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Assessment of Nasal Tip Projection and Rotation in Different Types of Malocclusions in Maharashtrian Population: A Photographic Study

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Abstract

Introduction: Nose holds an anatomically strategic position on face which influences the facial aesthetics and soft tissue profile of an individual, making it indispensable to understand the variations in nasal features and influence of different factors on it. Present study aims at assessing nasal tip projection and nasal tip rotation among patients with different sagittal skeletal relations and vertical facial patterns in Maharashtrian population using photographic analysis. **Materials and Methods:** Records of 410 patients with age ranging from 17 to 25 yrs were selected from the institutional archives; to assess the nasal projection and rotation. Data obtained was divided into groups depending on the type of sagittal skeletal relation and vertical facial pattern and subjected to the statistical analyses. **Results:** Nasal tip projection was greater among patients with skeletal Class III malocclusion (mean 0.39) as compared to other malocclusion types, but did not differ significantly (P-value>0.05). Nasal tip rotation was clockwise among patients with skeletal Class III malocclusion and anticlockwise in Class I and Class II malocclusion patients, which was statistically significant (P-value<0.05). Amongst the patients with different vertical facial pattern, no statistically significant result could be obtained for nasal tip projection and rotation. **Conclusion:** The result of the present study gives an insight about the nasal features prevalent among different types of malocclusion, thus assisting the clinician in treatment planning and achieving good facial aesthetics with pleasing soft tissue profile.

Keywords: Malocclusion, Nasal Tip Projection, Nasal Tip Rotation

1. Introduction

In the present era of soft tissue paradigm, the orthodontist deals with achieving ideal soft tissue facial profile and balance proportions of human face[1]. The soft tissue facial features are affected by numerous factors such as race, ethnicity, geographic location, climatic variations, age, sex, type of skeletal malocclusion, etc[2–8]. The soft tissues determine the anatomical boundary for various dental and skeletal changes that can be anticipated while planning of an orthodontic/ortho-surgical treatment[9]. Due to the domination of nose in the middle part of face, it influences perception of the lip and the chin prominence and affects the appearance of an individual[10]. The variations in the nasal morphological features play an important role in determining facial appearance and facial profile

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of the individual. Hence, it is imperative to understand the presence of different nasal morphological features among individuals with different type of malocclusion and recognize their influence on the treatment planning and outcome. In view of this, a study was planned with an aim to assess the nasal morphological features: nasal tip projection & rotation among individuals with different types of malocclusion in sagittal and vertical planes.

2. Materials and Methods

The cross-sectional observational study was formulated and conducted at Department of Orthodontics and Dentofacial Orthopaedics of a tertiary care government teaching institute using pre-treatment records of patients undergoing treatment and also who have completed treatment. After taking necessary ethical clearance, the study sample was selected using the following criteria:

Inclusion criteria: Pre-treatment records (including extra-oral lateral photograph and lateral cephalogram) of patients undergoing orthodontic or completed treatment at the department with age ranging from 17 to 25 years and Maharashtrian ethnicity.

Exclusion criteria: Records of patients with history of trauma to nasal structures, history of nasal surgery, history of orthodontic treatment, syndromic condition that affect the nasal structures such as cleft lip and palate, facial asymmetry, etc were excluded from the study. After application of inclusion and exclusion criteria, 410 patients were selected for the study.

The extra-oral lateral profile photographs of the patient were captured using a Nikon 3700 DSLR camera with standard orthodontic protocol for extra-oral photographic records as instituted by American Board of Orthodontics[11]. The angular and linear measurements were carried out for assessment of nasal tip projection and nasal tip rotation using measuring tools in Adobe Photoshop software version 2018CC (Adobe Inc. for Windows). Nasal tip projection is defined as the antero-posterior distance separating the nasal tip from the facial surface at the level of the alar fold[2]. The nasal tip projection relative to sagittal upper lip[2] was calculated by ratio of AC/BC, where AC is the rectilinear distance between nasal tip and most prominent surface of upper lip and BC is the rectilinear distance between nasal tip and most distal surface of ala of nose (Figure 1(a)). Both the rectilinear distances were measured using measuring tool in Adobe Photoshop software and the ratio was



