ORIGINAL ARTICLE

Bali Medical Journal (*Bali MedJ)* 2021, Volume 10, Number 3: 1144-1150
P-ISSN.2089-1180, E-ISSN: 2302-2914

The association between nasal septum deviation angle and type with the severity of nasal obstruction based on NOSE (Nasal Obstruction Symptom Evaluation) score before surgery at Sanglah General Hospital Denpasar

Luh Putu Happy Sandha[1*], Luh Made Ratnawati[1], I Ketut Suanda[1]

[1]Otorhinolaryngology Department, Faculty of Medicine, Udayana University, Sanglah General Hospital, Bali,Indonesia;

*Corresponding author:
Luh Putu Happy Sandha;
Otorhinolaryngology Department, Faculty of Medicine, Udayana University, Sanglah General Hospital, Bali,Indonesia;
happysandha111@gmail.com

Received: 2021-08-03
Accepted: 2021-10-14
Published: 2021-12-30

ABSTRACT

Introduction: Nasal obstruction is a nasal complaint that is not life-threatening but can affect the patient's quality of life while awake or sleeping. One of the anatomical factor that can affect this condition is nasal septum deviation including its angle and type. The purpose of this study was to assess the association between the angle and type of nasal septum deviation with the severity of nasal obstruction.

Method: This study was a retrospective observational analytic study with a cross-sectional design. The CT scan of the subject was analyzed to assess the angle of septum deviation and the Mladina's 7 type classification of septum deviation. The severity of nasal obstruction assessed by the NOSE questionnaire.

Results: Of the 50 subjects, 27 (54%) men and 23 (46%) woman with an average age of 34.64±12.8 years. Type III deviated nasal septum was the most frequent (28%) followed by type I (14%). The mean deviated nasal septum angle was 20,3±07,07°. There was a statistically significant association between the deviated nasal septum angle with the higher NOSE score with a strong positive correlation value based on the Pearson correlation test ($r=0.771$; $p < 0.000$). There was no statistically significant association between the type of deviated nasal septum with the NOSE score.

Conclusion: There is a statistically significant association between the angle and type of deviated nasal septum with the severity of nasal obstruction based on bivariate analysis. The angle of deviated nasal septum was a statistically significant independent factor of higher NOSE score.

Keywords: septum deviation type, septum deviation angle, NOSE score.
Cite This Article: Sandha, L.P.H., Ratnawati, L.M., Suanda, I.K. 2021. The association between nasal septum deviation angle and type with the severity of nasal obstruction based on NOSE (Nasal Obstruction Symptom Evaluation) score before surgery at Sanglah General Hospital Denpasar. *Bali Medical Journal* 10(3): 1144-1150. DOI: 10.15562/bmj.v10i3.2614

INTRODUCTION

Nasal obstruction is a nasal complaint that often makes patients come for treatment in the ear nose throat clinic. The state of nasal obstruction is not a life-threatening thing but it can affect a patient's quality of life while awake or during sleep. One of the anatomical factors in the nose that causes nasal obstruction is nasal septum deviation.[1]

Nasal septum deviation (NSD) is the convexity of bone or cartilage of the septum or both from the midline. Septum deviation is caused by congenital abnormalities, genetic disorders that cause impaired bone growth, trauma, infection, or malignancy.[2,3] The incidence of a septum that is completely straight in the midline is only in small numbers, where in general there is minimal bending or there is spina in the nasal septum. It is estimated that 75% - 85% of the world's population has anatomical deformities in the nose and the most common is septum deviation. A study in Pakistan in 2011 of patients with deviated nasal septum obtained an incidence rate of 88% in men and 12% in women.[3] There are some morphologies of NSD that affect the nasal obstruction, two of them are the angle and type of nasal septum deviation.

