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PERCEPTTON OF EFFECT OF NASOLABIAL ANGLE ALETRATION ON FACIAL ATTRACTIVENESS COMPARING FEMALE PROFILE MODIFICATIONS OF CLASS II DIV I MALOCCLUSION

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Abstract

Class II maloclussion is the most prevalent in orthodontic patients. During camolflauge treatment of this maloclussionnasolabial angel increases inevitably for which a threshold value needs to be defined. **Objective:** The objective of this study was to calculate the mean score for the modified profile of a woman of class II div 1, by digitally simulating a rise in nasolabial angle from the initial image. **Methods:** This cross-sectional study was undertaken at Puniab Dental Hospital/de' Montmorency College of Dentistry from July 15 to December 01, 2024. A profile picture and lateral cephalometric radiograph of a female with an untreated skeletal Class 2 Division I relationship, a normal mandibular plane angle and normal face height were used. The NLA of the subject's profile image was adjusted to 104.9±4º using Adobe Photoshop CS2. The base image was then digitally changed to produce additional profile photographs, imitating increase in nasolabial

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angle by 2.0, 4.0, and 6.0 standard deviations (corresponding images called C, B, and A in the questionnaire). **Results:** The mean age of lay persons was 29.14±5.41 years, minimum age was 18 and maximum age was 41 years. The gender of 90(58.1%) were males and 65(41.9%) were females. Mean attractiveness of facial profile was evaluated by calculating mean attractiveness as the lay people rank the images from 1 to 5. Mean attractiveness score was 4.74±0.44 for image B followed by 4.54±0.50 for image A, 4.37±0.50 for image C and 3.27±0.45 for base image. **Conclusions:** According to the study, both the nontreated and profile with biggest nasolabial angle (NLA) had the least pleasing appearance. To achieve an aesthetic profile at the end of treatment while treating a class II DIV 1 patient the nasolabial angle should not exceed 121°.

Keywords: Attractiveness score, Nasolabial angle, Base image, class II div 1, Malocclusion.

Introduction

Facial attractiveness plays a fundamental role in social interactions, shaping perceptions of competence, trustworthiness, and overall appeal. It is a key determinant in personal and professional relationships, influencing both self-esteem and societal impressions. Among the various parameters that define facial aesthetics, the harmony and proportional balance between different facial components are particularly critical in orthodontic diagnosis and treatment planning.In any social exchange, facial beauty is important as it establishes the perception around personal effectiveness, dependability, and general appeal. It is critical in personal dealings and professional engagements as it contributes to self-worth, as well as societal perceptions. One of the many aspects that constitute beauty is the symmetrical and proportional features of the face, which is very important for orthodontic diagnosis and treatment. The Nasolabial Angle (NLA) is one of those features which has significant effect on attractiveness of the facial profile. Variation of the angle, whether due to some anatomical configuration or orthodontic changes, can greatly affect the appreciation of facial beauty. Sufian et al. (2024) emphasize that meticulous calculation of this angle is very critical to orthodontic practice. Other clinical studies further stress the necessity of having the right angle NLA during orthodontic therapy in order to advance aesthetic (Ghazal et al., 2024) and global patient acceptance.

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For patients who have Class II Division I malocclusion, orthodontic camouflage treatment typically requires the retraction of upper incisors, which does result in an increase in the NLA. So, it is important to know the level of increase that is beyond aesthetically pleasant. This is important so that the treatment outcome remains favorable. There is evidence to suggest that a change in facial profile does affect the attractiveness scores which encourages observers to prefer more balanced changes as opposed to extreme NLA changes (Tarafder et al., 2024). This highlights the need to consider aesthetics while undertaking orthodontic treatment planning. Over-retraction of incisors, for example, leads to unreasonably obtuse NLA, which exacerbates the prominence of the nose in relation to the lips, and causes a poor profile (Noor et al., 2024). Therefore, orthodontists need to ensure that each case is thoroughly analyzed to achieve a compromise between the functional and aesthetic objectives.

