4.82	21.8	31.6	3.27	4.86	3.13	4.12	4.13	5.12				
20	DNS	1	20	1	1	1	9	1	1	4.89	3.23	20.3	32.5	4.72	4.12	4.62	4.22	5.28	4.56				
21	DNS	1	47	3	2	1	14	2	1	4.28	3.27	21.8	30.2	4.27	3.27	4.32	3.72	5.28	4.13				
22	DNS	1	57	4	1	1	9.2	1	1	4.82	3.32	20.9	31.2	4.15	3.72	4.25	3.26	5.21	4.18				
23	DNS	1	21	1	2	2	8.5	1	1	3.26	4.23	21.8	30.6	3.26	4.48	3.49	4.28	4.15	5.06				
24	DNS	1	53	4	1	2	13	2	1	4.22	4.68	20.9	31.2	3.12	4.38	3.26	4.52	4.16	5.21				
25	DNS	1	43	3	2	2	10.5	2	1	3.26	4.28	21.6	30.9	3.18	4.36	3.26	4.27	4.06	5.08				
26	DNS	1	36	2	2	1	8	1	1	3.5	3.25	23	29.6	4.3	3.26	4.26	3.3	5.12	4.2				
27	DNS	1	46	3	2	1	10.2	2	1	4.5	3.54	22	31	4.29	3.26	4.36	3.29	5.29	4.23				
28	DNS	1	41	3	1	1	10.4	2	1	4.48	3.14	21.8	30.4	4.28	3.21	4.16	3.28	5.2	4.13				
29	DNS	1	21	1	1	1	12	2	1	4.5	3.25	22	32	4.28	3.2	4.26	3.23	5.23	4.23				
30	DNS	1	29	1	1	2	12.7	2	1	3.24	4.09	20.2	30.18	2.53	4.78	2.54	3.66	3.89	4.25				
31	CRS	2	21	1	2				2	3.8	4.38	23	29.5	4.3	4.36	4.12	4.23	5.4	4.38	5	10		
34	CRS	2	27	1	2				2	4.16	4.23	24	30.6	4.12	3.26	4.32	3.82	4.32	5.2	7	1		
35	CRS	2	43	3	2				2	3.85	4.36	25	30	3.46	4.21	3.82	4.32	4.8	4.23		2		
36	CRS	2	50	4	2				2	4.02	3.65	25	32.8	4.46	3.3	4.4	3.8	5.25	5.12	10	6		
37	CRS	2	38	2	1				2	4.32	4.2	24	29.8	4.38	4.12	4.2	4.1	4.98	4.86	8	4		
38	CRS	2	62	4	1				2	4.25	3.9	22	32	4.86	3.68	4.32	3.82	5.23	5.12	9	5		

39	CRS	2	22	1	1				2	4.32	4.4	24	30	3.26	4.12	3.82	4.32	4.92	5.1	1	4		
40	CRS	2	31	2	1				2	4.24	4.86	24.2	31.2	3.98	4.98	3.26	4.3	4.96	4.3		4		
41	CRS	2	62	4	1				2	4.23	4.12	25	31.6	4.12	3.92	4.28	3.62	5.12	5.26	8	8		
42	CRS	2	43	3	2				2	4.32	4.4	25.2	30	3.62	4.21	3.8	4.32	5.12	5.28		6		
43	CRS	2	21	1	2				2	4.42	4.28	26	31.6	4.12	4.22	4.21	4.38	4.88	4.98	10	4		
45	CRS	2	20	1	2				2	3.82	4.32	23	31	3.89	4.23	3.82	4.29	5.1	4.16		10		
46	CRS	2	28	1	2				2	4.32	4.44	21	30	4.26	4.58	4.32	4.4	5.29	5.12	9	12		
48	CRS	2	55	4	1				2	4.82	4.12	24	29	4.36	4.12	4.26	4.12	4.98	4.88	10	4		
49	CRS	2	42	3	1				2	4.32	4.12	26	29.2	4.21	3.29	4.24	3.92	4.92	4.82	7	1		
50	CRS	2	48	3	1				2	4.26	4.12	24	32	4.32	3.92	4.26	3.82	4.92	4.28	8	1		
53	CRS+DNS	3	48	3	1	2	9	1	3	4.12	4.32	25	30.2	4.28	4.36	4.21	4.3	4.82	4.9	10	6		
54	CRS+DNS	3	62	4	1	2	8.2	1	3	4.21	4.36	26	30.8	3.92	4.32	3.83	4.38	4.58	4.82	10	6		
57	CRS+DNS	3	52	4	1	2	10	2	3	4.26	4.38	24	31	4.16	4.2	4.21	4.32	4.26	4.36	11	11		
32	CRS+DNS	3	25	1	1	2	10.2	2	3	3.26	4.32	20.8	31.5	3.16	4.15	3.26	4.25	4.13	5.29	6	7		
33	CRS+DNS	3	24	1	2	1	8.2	1	3	4.32	4.23	24	32	4.32	3.62	4.4	3.42	4.82	4.32	5	0		
44	CRS+DNS	3	29	1	1	1	8	1	3	4.12	4.32	22	33	4.33	4.38	4.42	4.46	4.98	4.12	6	10		
47	CRS+DNS	3	45	3	1	1	8	1	3	4.29	4.62	26	29.8	4.26	4.82	4.12	4.28	4.89	4.68	6	10		
51	CRS+DNS	3	50	4	1	1	9	1	3	4.32	4.46	25	31	4.24	4.12	4.27	4.21	4.92	4.26	10	10		
52	CRS+DNS	3	39	2	1	1	9.2	1	3	4.53	4.26	26	29.8	4.28	3.89	4.21	3.92	5.1	4.38	10	6		
55	CRS+DNS	3	42	3	1	1	8.6	1	3	4.32	4.12	26	31	4.24	3.86	4.12	3.82	4.92	4.86	10	2		
56	CRS+DNS	3	49	3	1	2	8.2	1	3	3.89	4.23	25	30.2	4.12	4.48	4.1	4.4	4.92	4.83	3	10		
58	CRS+DNS	3	42	3	1	1	8.2	1	3	4.32	4.12	26	31	4.24	3.38	4.12	3.82	4.92	4.26	10	1		
59	CRS+DNS	3	52	4	1	2	10	2	3	4.1	4.32	24	31.2	4.28	4.36	4.26	4.32	5.1	4.9	10	10		
60	CRS+DNS	3	48	3	2	2	8	1	3	4.12	4.28	26	31.2	4.21	4.38	4.28	4.3	5.1	4.82	10	10		