There are many classifications of NSD but Mladina's classification considered to be the most detailed. This comprehensive classification includes complicated anatomical variants of nasal septum and devides NSD into seven types. These 7 types are Type 1: unilateral vertical septal ridge in the valve region that does not reach the valve itself, Type 2: unilateral vertical septal ridge in the valve region touching the nasal valve, Type 3: unilateral vertical ridge located more deeply in the nasal cavity, Type 4: S-shaped, Type 5: Almost horizontal septal spur, Type 6: massive unilateral bone spur, and Type 7: variation of these types.[4]

It should be noted that the finding of septum deviation is not always associated with the patient's symptoms of nasal obstruction. For example, some patients

with a deviated nasal septum have little or no symptoms of nasal obstruction, whereas others may complain of nasal obstruction even though only minimal septum deviation is seen. These observations are well known to otorhinolaryngologists but the attempt to assess obstruction in research studies remains a long-term challenge. Several systems of scales and classifications for assessing variations in septum deviation as well as questionnaires for calculating the severity of nasal obstruction have been developed over years.[5]

The assessment of nasal obstruction itself can use objective and subjective assessments. For subjective assessment based on patient complaints, we can use the NOSE score. The NOSE (Nasal obstruction Symptom Evaluation) score developed by Stewart et al is a validated tool in assessing the quality of life and the severity of nasal obstruction and is often used in the international literature.[5,6] The NOSE score consists of 5 questions. Each question is scored on a Likert scale from 0 (no problem) to 4 (severe problem) and the final score will be multiplied by 5 so that the total score is between 0 to 100 (0 no obstruction and 100 severe obstruction).[5,6]

Various studies have also been carried out abroad to explore the association between various variations of septum deviation with the severity of nasal obstruction symptoms to consider in clinical surgical decisions to prevent inadequate therapy or excessive therapy. Similar studies have never been carried out at Sanglah Hospital so it is very important to evaluate the association between the deviated nasal septum angle and type with the severity of nasal obstruction before surgery.

METHOD

This research is a retrospective observational analytic study with cross-sectional design. Subjects participated in this study were the patient with nasal septum deviation which came to ENT Clinic at Sanglah General Hospital Denpasar. All the patients from January 2017 to Desember 2020 who met the inclusion and exclusion criteria were included in this study.

The inclusion criteria in this study were subjects aged more than 18 years who underwent treatment at Sanglah Hospital Denpasar who were diagnosed with nasal septum deviation with symptoms of nasal obstruction and had performed a computed tomography investigation. The exclusion criteria from this study were previous history of sinus or nasal surgery, history of nasal and maxillofacial trauma, suffering from adenoid hypertrophy, allergic rhinitis, vasomotor rhinitis, nasal polyps, nasal cavity tumors, sinonasal tumors, and nasopharyngeal tumors.

The medical record in the form of a CT scan of the patient was examined to assess the angle of septum deviation and the type of nasal septum deviation based on Mladina's 7 classification system. The angle of nasal septum deviation was measured by drawing a line from crista galli to maxillary crest and another line to the maximum deviation of nasal septum.[7] The angle formed is calculated using Ulite software. Patients were interviewed to complete the NOSE questionnaire. Data analysis in this study consisted of descriptive statistical analysis, bivariate test with comparison test, correlation test, and multivariate test. The whole process of data analysis is using SPSS version 22.0 software. All values are considered significant if $p<0.05$.

RESULT

This study collects 50 samples of septum deviation patients who had examined CT scan to know the NSD type and angle. The sample was also interviewed to fulfill the NOSE questionnaire. The study was done at the ENT Polyclinic in Sanglah Hospital. The average age of the sample is 34.64±12.804 years, with the majority of the samples is male as many as 27 (54%) samples, and the remaining 23 (46%) samples being female. From the whole sample, the average septum deviation angle in this study was 20.30±7.072 degrees. In terms of the type of septum deviation, this study found that the most common type of septum deviation was type III with 14 (28%) samples, followed by type I with 7 (14%) samples, and types II, V, VI, and VII with each 6 (12%) samples. The least type of septum deviation found in this study was type IV as many as 5 (10%) samples. After examining with a NOSE score, it was found that there were no patients who did not experience nasal cavity obstruction. In this study, the most common degrees of nasal obstruction experienced by patients were moderate obstruction in 16 (32%) samples, followed by severe obstruction in 15 (30%) samples, very severe obstruction in 11 (22%) samples, and mild obstruction in 8 (16%) samples.

Table 1. Basic characteristic of sample.