This study intends to investigate the effects of nasolabial angle changes using facial profile changes that have been digitally simulated. It is the goal of this research to clinically and expert evaluate Class II Division I profiles and subsequently find the medial and lateral limits of NLA adjustment. These findings thank do further NLA on orthodontic and clinician driven aesthetics by assisting in formulating malocclusion treatment plans and enhancing their functionality alongside convention visual appeal. Along this path, this study will result in understanding how people perceive facial balance and harmony, which would allow many practitioners to achieve the treatment results that they wanted while respecting the rules of orthodontics.

Literature Review

The nasolabial angle (NLA) is one of the most important aspects of assessment and diagnosis as well as treatment of an orthodontics patient's profile. The NLA is formed by the columella of the nose and the upper lip, thus it is an important contributor to the facial attractiveness and beauty. The proportions of this angle certainly have an impact on the attractiveness of the facial profile, and so NLA has to be calculated when evaluating an orthodontic profile. Its precise measurement is critical for evaluating NLA because achieving functional and aesthetic rehabilitation in the orthodontic patient is a very important goal.

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The position of the nose along with the inclination of the upper lip affects the nasolabial angle (NLA). Nandini and colleagues (2011) have also discussed in their work that clinical assessment of these relations suggests achieving optimal NLA involves coordination between nasal projection and the position and inclination of the upper lip. Similarly, it has been noted that incisor retraction can definitely influence the value of NLA, which quite often is greater than what is considered aesthetically pleasing (Sessions, 1987). Such an observation makes sense in the context of treatment because A/U changes in NLA do not lend themselves favorably to facial balance and attractiveness.

The NLA may be ideal for some, but for others including other observers such as orthodontists, general dentists, and laypersons, it can differ in perception. One study analyzing the correlation between facial beauty and NLA has found that normal to moderately increased angle of NLA is the most generally preferred profile (Kamal et al., 2024). This implies that more favorable perception of the NLA is brought out by moderate changes to the NLA, while extreme results can evoke a negative perception. Naini and his colleagues, on the other hand, have explained that the impact of upper lip posture on lip inclination in promoting facial attractiveness can be subtle when considering orthodontic modification aesthetic sensitivity (Naini et al., 2014).

Additionally, several scholars agree that the projection of the nasal tip and the angle of the upper lip are crucial in determining the nasolabial angle (NLA), as well as the need to consider their effect concurrently (Holland et al., 2016). These factors demonstrate the importance for every orthodotist to develop treatment methods that are relevant to the patients in order to ensure aesthetics. Likewise, recent investigations have argued that changes owing to soft tissue after an orthodontic procedure need to be evaluated for success of the procedure, as it participates largely in xacial balance (Fudalej et al., 2018).

In brief, NLA is of utmost importance in orthodontics. Its modification has a great impact on facial features, and so, the treatment of NLA needs to be approached with utmost care. It is paramount to identify all the components involved such as, how the NLA is affected, the projection of the nose, the angle of the lip, and the additional factors that Orthodontics is expected to intervene. Further studies should be conducted on how to achieve a more acceptable NLA for the patients

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without compromising the prerequisites for treatment functions, and the need to promote facial aesthetics.

The Role of Nasolabial Angle in Facial Aesthetics and Orthodontic Treatment Planning

In many contexts, people with attractive profiles receive positive treatment (Ghorbanyjavadpour & Rakhshan, 2019; Yüksel et al., 2017). Facial attractiveness has been linked to an individual's psychosocial well-being and success in a variety of disciplines. Soft tissue contours and the proportional relationship of various face components are the most important factors in determining facial attractiveness. The primary purpose of current orthodontic diagnosis and treatment planning is to enhance facial appearance. Pleasant aesthetics is related to the harmony and balance between the components that comprise the face profile(Torsello, Graci, Grande, & Deli, 2010). In line with an eye tracking study, the center of the gaze is in the middle of the face, near the symmetry plane, therefore the eyes, nose, and lips are the favored focus during the visual perception of the face(Meyer-Marcotty, Stellzig-Eisenhauer, Bareis, Hartmann, & Kochel, 2011).

