Review of Contemporary Philosophy
ISSN: 1841-5261, e-ISSN: 2471-089X
Vol 22 (1), 2023
Pp 5596 - 5603

# Effect of Nasolabial Angle on Nose Shape and Teeth Shape-An Updated Review

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**Abstract:**

**Background**: Facial aesthetics is influenced significantly by the shape and proportions of the nose. The nasolabial angle (NLA), a key cephalometric parameter, plays a pivotal role in assessing nasal morphology and its correlation with maxillofacial structures. Despite extensive studies, the relationship between nasal features, skeletal classifications, and orthodontic treatment planning remains complex and evolving.

**Aim**: To investigate the relationship between the NLA and its impact on nose and teeth shape, alongside skeletal classifications and orthodontic parameters.

**Methods**: This study analyzed 386 cephalograms of orthodontic patients aged 9–25 years, focusing on nasal and skeletal measurements. Measurements were performed using specialized software and established cephalometric techniques. Statistical tests, including Pearson and Spearman correlations, were applied to evaluate associations, with significance set at $p = 0.05$.

**Results**: Findings highlighted a significant positive correlation between the SFC angle and skeletal parameters such as the Holdaway ratio, ANB angle, and Wits appraisal. A weak negative correlation was observed between the NLA and mandibular inclinations. No significant differences in NLA were noted across skeletal classes, and sex-related differences were minimal. Nasal growth patterns varied, with notable changes during adolescence, yet limited correlation with skeletal classifications.

**Conclusion**: The NLA is a critical parameter in assessing facial aesthetics and planning orthodontic treatment. While nasal morphology is linked to skeletal structures, significant variability exists, influenced by age, sex, and growth patterns. The findings emphasize the need for individualized treatment planning in orthodontics, considering both nasal and skeletal features.

**Keywords**: Nasolabial angle, nasal morphology, skeletal classifications, orthodontic treatment, cephalometric analysis, facial aesthetics.

**Received**: 13 October 2023 **Revised**: 27 November 2023 **Accepted**: 11 December 2023

**Introduction:**

The nose is a central and highly visible feature of the facial profile, significantly influencing overall facial aesthetics and harmony [1,2,3,4,5]. Nasal balance plays a critical role in determining the attractiveness of the face. The nose exhibits considerable variability in size and shape, such as upturned or straight forms, with or without a nasal hump. In terms of facial profiles, the nasal dorsum can be categorized into straight, convex, or concave types [6]. Facial harmony is achieved through the interplay of the nose, lips, and chin. An ideal nasal proportion features a straight nasal dorsum, with the dorsal cartilage and nasal tip cartilage positioned above the nasal tip to create the supratip break. The alar rims are ideally situated 1–2 mm superior to the columella in a lateral perspective [2,4,5,7]. Research highlights that the key distinction between attractive and less attractive facial profiles lies not in the proportion of the nose itself but in the relationship between nasal and craniofacial measurements [5]. Furthermore, the concept of an ideal nose varies among different races, sexes, and ethnicities [1,4]. Typical racial and ethnic variations in nasal morphology pertain to the nostrils' width, protrusion, and the inclination of their longitudinal axis [5].

In cephalometric analysis, the nasolabial angle (NLA) characterizes the nasal shape in the soft tissue profile. It serves as a valuable clinical and cephalometric parameter to assess the anteroposterior maxillary position [1,8]. The NLA comprises two components: the inclination of the upper lip (lower nasolabial angle) and the upward inclination of the nasal tip (upper nasolabial angle) [1,9]. While upper lip inclination is closely correlated with the retraction of upper incisors, the nasal tip inclination shows no such correlation [1,9,10]. Lo and Hunter [9] further dissected the NLA into two contributing angles: (1) the nasal upward tip angle, formed by extending the tangent from the posterior columella point (PCm) to intersect with the Frankfurt horizontal plane, and (2) the upper lip inclination, defined by the angle between the PCm-Ls (labrale superius) line and the Frankfurt horizontal plane [1]. Previous investigations have examined the relationship between the nasal upward tip angle and vertical maxillary skeletal patterns. An upturned nose in adult patients has been associated with an anticlockwise tipping of the maxillary plane [1]. Robinson et al. [6] demonstrated that nasal shape is closely aligned with the underlying skeletal structure, as shown through lateral radiographs. Conversely, Fitzgerald et al. [10] reported no significant correlation between soft tissue and skeletal measurements in individuals with well-balanced profiles.