Variable	N = 50
Age (mean±SD)	34,64±12,804
Sex n (%)	
Male	27 (54%)
Female	23 (46%)
NSD angle (mean±SD)	20,30±7,072
NSD type n (%)	
Type I	7 (14%)
Type II	6 (12%)
Type III	14 (28%)
Type IV	5 (10%)
Type V	6 (12%)
Type VI	6 (12%)
Type VII	6 (12%)
Nasal obstruction NOSE score n (%)	
No obstruction	0 (0%)
Mild obstruction	8 (16%)
Moderate obstruction	16 (32%)
Severe obstruction	15 (30%)
Very severe obstruction	11 (22%)

Table 2. Normality test result in deviated nasal septum type.

NSD type	n (50)	P	Interpretation
I	7	0.503	Normal
II	6	0.813	Normal
III	14	0.126	Normal
IV	5	0.292	Normal
V	6	0.918	Normal
VI	6	0.787	Normal
VII	6	0.178	Normal

Normal distribution (p>0.05); Not normal distribution (p<0.05)

Table 3. Normality test result for the severity of nasal obstruction.

Variable	N	P	Interpretation
NOSE score	50	0.75	Normal

Normal distribution (p>0.05); Not normal distribution (p<0.05)

Table 4. Homogenity test of NOSE score.

Variable	Levene Statistic	df1	df2	P	Interpretation
Skor NOSE	0.961	7	43	0.463	Homogen

Ket: NOSE = Nasal Obstruction Symptom Evaluation; df1 = first degree of freedom; df2 = second degree of freedom; p = significant value; homogen data distribution (p>0.05); heterogen data distribution (p<0.05)

Table 5. Comparation of NSD type with NOSE score.

	Sum of Squares	Mean Square	F	P
NOSE score	14305.452	2384.242	4.460	0.001*

NB: (*) Significant p value

Data normality test

This study involved 50 samples with a numeric scale dependent variable, therefore it is necessary to test for data normality with the Kolmogorov-Smirnov test. From the results of the normality test in each group based on the type of septum deviation, p>0.05 was obtained which indicated a normal distribution of data, and the results of the normality test on the NOSE score also showed similar results (p>0.05).

Homogeneity data test

The results of the homogeneity test using the Levene statistic test are shown in Table 4. The homogeneity test shows the value of p = 0.463 which means that the variation of the data is homogeneous. This homogeneity test aims to determine the type of post-hoc test that will be used later.

Comparability test of NSD type with NOSE score

A comparability test was conducted to compare the NOSE score between groups based on the type of NSD. In the previous normality test, it was found that the data were normally distributed so that the comparison test for each group use One Way ANOVA with post hoc in the form of Bonferoni because the results of the previous homogeneity showed a homogeneous data distribution. The results of the average comparison test are presented in Table 5. The results of the comparison test between the type of septum deviation and the NOSE score obtained p value = 0.001, which indicates that there is a statistically significant difference between the groups. Therefore, it is necessary to continue with post-hoc analysis to find out the differences and similarities of each group.

The following are the analysis results of the post-hoc bonferoni test to see the mean difference between groups more specifically. Then found a significant difference in NOSE score between groups of deviation types (II-IV), (III-IV), (IV-II, III, IV, V, VII), (V-VI), (V-IV) which are marked with a p <0.05, and a 95% CI value that does not include a zero value. In addition, Table 6 shows the comparison between types of deviation. The comparison results can be known through the mean difference of each interaction between groups.

Comparability test of nasal septum angle with NOSE score

To determine the association between the nasal septum angle and the NOSE score, an unpaired t-test analysis was performed, because the results of the normality test for the NOSE score variable were normal (p>0.05). From the results of homogeneity using Levene's test, it was found that the distribution of the data was homogeneous as seen from the p value> 0.05. The mean difference between groups is 38.5. The results of the t-test showed a significant p-value and a 95% CI value that did not exceed zero (p=0.00; 95% CI= 50,201-26,799). These results indicate that there is a association between mild and severe deviation to the total clinical NOSE score.