This implies that the mid-facial region is essential for face perception(Hodgkinson, Firth, & Farella, 2019). When diagnosing and planning orthodontic treatments, is a key soft tissue feature to consider nasolabial. The nasolabial angle (NLA) forms at the union of the lines starting at sub-nasale, to inferior border of nose and the other to upper lip sulcus.(Nandini, Prashanth, Somiah, & Reddy, 2011; Sinno, Markarian, Ibrahim, & Lin, 2014). The inclination of the base of the nose and the prominence of upper lip determine the influence of this angle on the profile. Approximately 90% of an average NLA increase may be attributable to a change in the upper lip inclination angle following upper incisor retraction, and 10% to an increase in the slope along the nose's columella border(Hodgkinson et al., 2019). The stated normal range for the line from inferior nose border to the Frankfort horizontal (FH) plane angle is 18º±7°,that of upper lip to the same is 98º±5º and a nasolabial angle 1l4 ±10°(Kandhasamy et al., 2012; Nandini et al., 2011). When teeth are extracted in camouflage therapy, the incisors are retracted, resulting in an increase in this angle, making the nose more prominent than the lips. Over retraction can result in a depressed upper lip and a flattening of the profile.(Kandhasamy et al., 2012).

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Yuksel et al studied the effect of increasing NLA by simulating the profile image of a class 2 div I female (Yüksel et al., 2017). The laypeople rated the baseline profile, one without treatment having NLA of 104.9° to be most unattractive with a mean score of 3.99±0.18 on visual analogue scale (VAS) then the profile with NLA of 129° mean VAS score 4.68±0.19, profile with NLA l21° considered the upper limit to be aesthetically acceptable with attractiveness score of 4.92±0.17 and the profile with NLA l13° deemed to be the most aesthetic with mean attractiveness score 4.96±0.15. The mean ranking score corresponding to profile with NLA 104.9°, 129°, 121° and ll3° was 2.54, 2.8, 3.46 and 3.41 respectively. Perception based studies of laypeople preferences report the most accepted female NLA to be 104.9° and the most pleasing male NLA to be 97± 6.3°(Armijo, Brown, & Guyuron, 2012; Sinno et al., 2014). One should be cautious, to keep the nasolabial angle within the normal range as an overly obtuse nasolabial angle gives the face an aged look and is considered unaesthetic.

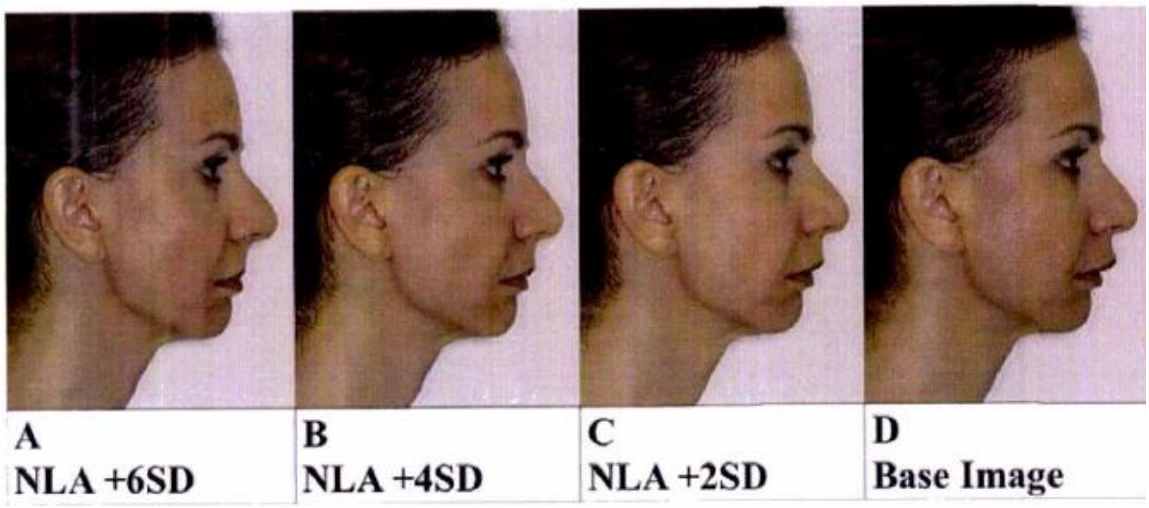

Figure 1: Illustrates profile images D, C, B, A corresponding to the nasolabial angles 104.9º,113º, 121º, and 129º respectively.