Figure 1(a). Nasal tip projection relative to sagittal upper lip position - ratio of AC/BC, (AC - Rectilinear distance between nasal tip and most prominent surface of upper lip, BC - Rectilinear distance between nasal tip and most distal surface of ala of nose). (b) Nasal tip rotation using Fitzergerald and Nanda's method (1 - Naso-labial angle, 2 - Upper component/ Nasal component of Naso-labial angle, 3 - Lower component/Labial component of Naso-labial angle) (Angle 2 = angle 1 – angle 3).

calculated using the said formula. Nasal tip rotation was assessed by measuring nasal component of naso-labial angle (angle 2 in Figure 1(b)) as described by Fitzergerald and Nanda[12]. Naso-labial angle, nasal component of naso-labial angle and labial component of naso-labial angle are shown in Figure 1(b) as angle 1, angle 2 and angle 3 respectively. The value of nasal component of naso-labial angle was derived using other two angles, measurable on the photograph. Nasal tip rotation was considered to be clockwise if the value of nasal component of naso-labial angle was less than 16°, anticlockwise if the value was more than 20° and was labelled as no rotation of nasal tip if the value was between 16° to 20°. Pre-treatment lateral cephalograms of the patients were used to determine the ANB angle and mandibular plane angle (FMA) to group the patients with different malocclusion in sagittal and vertical plane.

Patients were grouped as skeletal Class I with ANB of 0° to 4°, skeletal Class II with ANB of more than 4°and skeletal Class III when ANB was less than 0°. Similarly patients were grouped as Normodivergent with FMA of 22° to 25°, Hypodivergent when FMA was less than 22°and Hyperdivergent patients with FMA more than 25°. The nasal tip projection and nasal tip rotation of the study population was assessed among these groups.

In order to overcome the inter examiner repeatability and intra examiner agreement, randomly selected 100 sets of records were reassessed by principal investigator (PA) at interval of one week and also reviewed by a senior orthodontist (SD).

3. Statistical Methods

The data on categorical variables is mentioned as n (% of cases) whereas the data on continuous variables is presented as standard deviation and mean. The Chi-Square test was used to test the statistical comparison of distribution of categorical variables. The independent sample t test was used to test statistical comparison of distribution of means of continuous variables for two groups and Analysis of Variance (ANOVA) was used for more than two groups. The underlying assumption of normality was tested before subjecting the study variables to t test, and ANOVA. If the p-values were less than 0.05, the results were considered to be statistically significant. Two tailed alternatives against each null hypothesis were used to formulate all the hypotheses (hypothesis of no difference). Statistical Package for Social Sciences (SPSS ver 22.0, IBM Corporation, USA) for MS Windows was used for statistical analysis of the complete data.

4. Results

The inter-examiner repeatability and intra examiner agreement did not exhibit any significant difference (kappa value = 0.9).

On evaluation of the study sample, it was observed that the mean nasal tip projection was 0.39 in skeletal Class III malocclusion patients whereas in patients with skeletal Class I and Class II malocclusion, nasal tip projection of 0.35 and 0.38 was observed respectively. However, this data did not differ significantly in the study group (P-value>0.05) (Figure 2, Table 1).

Amongst the group of patients with different skeletal malocclusion in vertical plane, the mean nasal tip projection was found to be 0.39 in normodivergent patient. 0.38 in hyperdivergent patient and 0.35 in hypodivergent patients, but did not differ significantly among the groups studied (P-value>0.05) (Figure 3, Table 2).

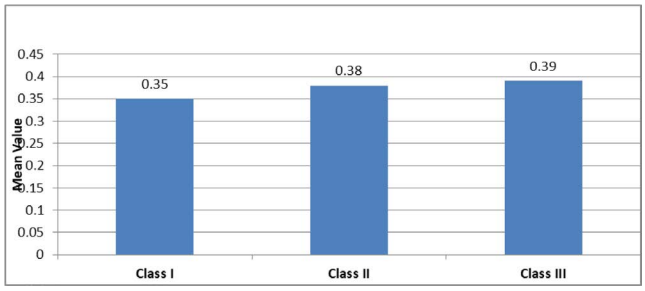


Figure 2. Distribution of mean tip projection according to type of malocclusion in sagittal plane.