Multivariate analysis of independently associated factors with NOSE score

Because the dependent variable used in this study is numerical, the multivariate analysis used is a simple linear regression with the backward method. Besides being able to get rid of confounding variables, multivariate analysis can also see the independence of a variable in its association to certain variables. Based on the analysis carried out, the results showed that only the deviation angle variable was statistically significant (p=0.000), while the deviation type variable showed insignificant results (p>0.05). This indicates that the angle of deviation variable is independently a factor associated with the NOSE score. More specific data are presented in Table 8.

Correlation analysis between the degree of septum deviation angle and NOSE score

A correlation test was performed to assess the association between the NSD angle and the severity of nasal obstruction. The correlation test used is the Pearson correlation test because the data distribution of the two correlated variables is normally distributed. The results of the correlation test will produce a correlation coefficient (r) to show the strength of the association between variables.

Obtained p value = 0.000 (p <0.001) indicates that there is a statistically

Table 6. Post-Hoc Bonferoni data NOSE score.

(I) Type	(J) Type	Mean difference (I-J)	Std. Eror	p	95% CI	
					Lower bound	Upper bound
I	II	-38.690	12.864	0.092	-80.23	2.85
	III	-31.071	10.703	0.122	-65.63	3.49
	IV	8.143	13.539	1.000	-35.58	51.86
	V	-38.690	12.864	0.092	-80.23	2.85
	VI	-33.690	12.864	0.255	-75.23	7.85
	VII	-39.524	12.864	0.077	-81.06	2.01
II	I	38.690	12.864	0.092	-2.85	80.23
	III	7.619	11.282	1.000	-28.81	44.05
	IV	46.833*	14.001	0.036*	1.62	92.04
	V	0.000	13.350	1.000	-43.11	43.11
	VI	5.000	13.350	1.000	-38.11	48.11
	VII	-0.833	13.350	1.000	-43.94	42.27
III	I	31.071	10.703	0.122	-3.49	65.63
	II	-7.619	11.282	1.000	-44.05	28.81
	IV	39.214*	12.046	0.046*	.32	78.11
	V	-7.619	11.282	1.000	-44.05	28.81
	VI	-2.619	11.282	1.000	-39.05	33.81
	VII	-8.452	11.282	1.000	-44.88	27.98
IV	I	-8.143	13.539	1.000	-51.86	35.58
	II	-46.833*	14.001	0.036*	-92.04	-1.62
	III	-39.214*	12.046	0.046*	-78.11	-.32
	V	-46.833*	14.001	0.036*	-92.04	-1.62
	VI	-41.833	14.001	0.097	-87.04	3.38
	VII	-47.667*	14.001	0.030*	-92.88	-2.46
V	I	38.690	12.864	0.092	-2.85	80.23
	II	.000	13.350	1.000	-43.11	43.11
	III	7.619	11.282	1.000	-28.81	44.05
	IV	46.833*	14.001	0.036*	1.62	92.04
	VI	5.000	13.350	1.000	-38.11	48.11
	VII	-0.833	13.350	1.000	-43.94	42.27
VI	I	33.690	12.864	0.255	-7.85	75.23
	II	-5.000	13.350	1.000	-48.11	38.11
	III	2.619	11.282	1.000	-33.81	39.05
	IV	41.833	14.001	0.097	-3.38	87.04
	V	-5.000	13.350	1.000	-48.11	38.11
	VII	-5.833	13.350	1.000	-48.94	37.27
VII	I	39.524	12.864	0.077	-2.01	81.06
	II	0.833	13.350	1.000	-42.27	43.94
	III	8.452	11.282	1.000	-27.98	44.88
	IV	47.667*	14.001	0.030*	2.46	92.88
	V	0.833	13.350	1.000	-42.27	43.94
	VI	5.833	13.350	1.000	-37.27	48.94

(*) Significant p value; I-VII: Nasal septum deviation type; SE = Standar error; CI= Confident interval

significant correlation between the NSD angle and the NOSE score severity of nasal obstruction. The Pearson correlation value of 0.771 indicates a positive correlation with statistical strong correlation strength (0.6 - <0.8). The correlation between the NSD angle and the severity of nasal obstruction can be shown in the form of a graph like Figure 1. It shows that the greater the NSD angle, the higher will be the NOSE score severity of nasal obstruction.