Understanding the visually acceptable range of the nasolabial angle is paramount to develop a comprehensive diagnosis and a successful treatment plan. The orthodontic literature has a limited number of research on laypeople's perceptions of an increase in nasolabial angles. No such study has been conducted including the local population. As a result, the objective of this study is the evaluation of mean attractiveness score of profile image modifications of a class II div 1 female

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created digitally by increasing the nasolabial angle in base image subsequently, giving 3 simulated profile images. This will assist us grasp what our population's expectations are so that we can use them when treating class II div I patients. It will aid in determining the cut-off value for an increase in nasolabial angle, as well as the profile that the majority of observers like.

Methodology

This cross-sectional study was conducted in Punjab Dental Hospital/ de' Montmorency College of Dentistry in months from 15 July 2024 to 01 December 2024. Sample size of 155 was calculated with 95% confidence interval, absolute precision 0.03 and mean attractiveness score of 3.99±0.15(Yüksel et al., 2017). Laypeople of both gender, age 18-50 years visiting the out-patient department of Punjab dental hospital with no former orthodontic or maxillofacial surgical treatment, no face deformities, no history of trauma, and not a health care employee were included in the study. The demographic information such as name, age, gender, and phone number were acquired.

People with poor eyesight and unwilling to engage in the study were eliminated. A profile picture and lateral cephalometric radiograph of a female with a non-treated skeletal Class 2 Div I relationship, normal facial height, and normal mandibular plane angle are used. The profile picture and the lateral cephalometric X-ray are uploaded in the software, Adobe Photoshop cS2 (San Jose, California, USA), the NLA of the subject's profile image was changed to 104.9±4 based on Sinno et al.'s norm value. Then that base image was modified digitally to obtain further 3 profile images, to simulate increase of NLA incrementally, by 2.0, 4.0 and 6.0 standard deviations (giving NLA 113, 12l°, 129° respectively) corresponding images named C, B and A in the questionnaire. A questionnaire was given to the participants with grading scale (l being least attractive and 5 being most attractive) and images A, B, C and D printed alongside each other on A4 size photographic paper attached to it. A questionnaire was presented to participants, it was explained to them and they were asked to score the attractiveness of each profile and rank them accordingly without any help. Data was transferred and analyzed in SPSS version 20. Qualitative variables depicted in form of frequency and percentages while quantitative variables as mean± SD. T-test is performed to calculate mean score with a P-value under 0.05 indicating significance.

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Results

To evaluate the socioeconomic status of the sample and its impact on the perception based study both rural and urban population was taken. From 155 persons, residence of 97(62.6%) was urban and 58(37.4%) was rural. As shown in Figure 2.

Likewise, to evaluate the effect of gender 90(58.1%) of assessors were males and 65(41.9%) were females as shown in figure 2. There was negligible difference in the perception of both genders. Majority of the observers allotted highest score to image B (nasolabial angle of 12l°) as described in Table 1.