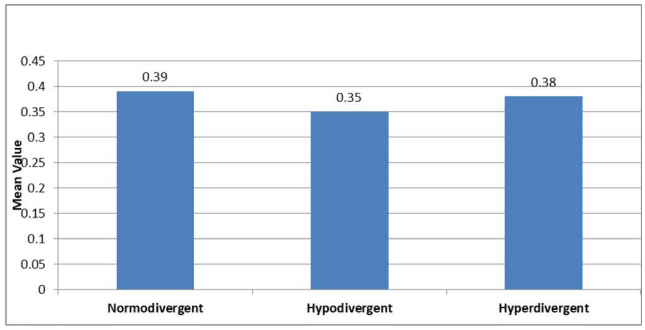


Figure 3. Distribution of mean tip projection according to type of malocclusion in vertical plane.

Table 1. Distribution of mean tip projection and tip rotation according to type of malocclusion in sagittal plane

	Class I (n=115)		Class II (n=245)		Class III (n=50)		P-value
Tip Projection	Mean	SD	Mean	SD	Mean	SD	
	0.35	0.09	0.38	0.08	0.39	0.07	0.404NS
Tip Rotation	Individuals (n)	(%)	n	(%)	n	(%)	
Anti clockwise	45	39.2	35	14.3	10	20.0	0.001***
Clockwise	05	4.3	10	4.1	20	40.0	
No rotation	65	56.5	200	81.6	20	40.0	

P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant.
***P-value<0.001. NS-Statistically non-significant.

On assessing the nasal tip rotation among patients with different malocclusion in sagittal plane, skeletal Class I and Class II malocclusion patients exhibited anticlockwise rotation whereas skeletal Class III patients exhibited clockwise rotation of nasal tip which was statistically significant (P-value<0.001) (Figure 4, Table 1).

Amongst the different groups in vertical plane facial types groups, all three groups (normodivergent, hypodivergent and hyperdivergent) exhibited anticlockwise nasal tip rotation. However, no statistically significant results could be obtained in terms of malocclusion in vertical plane and nasal tip rotation (P-value>0.05) (Figure 5, Table 2).

5. Discussion

Achieving good facial aesthetics and a well-balanced face with pleasing profile is one the important objective of orthodontic treatment planning. The morphological features of the nose are influenced by various genetic and environmental factors and vary with race, ethnicity, geographic location, climatic variations, age, sex, underlying skeletal malocclusion etc; therefore it becomes essential to understand these variations while formulating the treatment plan for an individual. The growth and development of nose has been studied and described by various authors as downward and forward growth with more growth in vertical direction than in sagittal[13]. The longitudinal study to observe the changes in dorsum of nose has confirmed that the changes during adolescent period are result of anticlockwise rotation of upper part of the dorsum and clockwise rotation of lower part of the dorsum of nose[14]. The maxilla-mandibular skeletal relation to the cranial base (both in sagittal and vertical relation) is known to influence the facial features of an individual. The influence of skeletal malocclusion on nasal features has been observed by various authors;

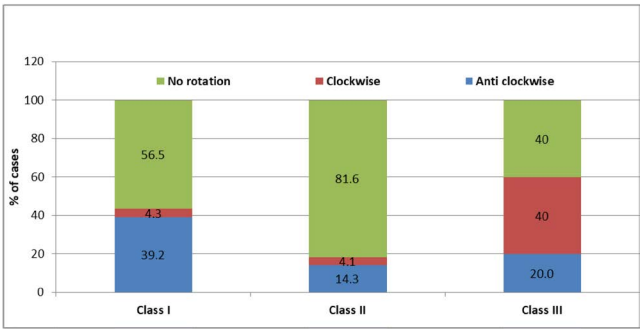


Figure 4. Distribution of tip rotation according to type of malocclusion in sagittal plane.

