ORIGINAL RESEARCH

Relationship of Nasolabial Angle with Maxillary Incisor Proclination and Upper Lip Thickness in North Indian Population

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Abstract

Aim: The aim of the study was to evaluate the relationship between nasolabial angle (NLA) with maxillary incisor proclination (U1-NA) and upper lip thickness (ULT).

Materials and methods: Pretreatment lateral cephalometric radiographs of 120 patients were taken, and NLA, U1-NA, and basic ULT measurements were obtained for each patient. Descriptive statistics were calculated for all the variables involved in the study. The correlation was found using the Pearson correlation coefficient (r) test. $p < 0.01$ was considered statistically significant.

Results: The mean values of NLA, upper incisor proclination, and ULT were found to be 91.38° ± 7.10°, 34.21° + 5.17°, and 15.38 ± 1.76 mm, respectively. r (r = −0.583) was found between NLA and upper incisor proclination and (r = −0.040) for NLA and ULT.

Conclusion: There is a statistically significant relationship between NLA and U1-NA.

Keywords: Facial esthetics, Maxillary incisor proclination, Nasolabial angle, Upper lip thickness.

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Introduction

Facial esthetics plays an important role in many patients seeking orthodontic treatment.[1] In contemporary orthodontics, soft tissue parameters have taken over hard tissue for comprehensive diagnosis and final treatment planning.[2] Achieving the best esthetic results along with stable and functional occlusion are a part of the soft tissue paradigm.[1]

Nasolabial angle (NLA) is a frequently used soft tissue profile parameter to determine facial harmony.[3] This soft tissue cephalometric landmark indicates the position of the maxillary skeletal bone, the maxillary dentoalveolar area in the anterior region, ULT, and alar base inclination. The NLA is formed between two tangents, one passing below the lower border of the nose and the other passing above the labrale superius (Ls), both intersecting at the subnasale (Sn).[4] Various studies have been conducted to emphasize the role of NLA in facial esthetics.[5–8] The inclination of the maxillary incisors and thickness of the upper lip influence the NLA.[9] The decision for orthodontic treatment planning, like extraction and non-extraction, maxillary advancement, and setback, all depends on the assessment of NLA.[10,11]

Nandini et al.[12] advocated that NLA should be maintained within the normal range to get the best esthetic profile. NLA is influenced by various forces and factors, among which the proclination of incisors and the position of the upper and lower lips play an important role. These factors lead to changes in the resting position of the lips. Altogether affecting the overall smile esthetics.[13]

Several studies have utilized lateral cephalograms to analyze the hard and soft tissue parameters.[12] These studies have highlighted the influence of incisor position over NLA. However, this influence is insignificant and controversial in nature because of the contradicting results in all these studies. In patients with class II division 1 malocclusion, a correlation was found between

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the perioral soft tissue measurements and incisor position.[13] The overlying soft tissue does not drape or follow the underlying bone in a harmonious manner, so the esthetic results cannot be achieved by merely positioning the incisors according to set cephalometric norms. This variation was observed owing to the difference in the thickness of the soft tissue coverage over the bone and teeth.[14] According to Kasai,[15] some soft tissue structures are closely related to the underlying hard tissues, while others are not, so the constant relationship between hard and soft tissue profiles is unpredictable.

Various studies are conducted to calculate the ratio of maxillary incisor retraction to upper lip retraction. Rains and Nanda reported a ratio of 1.6:1, Rudge and Hunt noted 2:1, Hershey et al. noted 3:1, Finnoy et al. reported 2:1 in non-extraction and 3:1 in extraction cases, and Arumugam et al. suggested 3:1. However, the exact relationship between upper lip response and sagittal change of incisor position is still a debatable issue.[16–19]

The present study is aimed to evaluate the relationship of NLA with U1-NA and ULT in the North Indian population.

Inclusion Criteria

This study included patients having Angle's class I malocclusion, with proclined maxillary and mandibular anterior teeth, along with a healthy periodontal condition, whose pretreatment and posttreatment lateral cephalograms were available. Also, it was made sure these patients had previously not undergone orthodontic treatment. For all these patients, fixed appliance therapy was followed after the extraction of all first premolar teeth.

Exclusion Criteria

The study excluded patients having Angle's class II and III malocclusion. Also, those having either retroclined maxillary anterior, short upper lip, upturned nose, poor periodontal conditions, or non-extraction cases with fixed orthodontic treatment were also not included in the study.