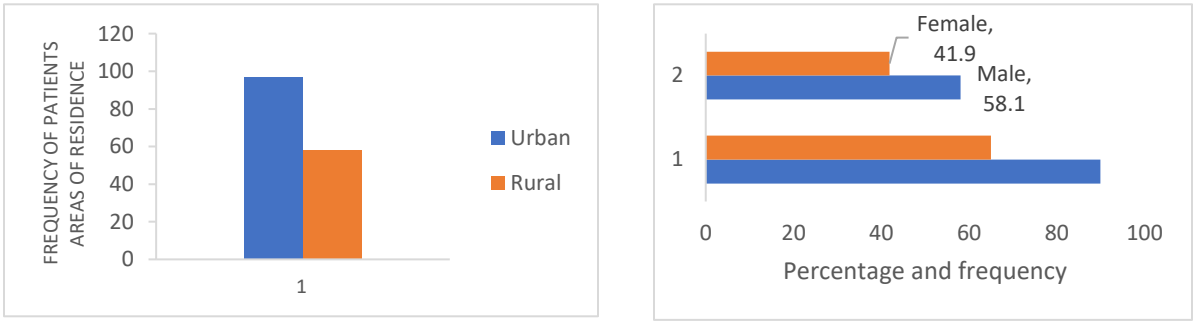

Figure 2. (A) Illustrates the frequency of the rural and urban residents. (B) Illustrates the gender distribution of assessors.

The mean sample age of lay persons is taken to be 29.14±5.41 years, minimum age was 18 and maximum age was 41 years. The classification of education status of 51(32.9%) was middle, 47(30.3%) was matric, 47(30.3%) was intermediate and 10(6.5%) were bachelors and above. Socioeconomic status of most (43.2%) of the persons was low followed by middle (31.6%) and higher (25.2%) class as shown in figure 3.

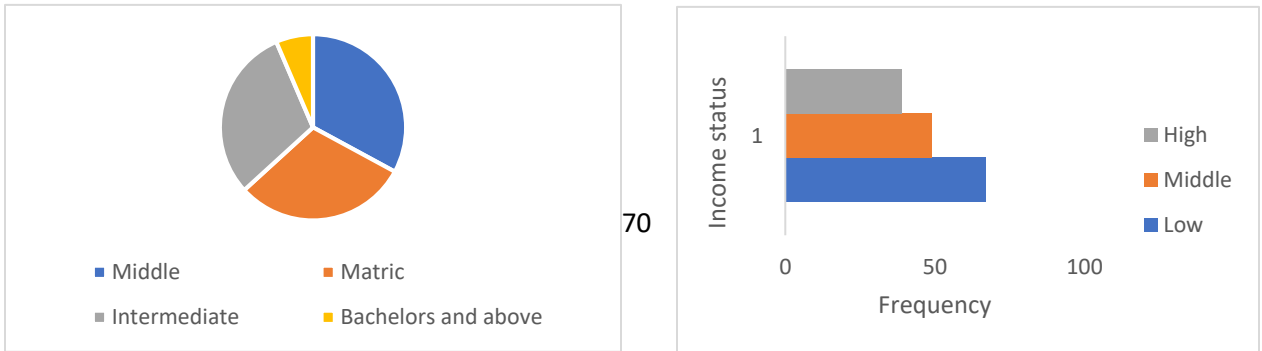

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Figure 3: Illustrates the frequency distribution of education and income status of assessors.

Table 1: Mean Attractiveness Score between lay people for female profile by 't' test

Score	Mean	S. D
Score of Image D (Base)	3.27	0.45
Score of Image C	4.37	0.5
Score of Image B	4.74	0.44
Score of Image A	4.54	0.5

Mean attractiveness of facial profile was evaluated by calculating mean attractiveness as the lay people rank the images from 1 to 5 (Table 1) and shown in Figure.4. Mean attractiveness score was 4.74±0.44 for image B (NLAl21°) followed by 4.54±0.50 for image A (NLAl29°), 4.37±0.50 for image C (113°) and 3.27±0.45 for base image (NLA104.9°). These results showed that layperson considered the base image as aesthetically less attractive.