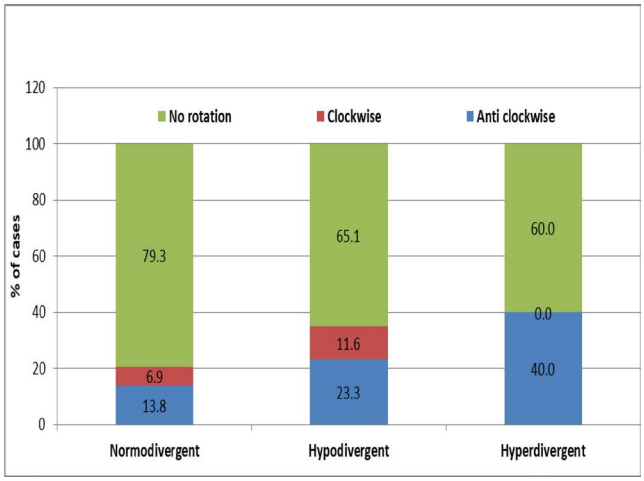


Figure 5. Distribution of tip rotation according to type of malocclusion in vertical plane.

Table 2. Distribution of mean tip projection and tip rotation according to type of malocclusion in vertical plane

	Normodivergent (n=145)		Hypodivergent (n=215)		Hyperdivergent (n=50)		P-value
Tip Projection	Mean	SD	Mean	SD	Mean	SD	
	0.39	0.08	0.35	0.08	0.38	0.08	0.130NS
Tip Rotation	Individuals (n)	(%)	n	(%)	n	(%)	
Anti clockwise	20	13.8	50	23.3	20	40.0	0.346NS
Clockwise	10	6.9	25	11.6	0	0.0	
No rotation	115	79.3	140	65.1	30	60.0	

P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant.
NS-Statistically non-significant.

subjects with Class I malocclusion have been reported with more prominent nasal tip as compared to individuals with Class II malocclusion[15]. In the present study patients with different skeletal malocclusions were observed for prominence and rotation of nasal tip: Skeletal Class III patients were found to be with more nasal projection as compared to other two groups studied and an anticlockwise rotation of the nasal tip was observed among patients with skeletal Class III relation, while it was clockwise rotation among patients with skeletal Class I and Class II malocclusion. Nehra K and Sharma V[10] studied the nasal morphology to establish relationship with vertical maxillary skeletal patterns and concluded that an upturned nose may correlate with counter-clock rotation of the maxilla. In the present study, patients with different vertical facial patterns (different FMA) were studied for their nasal features and it was observed that the nasal tip was more prominent among patients with normodivergent followed by hyperdivergent and least among hypodivergent pattern. Nasal tip rotation was found to be anticlockwise in all three vertical groups studied. The nasal morphological features studied were found to be non-significantly related among the different vertical facial patterns studied. The results of present study are in agreement with previous study by Khare V and Niwlikar KB[16]. The present study highlights the role of underlying sagittal and vertical skeletal malocclusions on the nasal morphological features. Therefore, in clinical setup due consideration need to be given to nasal features while considering the planed incisor position as it will influence the lip prominence and its correlation with nasal prominence will affect the overall facial aesthetics of the individual. Further studies are recommended with a larger sample size and designed for individuals with different racial and ethnical background to obtain more prolific results, which will benefit the clinician in treatment planning and achieving aesthetically pleasing results.

6. Conclusions

The nasal tip projection was found to be more prominent among patients with skeletal Class III malocclusion and normodivergent facial patterns as compared to patients with Class II malocclusion and with hypodivergent facial pattern. The nasal tip rotation was reported to be clockwise among patients with skeletal Class III malocclusion patients whereas all the remaining groups of skeletal malocclusion and vertical facial pattern cases exhibited anticlockwise rotation of nasal tip. Since, the nasal morphological features studied may have a reflection of underlying sagittal skeletal and/or vertical facial pattern, planning for any orthodontic/ortho-surgical procedure which may alter these parameters should be considered carefully.

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