DISCUSSION

Nasal obstruction is one of the most common symptoms encountered in primary care and otorhinolaryngology clinics. Nasal obstruction often becomes the main symptom in upper respiratory tract disorders, such as allergic rhinitis, rhinosinusitis, non allergic rhinitis, and nasal polyps.[8] Nasal congestion can be described as the sensation of a full, or stuffy nose which is also synonymous

Table 7. Comparison between NSD angle and NOSE score.

	Levene's Test For Equaity Of Variances			T-Test non paired			95% CI	
	Mean±SD	F	p	Mean difference	p	SE	Upper bound	Lower bound
Mild Deviation	30±17.69	2.376	0.13	-38.500	0.00*	5.82	-50.201	-26.799
Severe Deviation	68.5±21.62							

(*) Significant p value; SE = Standar error; CI= Confident interval; SD= Standar deviation

Table 8. Linear regression analysis.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	SE	Beta		
Constanta	-8.500	9.738		-.873	0.387
Angle deviation	38.500	5.820	0.691	6.616	0.000*

NB: (*) Significant p value; SE = Standar error

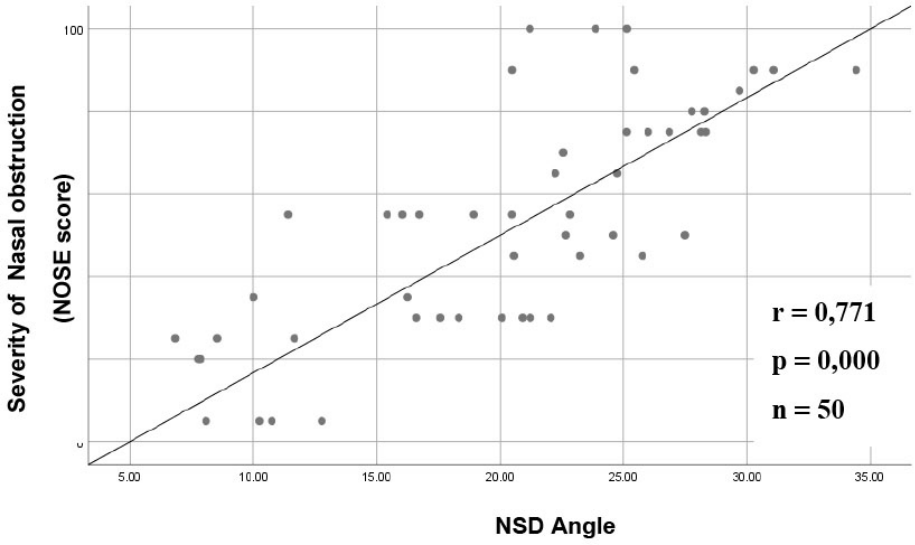

Figure 1. Scatter plot correlation of NSD angle and severity of obstruction.

with obstruction. However, obstruction usually refers to a permanent blockage, therefore the doctor needs to perform a detailed history and physical examination to distinguish the underlying etiology due to persistent anatomic abnormalities or due to other curable factors such as allergies, infections, or upper respiratory tract malignancies.[6] Nasal obstruction due to infection or allergy involves several mechanisms including mucosal inflammation due to inflammatory and neurogenic mediators that contribute to plasma exudation and vasodilation. This will result in edema and swelling of the nasal mucosa leading to venous engorgement, increased nasal secretions, and tissue edema.[8] In addition, there are anatomical problems that affect the structure of the nasal passages, such as turbinate hypertrophy and septum deformity.[6]

Septum deformity such as nasal septum deviation is one of the most common causes of nasal obstruction, in addition to mucosal abnormalities. This process involves the septum bone, cartilage, or both. Variations in the size of the nasal cavity due to this deviation will cause a difference in total nasal resistance so that patients often feel the presence of nasal obstruction regularly. The nasal cavity segment that is narrowed due to deviation will also easily collapse during inspiration.[9] Septum deviation can gradually affect the growth of the nasal bone, facial morphology, and collapse of the nasal valve. Trauma from birth or microfractures can also cause a deviated nasal septum. However, this is contrary to the findings of Verhoeven and Schmelzer, who showed that from 196 patients who had nasal obstruction during the last month, there was no association between nasal septum deviation and nasal obstruction. This statement is also supported by the characteristics of the sample which found in 7.4% of cases had complaints of moderate to severe degree of nasal obstruction (VAS>4) although no septum deviation was found.[10] Demographically, this study showed that the majority of patients with a deviated nasal septum at Sanglah General Hospital were male. The results of this study are in line with several previous studies such as research by Mladina et al., Rao et al., and Wee et al.[4,11,12] which shows that the majority of patients with nasal septum deviation are male. However, the results of this study are slightly different from those of Janovic et al. who found that the majority of septum deviation patients were female (60.4%). However, these findings based on gender did not show a significant difference with the patient's obstructive symptoms.[7]