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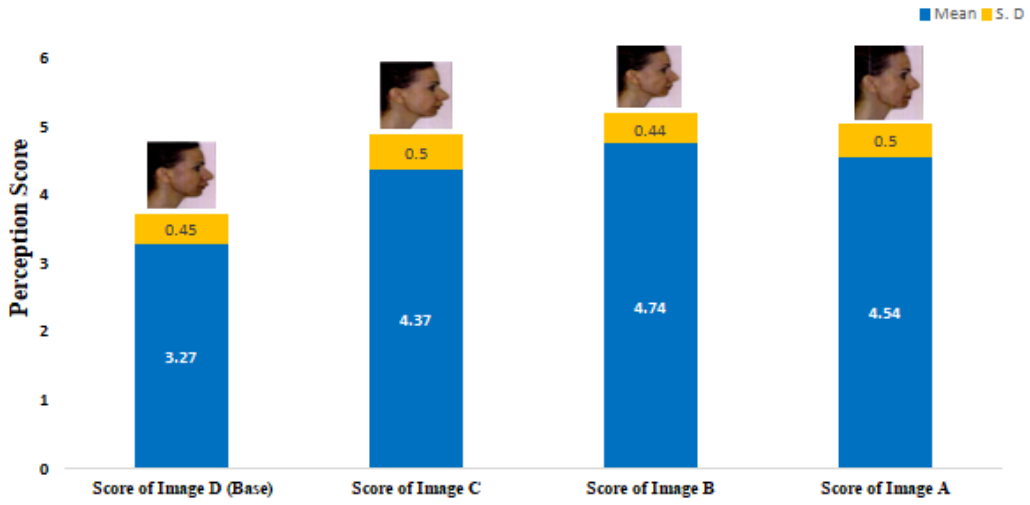

Figure 4: Mean attractiveness score for female profile

Discussion

An appealing facial appearance is linked to improved psychosocial well-being and greater success in numerous areas of life (Toledano, 2013). Unattractive persons are thought to have inferior social skills and be less competent. Unattractiveness lowers a person's self-esteem and self-image (Mortada, Burhan, Hajeer, Nawaya, & Sahtout, 2023). The main motivating factor for people to pursue orthodontic treatment is to enhance facial appearance. The perception of laypeople is significant for orthodontic professionals to devise an effective treatment plan. That is why they were chosen as assessors in this study. Two often used treatments for class 2 div 1, are camouflage and maxillofacial surgery. Surgery is invasive and most people are reluctant to opt for it (Mihalik, Proffit, Phillips, & Orthopedics, 2003; Pinho & Raposo, 2017). Nevertheless, both these approaches lead to better aesthetics than original profile. As proposed by Mishra et al (Mishra, Natarajan, Urala, & Orthopedics, 2020)who inferred post-camouflage profiles equal to those having no malocclusion and pleasing aesthetics. In another study by Ng et al facial aesthetics of Class II patients were assessed pre and post mandibular advancement surgery, using perceptual evaluations from a diverse group of observers (Naini, Donaldson, McDonald, & Cobourne, 2013; Ng, De Silva, Smit, De Silva, & Farella, 2013). It was proposed that post-treatment photographs

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were better appreciated than the pre-treatment profile images by all groups. The result of this study is in accordance with these above-mentioned studies. Lay people's perception may differ from that of orthodontists and surgeons, who judge aesthetics based on their professional expertise. Orthodontists often employ hard tissue measurements as benchmark to diagnose and finalize treatment plans. This is in contrast to the literature that shows variability in soft tissue thickness between people of different populations and inadequate adaptation of soft tissue to the underlying hard tissues (Paduano, Rongo, Bucci, Carvelli, & Cioffi, 2020). The soft tissue parameters specifically nasolabial angle plays a pivotal role to contemplate a successful treatment plan (Barakaat, Tahir, Sukhia, & Fida, 2024). For each 1mm of retrusion of lips following retraction of incisors, NLA increases by 1.6º. Taking into account this relationship is very important in planning extractions when treating class 2 malocclusion by two or four premolars extractions (Almeida-Pedrin, Guimarães, Almeida, Almeida, & Ferreira, 2012). As retrusive lips and flattened profile appear unaesthetic (Konstantonis, Vasileiou, Papageorgiou, & Eliades, 2018).