The morphology of the nose exhibits associations with skeletal classes. Individuals with skeletal Class II commonly present with a pronounced nasal dorsum and greater nasal bone projection [6,11,12,13,14]. Class III profiles are often characterized by a concave nasal dorsum, while Class I individuals typically exhibit a straight dorsum [12]. However, the overall nasal growth appears relatively independent of the underlying skeletal class, as the development of the nose is not directly correlated with skeletal hard tissue patterns [15]. The size, shape, and inclination of the nose play a crucial role in orthodontic treatment planning. For instance, excessive nasal growth in conjunction with tooth extractions could lead to additional lip flattening, resulting in an unbalanced facial profile [14]. Consequently, orthodontic diagnosis and treatment planning must account for nasal evaluation and predict changes in facial aesthetics by considering the cumulative effects of growth, development, and therapeutic interventions [16].

**Case Study:**

A total of 386 cephalograms of orthodontic patients aged 9 to 25 years, were selected from the Department of Radiology at Pomeranian Medical University in Szczecin. The inclusion criteria for the study population included Caucasian ethnicity, an age range of 9–25 years, clear visibility of all cephalometric and nasal structures, a natural head position with teeth in maximum intercuspation and relaxed lips, absence of craniofacial deformities, and no fixed orthodontic braces at the time of imaging. Cephalometric analysis was conducted by the first author using the Segner and Hasund method [17] with specialized software (Ortodoncja 8.0, Ortobajt, Wrocław, Poland). Nasal morphology was assessed based on the approach by Gulsen et al. [4], utilizing acetate paper and a 0.5-mm pencil to delineate landmarks, as presented in **Figure 1.** To ensure the reliability of measurements, cephalometric and nasal analyses were repeated six months later by the same investigator on 100 randomly selected cephalograms. Repeatability was evaluated using the one-sided Wilcoxon test, with clinical significance thresholds set at 5 degrees for angular measurements and 2 mm for linear measurements. Statistical analyses were performed using R software, version 4.0.3 [18]. The Shapiro–Wilk test was employed to assess the normality of data distribution. Statistical significance was set at p = 0.05. Quantitative variables between groups were compared using the Student t-test for normally distributed data and the Mann–Whitney test otherwise. Correlations were determined using Pearson's correlation coefficient for normally distributed data or Spearman's coefficient otherwise, with correlation strength categorized as follows: |r| ≥ 0.9 (very strong), 0.7 ≤ |r| < 0.9 (strong), 0.5 ≤ |r| < 0.7 (moderate), 0.3 ≤ |r| < 0.5 (weak), and |r| < 0.3 (very weak) [19].

Sample size verification demonstrated that a minimum of 11 subjects was sufficient to validate the correlation coefficient of 0.763 between the SFC (Soft Tissue Facial Convexity) angle and the Holdaway ratio (H) angle. For the correlation coefficient of −0.517 between the NMA (Nasomental Angle) angle and the H angle, a sample size of 37 was adequate, while 327 subjects were necessary for the correlation coefficient of 0.247 between the NLA (Nasolabial Angle) angle and the ANB angle. The Wilcoxon one-sided test for repeated measurements revealed no discrepancies exceeding clinical significance thresholds for angular and linear measurements of variables such as the nasal hump, NBA (Nasal Base Angle), NMA, and SFC. Minor discordances were observed, including 1% for the dorsum axis (N'–St) and nasal length (N'–Pr), 2% for nose depth (1) and NBoneA (Nasal Bone Angle), 3% for nose depth (2), and up to 11% for the lower incisor position (1−:NB in mm).

A correlation matrix indicated strong positive correlations between SFC angle and Holdaway ratio (H), sagittal maxilla-mandible angle (ANB), and Wits appraisal. Weak positive correlations with age were noted for parameters such as dorsum axis, nasal length, nose depth (1), and nose depth (2), while nasal bone length (NBoneL) exhibited no age correlation. Weak negative correlations with age were observed for NBA, and very weak negative correlations were noted for NLA, NMA, SFC, and NBoneA. Sex-related differences were statistically significant for certain parameters. Females exhibited smaller NBA and NMA values (p < 0.05). The average NLA in females was 113.32 ± 10.4, compared to 112.64 ± 13.34 in males, with no significant differences identified between the sexes.