The type and angle of the deviated nasal septum is a predisposing factor for the patient's nasal obstruction. This study found that the most common type of septum deviation was type III and type I. The results of this study were in line with the research of Mladina et al who found that type III was the most common type of nasal septum deviation found in the world, amounting to 20.4% of all patients with nasal septum deviation, followed by type II (16.4%) and type I (16.2%).[4] But another study by Janovic et al. in Serbia found a slightly different thing, where out of 225 patients with the deviated nasal septum, the most common type found was type VII (34.2%), type V (26.2%), and type III (23.6%). However, global research shows that type I is the most common type of nasal septum deviation found in Asian populations including Korea, Saudi Arabia, and India.[7]

The finding of prevalence difference of the NSD type obtained in this study and several previous studies could be caused by the variability of the procedure in the examination of nasal septum deviation. Some simple procedures such as anterior rhinoscopy and nasoendoscopy are two procedures that are often used in diagnosing nasal septum deviation. However, this procedure has some limitation such as limited visualization of the posterior segment of the nasal septum so that some deviations may be missed on examination. In addition, this procedure also cannot measure the NSD angle accurately. Examination procedure with CT scan provide more comprehensive results even though they are not used routinely for examination of nasal septum deviation. This procedure is superior to anterior rhinoscopy and endoscopy because it can provide visualization of the entire septum in 3 dimensions, and allows a more precise examination of the morphology of the septum to minimize errors in determining the NSD type.[7] One study showed that septum deviation evaluated using maxillofacial computed tomography (CT) showed significant differences between sexes for all parameters except NSD angle (p = 0,660).[13]

The results of the bivariate analysis in this study found significant results between the type of NSD and the severity of nasal obstruction which was calculated based on the NOSE score. The results of this study are in line with several previous studies. The research of Janovic et al. found that patients with type II nasal septum deviation had the worst NOSE scores among the other types. In addition, this study also found that patients with type VII NSD had a lower NOSE score which was in line with several other studies.[7] Based on several previous studies, deviation in the nasal valve area plays an important role in the severity of patient's obstruction symptom. This is related to the airflow resistance mechanism in patient with nasal septum deviation. Disturbance in the nasal valve area causes constriction in the valve area which increases airflow resistance. When this condition is combined with the narrowing in the middle area of the nasal cavity which is commonly found in type VII, the severity of the nasal cavity obstruction can be even more severe. In addition, changes in valve area in type I nasal septum deviation also cause more severe symptoms of nasal obstruction.[7] Furthermore, type V NSD can also increase the severity of nasal obstruction due to the presence of a bony spur which causes turbulence of airflow behind the bony spur, causing airflow obstruction and air distribution velocity disturbance in the nasal cavity which leads to symptoms of nasal obstruction.[12,14,15]

The study by Gerecci et.al. evaluated the severity of nasal obstruction by the Nasal Obstruction Symptom Evaluation (NOSE) in a prospective design in 49 people with a follow-up period of more than 10 months. The results of the analysis showed that there was a significant association between deviated nasal septum angle and severity of nasal obstruction ($p<0.001$).[16] We found similar results in our study to Gerecci's study. The results of bivariate (p=0.00) and multivariate (p=0.00; SE=5.82; Beta=0.691) analysis showed a significant association between deviated nasal septum angle and the severity of obstruction. The results of the correlation analysis also showed a significantly strong association (r=0.771).

The limitation of this study is that it only discusses two factors that can cause nasal obstruction, which are the NSD angle and type. There are several causes of nasal septum deviation that have not been evaluated such as congenital abnormalities, trauma, infection, or malignancy which can also affect the NOSE score in nasal obstruction. Therefore, it is necessary to carry out further research as a consideration in determining the association between nasal septum deviation and the severity of nasal obstruction.