The objective of current study was to calculate the mean attractiveness score of the profile image modifications, of a class II div 1 female produced by digitally simulating the incremental increase of NLA from the base image. Mean attractiveness of facial profile was evaluated by calculating mean attractiveness as the lay people rank the images from 1 to 5. Mean attractiveness score was 4.74±0.44 for image B (NLAl21°) followed by 4.54±0.50 for image A (NLAl29°), 4.37±0.50 for image C (113°) and 3.27±0.45 for base image (NLA104.9°). These results showed that layperson considered the base image as aesthetically less attractive. In present study the laypeople assigned least score for untreated base image (profile D) and is considered to be least attractive as the profile with greatest Nasolabial angle of 121 degrees (profile B). This inferred that the indirect increase of the Nasolabial angle during camouflage therapy due to retraction of incisors affects the facial aesthetics negatively. The moderate increase in Nasolabial angle is more appreciable aesthetically than the profile with no treatment and better than the increase in Nasolabial angle of 129 degrees (profile A) for both male and female profiles. This indicates that some counterbalance of a pronounced sagittal inter-labial step by increasing the Nasolabial angle is better accepted than non-treatment of malocclusion (Swamy, Chandulal Jadav, Lakshmi, Mothe, & Asudaria, 2020).

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These results are in line with other studies(Pace et al., 2018). Yuksel et al studied the effect of increasing NLA by simulating the profile image of a class 2 div I female. The laypeople rated the baseline profile, one without treatment having NLA of 104.9° to be most unattractive with a mean score of 3.99+0.18 on VAS then the profile with NLA of 129° mean VAS score 4.68+0.19, profile with NLA l21° considered the upper limit to be aesthetically acceptable with attractiveness score of 4.92+0.17 and the profile with NLA l13° deemed to be the most aesthetic with mean attractiveness score 4.96+0.15 (Yüksel et al., 2017).

Orthodontists and laypeople may have diverse perceptions of aesthetics(Yüksel et al., 2017). According to another study, by Kalin et al, involving both orthodontists and laypeople, Orthodontists preferred straighter profiles and ranked the non-treated Class II Divi 1 female profile-image less than the lay-people. Nonetheless, both of them tend to favor the results of treated profiles above the non-treated Class II Divi 1 original profile.(Kalin, Iskender, & Kuitert, 2021)This current study included only laypeople's perceptive judgement of the profile images produced by virtually altering nasolabial angle but no orthodontic professionals were included. In future more perception-based studies should be conducted involving orthodontists and laypeople to differentiate between the judgement criteria of both.

Conclusion

The findings of this research show that changes in nasolabial angle (NLA) impact facial beauty, especially among patients with Class II Division 1 malocclusion during orthodontic camouflage therapy. It was observed that the most non-attacted profile along with the smallest NLA and the most exaggerated NLA, which was 129 degrees, received the lowest attractiveness assessment by the lay observers. Moderate increases, however, specifically nasolabial angles up to 121 degrees were perceived as most attractive.

These findings explain the justification for the existence of adult patients suffering from orthodontic disharmony of the face. While detailing the negative impact, it was depicted that several features of physical appearance had to be compromised. As it is previously verified, the increasing NLA is an inevitable outcome of incisor retraction in camouflage treatment. Comparison of moderate and excessive retraction indicates the latter was put in the category of undesirable NLA, which has poor results in defining the elegance of nose, lips, and chin. Even

though this study exposed the manipulation of NLA above the average has the risk of negative aesthetic value, for the patients' opinion towards the outcome of the treatment improves significantly, further investigation of the value is needed.

It also opens a discussion for further investigation on the management of orthodontic Class II Division 1 malocclusion. Again, the approaches suggest using the wrong retainer gives a refined level of agreement between facial beauty and biological esteem. Future studies should find a collaborative input for determining comfortable NLA borders from orthodontists and maxillofacial surgeons perspectives.

Finally, based on NLA, 121 degrees might be the maximum limit for the patients having Class II Division 1 features for whom camouflage orthodontics is done. These results are useful in assisting orthodontists with the skills of balancing facial beauty and the treatment's function.

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Author's contribution: M.J. "manuscript write-up and analysis". M.W.U.H. "research supervision and manuscript review".

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