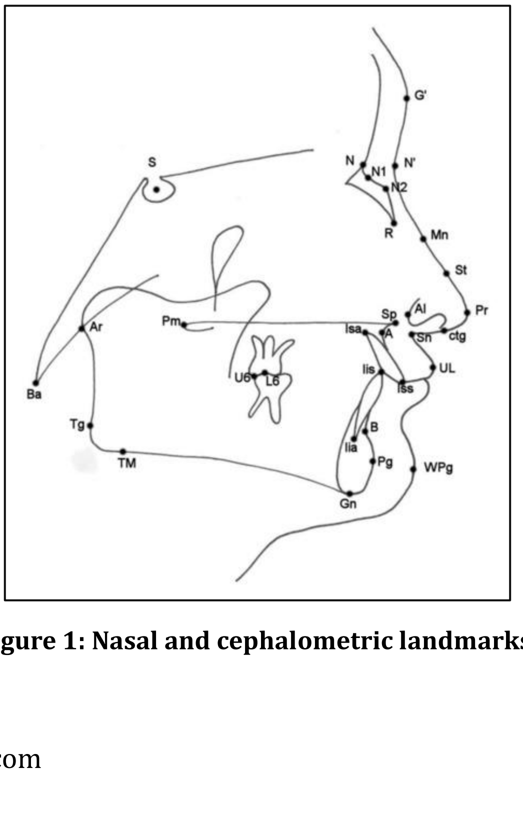


**Figure 1: Nasal and cephalometric landmarks.**

**Data Analysis:**

**Correlations Between Nasal Parameters and Skeletal Structures**

Understanding the relationships between nasal parameters and skeletal structures is critical for orthodontists and maxillofacial surgeons in diagnosis and treatment planning. Key nasal features such as nose depth, nasal length, SFC, NMA, NBA, and the nasal hump influence the size and shape of the nose, while the NLA angle plays a significant role in extraction treatment decisions. The size of the nose is particularly relevant for maxillofacial surgeons as it impacts both occlusion and the facial profile. In the current study, a statistically significant positive correlation was observed between the SFC angle and H, ANB, and Wits, corroborating the findings of Arshad et al. and Gulsen et al. [2, 4], who linked the SFC angle to skeletal classes. Additionally, a weak negative correlation was found between the SFC angle and the SNB angle, aligning with previous research by Gulsen et al. [4]. The minimal negative correlation between nasal bone length and the SNA angle supports the findings by Gulsen et al. [4]. The NMA angle showed a negative correlation with H, ANB, and Wits, consistent with Arshad et al. and Gulsen et al. [2, 4], and was associated with skeletal classes, incisor inclinations, and maxillary and mandibular positions. Gulsen et al. [4] reported a significant relationship between the NMA angle and mandibular and maxillary positions, while Taha and Ahmed [20] identified a higher NMA angle in skeletal Class III compared to Classes I and II.

Contrary to Chaconas [13], this study did not find a significant correlation between the nasal hump and skeletal classes. Chaconas [13] reported that Class II subjects tend to have a more pronounced nasal hump compared to Class I subjects. Furthermore, a positive correlation between the NLA and ANB angles was observed, albeit weak, which aligns with Gulsen et al. [4] but diverges from Arshad et al. [2] and Taha and Ahmed [20]. This discrepancy may stem from variations in study group sizes, ranging from 90 to 386 subjects in the respective studies. No significant differences in NLA angle were found across skeletal classes (Class I, Class II/1, Class II/2, Class III) [21], and a very weak negative correlation was identified between the NLA and SNB angles, consistent with Gulsen et al. [4]. Additionally, the present study confirmed a positive correlation between the NLA and mandibular inclination, a finding also reported by Gulsen et al. [4] in patients with a history of orthodontic treatment. However, this contradicts Nehra and Sharma [1], who observed no significant correlation among Indian adults undergoing orthodontic treatment. Increased NLA has been associated with maxillary retrusion, as noted by Burstone [8], though Gulsen et al. [4] and this study found no correlation between NLA and maxillary position.