CONCLUSIONS

The most common type of nasal septum deviation experienced by the patient was type III with the most dominant severity of obstruction is moderate. There is a significant association between the type and angle of nasal septum deviation with the severity of nasal obstruction based on bivariate analysis. The independent factor that affects the severity of nasal obstruction is the deviated nasal septum angle. There is a strong positive correlation between the angle of the deviated nasal septum with the severity of nasal obstruction.

REFERENCES

1. Ballenger JJ. Anatomy and Physiology of the Nose and Paranasal Sinuses. In: Ballenger's Otorhinolaryngology Head and Neck Surgery. 6th ed. Hamilton: BC Decker Inc; 2003. p.547-60.
2. Jin HR, Lee JY, Jung WJ. New Description Method and Classification System for Septum Deviation. Original article J Rhinol. 2007; 14 (1): 27-31.
3. Aziz T, Vincent LB, Ansari K, Flores CM. Measurement Tools for Diagnostic and Management of Nasal Septum Deviation: A Systematic Review. Journal of Otorhinolaryngology Head and Neck. 2011; 43 (11): 2-9.
4. 9Mladina R, Cujic E, Subaric M, Et Al. Nasal Septum Deformities in Ear Nose and Throat Patients. An International Study. Am J Otol. 2008; 29(2): 75–82.
5. 4Camacho M, Zaghi S, Certal V, Abdullatif J, Modi R, Sridhara S, Tolisano A, Chang ET, Cable BB, Capasso R. Predictors of Nasal Obstruction: Quantification and Assessment Using Multiple Grading Scales. Plastic Surgery International. 2016; 1-9.
6. 6Stewart, Michael, B. J. Ferguson, and Len Fromer. 2010. "Epidemiology and Burden of Nasal Congestion." *International Journal of General Medicine* 3: 37–45.
7. 12Janovic, Natasa, Aleksa Janovic, Biljana Milicic, and Marija Djuric. 2020. "Association between Nasal Septum Morphology and Nasal Obstruction Symptom Severity: Computed Tomography Study." *Brazilian Journal of Otorhinolaryngology* (xx).
8. 5Naclerio, Robert M., Claus Bachert, and James N. Baraniuk. 2010. "Pathophysiology of Nasal Congestion." *International Journal of General Medicine* 3: 47–57.
9. 7Verhoeven, Sarah, and Bert Schmelzer. 2016. "Type and Severity of Septal Deviation Are Not Related with the Degree of Subjective Nasal Obstruction *." 2013(4): 355–60.
10. 8Budiman, Bestari J, and Ade Asyari. 2012. "Tinjauan Pustaka Pengukuran Sumbatan Hidung Pada Deviasi Septum Nasi." 1(1): 16–21.
11. 10Rao, J. Janardhan et al. 2005. "Classification of Nasal Septal Deviations - Relation to Sinonasal Pathology." *Indian Journal of Otolaryngology and Head and Neck Surgery* 57(3): 199–201.
12. 11Wee, Jee Hye et al. 2012. "Classification and Prevalence of Nasal Septum Deformity in Koreans According to Two Classification Systems." *Acta Oto-Laryngologica* 132(SUPPL. 1): 52–57.

13. 13Serifoglu, Ismail et al. 2017. "Association between the Degree and Direction of Nasal Septum Deviation and Nasal Bone Morphology." *Head & face medicine* 13(1): 3.
14. 14Liu, Ting et al. 2012. "Effects of Septum Deviation on the Airflow Characteristics: Using Computational Fluid Dynamics Models." *Acta Oto-Laryngologica* 132(3): 290–98.
15. 15Simmen, Daniel, José L. Scherrer, Kris Moe, and Benjamin Heinz. 1999. "A Dynamic and Direct Visualization Model for the Study of Nasal Airflow." *Archives of Otolaryngology - Head and Neck Surgery* 125(9): 1015–21.
16. 16Gerecci, Deniz et al. 2018. "Nasal Obstruction Symptom Evaluation Score Outcomes After Septorhinoplasty." : 1–6.