MATERIALS AND METHODS

This study involved pretreatment lateral cephalometric radiographs of 120 patients between the age-group of 12–20 years. Steiner's and Holdaway analyses were done, and NLA, U1-NA, and basic ULT measurements were obtained for each patient.

The NLA was formed by drawing a line tangent to the posterior columella of the nose and a line joining the Sn with the Ls (Fig. 1). U1-NA angle was formed between the long axis of the upper incisor and a line drawn from nasion to point A (Fig. 2), and ULT was measured as the linear distance from Ls to the greatest concavity of the incisor (Fig. 3).

Statistical Analysis

The data obtained were subjected to statistical analysis, which was performed using Statistical Package for Social Sciences version 25. A "two-tail t-test" was performed to find the correlation between NLA with U1-NA and ULT. p-values of <0.01 were considered statistically significant.

RESULTS

Lateral cephalograms of 60 males and 60 female patients were analyzed, and descriptive statistics for the variables NLA, upper incisor proclination, and ULT were calculated.

The NLA showed a mean value of 91.38° and a standard deviation (SD) of 7.10°. The mean values of U1-NA were found to be 34.21° with an SD of 5.17°, and for ULT, the mean value was found to be 15.38 mm with an SD of 1.76 mm (Table 1).

The results of r were measured among different variables and depicted in Table 2.

Nasolabial angle (NLA) showed a weak negative correlation (r = −0.583) with the U1-NA angle. The negative correlation means that when U1-NA angle increases, the NLA decreases. However, p-value > 0.01 indicates that there was a statistically significant relationship between NLA and U1-NA.
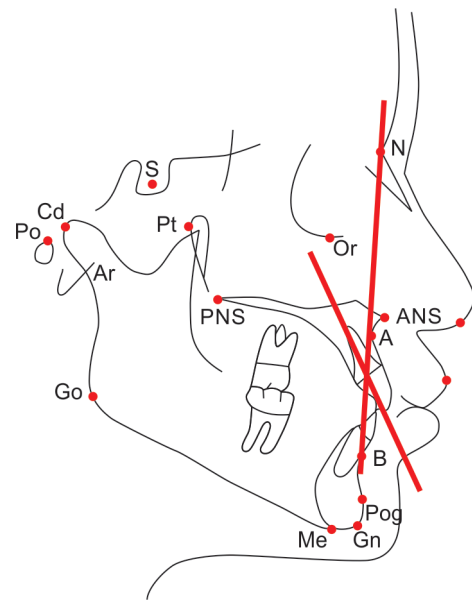

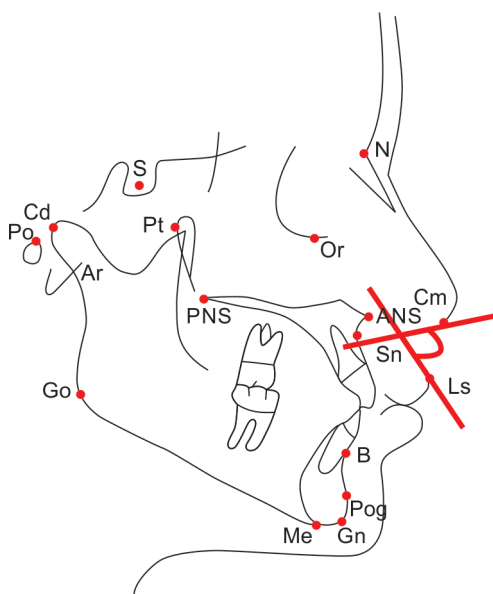Fig. 2: Maxillary incisor proclination
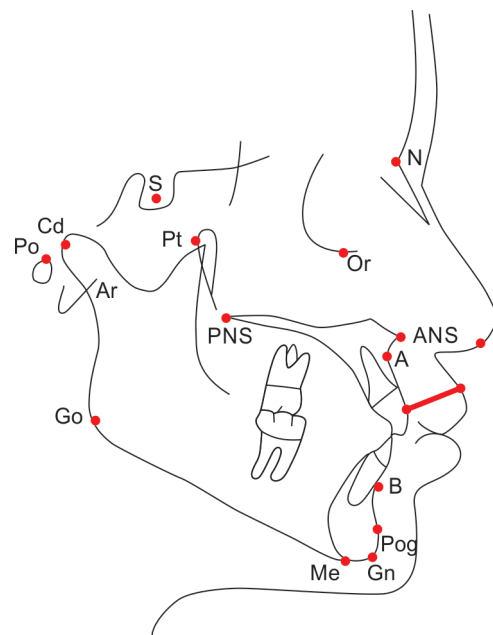