**Nasal Growth Patterns**

The nasal dorsum undergoes significant shape changes during adolescence (ages 10–14), with the hump forming due to positional alterations of the nasal bone [11, 22, 23]. The nasal dorsum comprises upper and lower sections, with the lower section's angulation closely linked to vertical growth changes at the nasal tip [11]. While nasal development concludes in females by age 16 and in males by age 18 [1, 3, 12, 22, 23], Meng et al. [3] noted continued nasal growth in males beyond age 18. In contrast, most soft tissue development ceases by ages 12 and 17 for females and males, respectively [15]. The nose contributes to an increase in soft tissue profile convexity with age [12, 13], growing forward and downward during maturation [2, 3, 12, 13, 22, 23, 24]. This growth enhances nasal prominence relative to the facial profile [13, 14, 15, 22, 24, 25, 26], with males experiencing a greater increase in nasal depth than females [3, 12]. Post age 14, the nasal tip's forward growth diminishes relative to the nasal bone, leading to nasal dorsum straightening or humping [22]. Nasal bone length constitutes approximately 40–45% of the nose's total length [24]. Vertical growth outpaces anteroposterior growth in both sexes [24]. During orthodontic therapy, nasal growth occurs even in patients with diminished skeletal growth, potentially intensifying nasal imbalance [14]. Soft tissue facial profiles remain stable during growth, excluding the nose, which markedly increases convexity [12, 15, 23]. This study supports these findings, revealing consistent angular shapes and positional relationships among the nose, lips, and chin throughout development [15].

**Sexual Dimorphism and Ethnic Variability**

This study found that nasal depth and dorsum growth align with Meng et al. [3], who reported significant growth in upper and lower nasal heights between ages 7 and 16, with females showing smaller increases. Buschang et al. [11] reported a 10-degree increase in nasal dorsum between ages 6 and 14, with more pronounced changes in childhood. Nasal length correlated with mandibular length and contributed to soft tissue profile convexity [13, 27]. No statistically significant differences in NLA were found between white men and women, consistent with Fitzgerald et al. [10], Hwang et al. [28], and Bagwan et al. [29]. However, contrary findings were reported by Magnani et al. [30] among Brazilian black youths and by Taha and Ahmed [20] among Iraqi adults. Sexual dimorphism in the NMA angle was inconsistent with findings by Taha and Ahmed [20], Hwang et al. [28], and others, potentially due to variations in group sizes and demographics. Ethnic variability is evident, with smaller NLA angles in Brazilian subjects of color and similar angular measurements between sexes among black individuals [10, 30]. Significant sex differences in nasal length, depth, and hump were observed, aligning with Aljabaa [32] on Saudi subjects but contrasting with Gulsen et al. [4] and Kumar et al. [27], who found no such differences. SFC angle differences confirm Gulsen et al. [4] but contradict Arshad et al. [2]. These variations highlight the importance of considering demographic and ethnic diversity in nasal parameter analyses.

**Effect of Nasolabial Angle with Teeth Shape:**

The nasolabial angle (NLA) plays a critical role in the evaluation of facial aesthetics and dental structures, particularly in the relationship between the upper lip, columella, and the maxillary anterior teeth. This angle, which is formed by the intersection of the lines drawn from the columella to the subnasale and the subnasale to the philtrum, reflects not only the nasal profile but also the alignment and inclination of the anterior teeth. Variations in the NLA are influenced by multiple factors, including tooth morphology, dental occlusion, lip thickness, and underlying skeletal structures [33].

In dental and orthodontic treatment planning, the interaction between the NLA and teeth shape is crucial for achieving optimal facial harmony. Specifically, the morphology of the maxillary central incisors, which significantly contribute to dental esthetics, can influence the inclination and prominence of the upper lip, thereby altering the NLA. Studies have demonstrated that an increased proclination of the maxillary incisors tends to reduce the NLA, leading to a more convex profile. Conversely, retrusion of these teeth increases the NLA, producing a straighter profile. These findings underline the importance of considering tooth shape and positioning during orthodontic interventions, particularly in cases involving extraction or anterior tooth retraction. The relationship between the NLA and teeth shape is particularly significant in the context of dental esthetics. The shape and size of maxillary incisors are highly variable and are influenced by genetic, developmental, and environmental factors. For instance, long, narrow incisors are often associated with a reduced upper lip support, which can lead to an increased NLA. On the other hand, short, wide incisors provide greater support to the upper lip, potentially reducing the NLA. These variations highlight the need for individualized treatment planning that accounts for the unique dental and facial characteristics of each patient.

Orthodontic procedures such as retraction or advancement of the maxillary incisors directly influence the NLA. When incisors are retracted during orthodontic treatment, the upper lip often moves posteriorly, increasing the NLA. This change is more pronounced in patients with prominent incisors and a convex facial profile. By contrast, advancing the incisors tends to push the upper lip forward, reducing the NLA. These alterations are particularly relevant in patients undergoing treatment for Class II malocclusions or those requiring anterior tooth alignment to correct facial convexity. Furthermore, tooth shape plays a significant role in determining the soft tissue response to orthodontic and prosthodontic treatments. Patients with triangular or tapered incisors often exhibit less lip support compared to those with square or rectangular-shaped teeth. The reduced lip support in individuals with tapered teeth can result in a more obtuse NLA, particularly in cases of maxillary retrusion. In contrast, square-shaped teeth offer greater lip support, which can lead to a more acute NLA. These variations underscore the necessity for clinicians to carefully assess tooth morphology and its impact on the facial profile when planning treatment [33].

The restorative management of missing or malformed maxillary incisors also affects the NLA. Prosthodontic interventions, such as crowns, veneers, or dental implants, can be utilized to modify the shape, size, and alignment of the anterior teeth. These modifications, in turn, influence the upper lip contour and the NLA. For example, restoring the length and contour of the incisors in edentulous or partially edentulous patients can improve lip support and create a more aesthetically pleasing NLA. Prosthodontists must, therefore, consider the interplay between teeth shape and the nasolabial region when designing restorations to ensure functional and aesthetic harmony. The impact of the NLA on teeth shape is also evident in orthognathic surgery. Surgical procedures aimed at correcting maxillary or mandibular discrepancies, such as Le Fort I osteotomy, alter the position of the anterior teeth and the upper lip, thereby influencing the NLA. For instance, maxillary advancement surgeries often result in a decreased NLA due to forward movement of the upper lip. Conversely, maxillary setback procedures increase the NLA. These changes highlight the need for precise pre-surgical planning and simulation to predict the aesthetic outcomes of such interventions [33].

Cultural and ethnic variations also play a role in the relationship between the NLA and teeth shape. Different populations exhibit distinct norms for the NLA and associated dental characteristics, which must be considered during treatment planning. For example, individuals of European descent typically exhibit larger NLAs compared to Asian or African populations. These differences are attributed to variations in nasal morphology, lip thickness, and dental alignment. Recognizing these ethnic variations allows clinicians to tailor treatment plans to meet the aesthetic and functional expectations of patients from diverse backgrounds. In conclusion, the nasolabial angle is a critical parameter in evaluating facial aesthetics and dental relationships, particularly with respect to teeth shape. The interplay between the NLA and anterior tooth morphology significantly impacts orthodontic, prosthodontic, and surgical treatment outcomes. Variations in tooth shape, lip support, and skeletal structures influence the NLA, highlighting the need for individualized and comprehensive treatment planning. By considering the intricate relationship between the NLA and teeth shape, clinicians can achieve superior functional and aesthetic results, enhancing both facial harmony and patient satisfaction.