Fig. 1: Nasolabial angle

Fig. 3: Upper lip thickness

Table 1: Descriptive statistics for different variables involved in the study

Descriptive statistics			
	Mean	SD	N
NLA	91.3083	7.10639	120
U1-NA	34.2167	5.17132	120
ULT	15.3833	1.76894	120

Table 2: Correlation of NLA with upper incisor proclination and lip thickness

	NLA	U1-NA	ULT
r	1	−0.583[**]	−0.040
Significance (two-tailed)		0.000	0.668
Sum of squares and cross-products	6009.592	−2550.017	−59.183
Covariance	50.501	−21.429	−0.497
N	120	120	120

**Correlation is significant at the 0.01 level (two-tailed)

Pearson's correlation (r) between NLA and ULT (r = −0.040) was comparatively less significant and negative, meaning when the NLA increases, the ULT decreases. The relationship between NLA and ULT was statistically insignificant, with *p*-value < 0.01.

Discussion

In clinical orthodontics, lateral cephalometry is a valuable tool to evaluate the relationships between various skeletal, dental, and soft tissue components of the craniofacial complex.[4] It is essential to evaluate the soft tissue parameters for diagnosis and treatment planning of patients in orthodontics and dentofacial orthopedics.[12] Growth, as well as orthodontic treatment, results in variable soft tissue changes, which are apparent on the profile view.[20] It is important to keep NLA within accepted norms clinically.[1] The NLA is formed by two components, that is, the upper and lower component, by a true horizontal line intersecting the Sn. So, it is important to analyze these components because any changes in these structures will affect the NLA.[4] This angle is also influenced by the movement of anterior maxillary teeth.[20] Although growth does not change this angle to a significant amount, the amount of retraction of maxillary incisors influences the NLA to a good extent. If there is an increase in mandibular plane angle and lower facial height, the NLA will also increase.[7] According to Burstone,[21] the NLA represents maxillary inclination. If this angle is increased, it suggests maxillary retrusion, while decreased angle suggests maxillary protrusion. Upper lip protrusion is probably due to reduced NLA, while a dished-in profile can be a result of excessive retraction of the upper lip leading to increased NLA.[1,22] Although thick lips provide better support, their response to the amount of incisor retraction is less as compared to thin lips. The profile tends to become flat when treated with extraction, whereas it becomes protrusive in non-extraction cases.[17]

Yogosawa[23] stated that the two factors responsible for lip strain are protrusion of anterior teeth and lower facial height. The changes produced by orthodontic tooth movement on soft tissue profile are distinct and cannot be described or calculated by a formula. So, it is important to assess preoperative relaxed lip posture for the prediction of postorthodontic changes in the facial profile.[15] A proper decision should be made for determining the amount of incisor retraction required to reduce facial convexity and lip procumbency.[17] Thus, analysis of the NLA is an important auxiliary parameter to assist in the differential diagnosis of normal values from its variation.[12]

The mean value of the NLA in this study was 91.38° ± 7.10° and shows reduced when compared to other studies, like Fitzgerald et al., 105.8° ± 9° for men and 110.7° ± 10.9° for women, Scheideman 111.4° ± 11.7° for males and 111.9° ± 8.4° for females, Dua et al. 96.74° ± 10.89° for males and 95.64° ± 8.9° for females, Nandini et al., 98.1° ± 10.75°, and Owen 105° ± 8. The difference in the mean values could be attributed due to the difference in ethnicity of the patients included in the sample and due to the difference in methods to locate the Sn point.[3,12,20,24,25]

In the present study, both the U1-NA angle and ULT were found to have a negative correlation with NLA, while U1-NA shows a significant correlation. However, ULT shows an insignificant correlation with NLA. From the above findings, it was observed that a positive correlation exists between U1-NA and NLA. Therefore, illustrating the vital role played by NLA in soft tissue diagnosis and treatment planning.

Conclusion

- The relationship between NLA and U1-NA was statistically significant.
- The relationship between NLA and ULT was statistically insignificant.
- It is, thus, important to record soft tissue parameters and utilize them during orthodontic diagnosis and treatment planning in order to obtain a harmonious functional and esthetic relationship.
- This study, however, focused only on the correlation between the NLA and ULT using pretreatment cephalograms. Further studies are required to compare the correlation between the pre and posttreatment changes in NLA, upper incisor proclination, and lip thickness.

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