**Conclusion:**

The nasolabial angle (NLA) emerges as a vital determinant in understanding the interplay between nasal morphology, skeletal structures, and orthodontic treatment outcomes. This review underscores the nuanced relationship between the NLA, nose shape, and teeth alignment, providing insights crucial for orthodontists and maxillofacial surgeons in diagnosis and treatment planning. The study's findings reaffirm the role of the NLA as a reliable cephalometric parameter. Positive correlations between the SFC angle and skeletal measurements like the Holdaway ratio, ANB angle, and Wits appraisal highlight its significance in evaluating skeletal harmony. Conversely, the weak negative association between the NLA and mandibular inclination suggests a limited but noteworthy role in defining lower facial aesthetics. Importantly, the absence of significant differences in NLA across skeletal classifications emphasizes that nasal growth and morphology are relatively independent of underlying skeletal patterns. Adolescence marks a critical phase in nasal development, with substantial transformations in the nasal dorsum due to positional shifts in the nasal bone. The findings highlight gender-specific growth patterns, with females typically reaching developmental milestones earlier than males. These variations necessitate a gender-sensitive approach in orthodontic assessments. Clinically, the results provide a framework for integrating nasal and skeletal evaluations into orthodontic planning. For instance, recognizing the potential effects of excessive nasal growth and tooth extractions on lip aesthetics can guide treatment decisions. Furthermore, the study underscores the need to account for individual variability in facial proportions, influenced by genetic, racial, and developmental factors. In conclusion, the NLA serves as a critical bridge between aesthetic and functional considerations in orthodontics. Future research should focus on longitudinal studies and advanced imaging techniques to further unravel the complexities of nasal and skeletal interrelations, ensuring more precise and personalized treatment outcomes.

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**تأثير الزاوية الأنفية الشفوية على شكل الأنف والأسنان – مراجعة محدثة**

**الملخص:**

**الخلفية :**تؤثر جماليات الوجه بشكل كبير على شكل وتناسب الأنف. تلعب الزاوية الأنفية الشفوية(NLA) ، كأحد المعايير السيفالومترية الرئيسية، دورًا محوريًا في تقييم مورفولوجيا الأنف وعلاقتها مع الهياكل الوجهية الفكية. وعلى الرغم من الدراسات المكثفة، فإن العلاقة بين ميزات الأنف والتصنيفات الهيكلية وتخطيط علاج تقويم الأسنان لا تزال معقدة ومتطورة.

**الهدف :**التحقيق في العلاقة بين الزاوية الأنفية الشفوية وتأثيرها على شكل الأنف والأسنان، بالإضافة إلى التصنيفات الهيكلية ومعايير تقويم الأسنان.

**الطرق :**شملت هذه الدراسة تحليل 386 صورة سيفالومترية لمرضى تقويم الأسنان تتراوح أعمارهم بين 9-25 عامًا، مع التركيز على قياسات الأنف والهيكل العظمي. تم إجراء القياسات باستخدام برامج متخصصة وتقنيات سيفالومترية معروفة. تم تطبيق اختبارات إحصائية، بما في ذلك ارتباط بيرسون وسبيرمان، لتقييم العلاقات، مع تحديد مستوى الدلالة عند.$p = 0.05$

**النتائج :**أبرزت النتائج وجود علاقة ارتباط إيجابية ذات دلالة إحصائية بين زاوية SFC والمعايير الهيكلية مثل نسبة هولداواي وزاوية ANB وتقييم ويتس. لوحظ ارتباط سلبي ضعيف بين الزاوية الأنفية الشفوية وميلان الفك السفلي. لم تُلاحظ فروق ذات دلالة إحصائية في الزاوية الأنفية الشفوية عبر الفئات الهيكلية، وكانت الفروقات بين الجنسين طفيفة. اختلفت أنماط نمو الأنف مع تغييرات ملحوظة خلال فترة المراهقة، ولكنها أظهرت ارتباطًا محدودًا مع التصنيفات الهيكلية.

**الخاتمة :**تعد الزاوية الأنفية الشفوية معيارًا حاسمًا في تقييم جماليات الوجه وتخطيط علاج تقويم الأسنان. وعلى الرغم من ارتباط مورفولوجيا الأنف بالهياكل الهيكلية، توجد تباينات كبيرة تتأثر بالعمر والجنس وأنماط النمو. تؤكد النتائج على أهمية تخطيط العلاج الفردي في تقويم الأسنان، مع مراعاة ميزات الأنف والهيكل العظمي.

**الكلمات المفتاحية :**الزاوية الأنفية الشفوية، مورفولوجيا الأنف، التصنيفات الهيكلية، علاج تقويم الأسنان، تحليل سيفالومتري، جماليات الوجه.