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Nasal soft tissue parameters, Mentolabial angle and Holdaway's ratio as a deciding factor in extraction vs non extraction camouflage therapy in class II and class III subjects

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Abstract: Introduction: *While planning treatment an orthodontist must keep in mind that the soft tissues of the nose, lips and chin has a great impact on the overall facial appearance of a person. If the prominence and length of nose and position of lips and chin is acceptable to the patient, it must be made sure that it remains the same way even after orthodontic treatment. Moreover some orthodontic procedures like extractions, orthognathic surgery, rapid maxillary expansion, and facemask therapy has an effect on the nasal morphology, position of lips and chin. So this study was carried out to assess all these factors while planning treatment.*
Aims and objectives: *To assess the role of nasal soft tissues, lips and chin position while treatment planning during camouflage therapy for Class II and Class III cases and to decide whether to go for extraction or non extraction therapy.*
Materials and Methods: *The sample size was 90 with 45 subjects in each skeletal Class II and Class III group. The age group of the patients was between 18 and 30 years. All the lateral cephalograms were traced upon an A4 size acetate paper with a 2B or 3HB hard lead pencil over well-illuminated viewing screen. The nasal soft tissue parameters, mentolabial angle and holdaway's ratio were measured in each group and their influence on treatment planning decision was evaluated, and mean values, SDs, and P values were calculated with Statistical software SPSS (version 20.0) and Microsoft Excel.*
Results: *The descriptive statistical analysis was performed and the mean of each parameter was calculated along with standard deviation in both the groups, the comparison between the two groups was done by using the student's independent t-test and level of significance was checked for each parameter. The level of significance was set at $p < 0.05$. The p value for nasolabial angle in class II subjects and the inclination of the nose in both the class II and class III subjects was found to be < 0.001 which was considered to be statistically significant. However, no statistically significant difference was found when other parameters were compared between two groups.*
Conclusion: *From the above results of the study it can be concluded that the soft tissues play a major role in deciding between extraction and non extraction treatment modality especially in borderline cases. Nasolabial angle and inclination of the nose are deciding factors whether to go for retraction or protraction of upper incisors in class II and class III camouflage respectively, while as mentolabial angle and holdaway's ratio are the determining factors in the position of lower incisors while maintaining the facial balance, harmony and facial attractiveness in class II and class III camouflage cases.*
Key words: *Soft tissues; holdaway's ratio; mentolabial angle; camouflage.*

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I. Introduction

Although the importance of diagnosing and planning for the treatment of an esthetic result was emphasized by many, the measurement of soft tissue variables was lacking. Most thought that establishing normal dental relationships would result in an esthetic face. Hence, cephalometrics was embraced as a medium for evaluating teeth over basal bone and, therefore, the basis by which to extract premolars. As cephalometrics became the accepted method for orthodontic diagnosis, soft tissue measurements were introduced. Nose is one of the most important parts on face other than lips and chin. There is direct impact of expansion, face mask therapy, extraction decision, growth modification, surgical orthodontics and growth on the nasal appearance.[1,5] Nasal prominence also effects the extraction decision as in patients with already prominent nose, extraction of maxillary 1st premolars will further worsen the profile.[6] It is also important to note that nasal profile is different

in patients with underlying skeletal sagittal, transverse and vertical dysplasia.[7,8] The nose may be evaluated by direct clinical measurements (morphometry), by photogrammetry, by radiographs (cephalometry) or more recently by three-dimensional stereo-photogrammetric systems.[9,13] The mentolabial (or labiomental) region is evident in frontal and profile views and forms the transition from the lower lip to the soft tissue chin. The morphology of this region is one of the most important aesthetic parameters of the facial profile, and an observer's visual perception of the lower face is often drawn to this region. The mentolabial region and angle must be carefully evaluated when planning orthognathic surgery, particularly mandibular surgery, osseous genioplasty or the placement of chin implants.[15] For better esthetics, the lower lip should be at least as prominent as the chin.[16] While planning treatment an orthodontist must keep in mind that the soft tissues of the nose, lips and chin has a great impact on the overall facial appearance of a person. If the prominence and length of nose and position of lips and chin is acceptable to the patient, it must be made sure that it remains the same way even after orthodontic treatment. The rationale of performing this study was to have population-specific values of nasal soft tissue measurements, mentolabial angle, chin position by holdaway's ratio which could assist us in orthodontic and orthognathic surgical treatment planning.

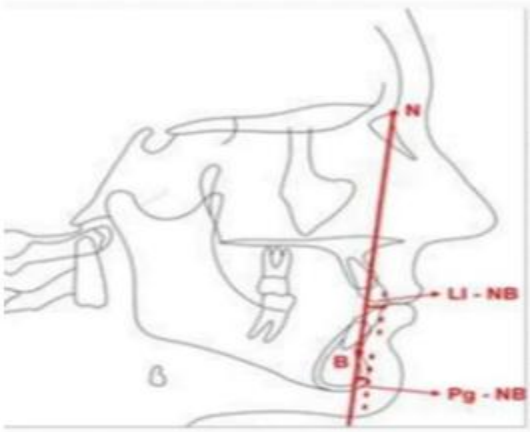
II. Aims and objectives

Assessment of population-specific values of nasal soft tissue measurements, mentolabial angle, chin position by holdaway's ratio which could assist us in orthodontic and orthognathic surgical treatment planning and to assess the role of nasal soft tissues, lips and chin position while treatment planning during camouflage therapy for Class II and Class III cases, whether to go for extraction or non extraction therapy in a specific population group.

III. Materials and Methods

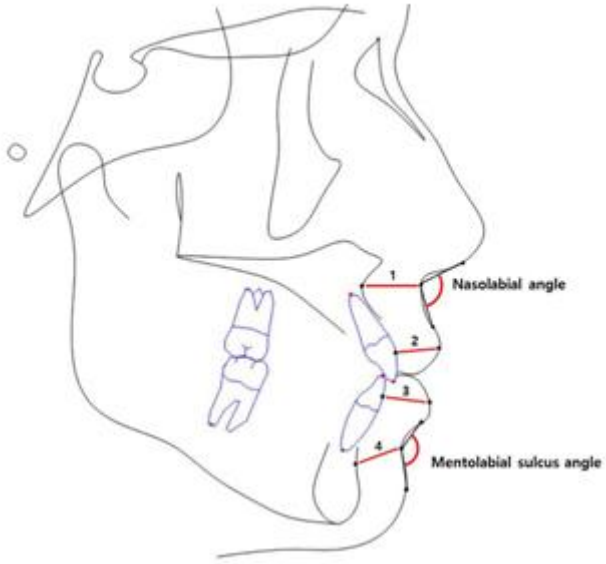
The study was conducted on lateral cephalograms of 90 subjects with 45 subjects in each skeletal Class II and Class III group who had to undergo orthodontic treatment at the Department of Orthodontics Government Dental College and Hospital Srinagar, Kashmir. To have standardized cephalometric radiographs it became important that all the radiographs were taken from the same X-ray machine with the subjects in the natural head position, with teeth in maximum intercuspation and lips at repose. All the lateral cephalometric radiographs were taken by the same operator from the standardized Orthophos XG5 DS CEPH (SIRONA) on a standard Konica Minolta 8 × 10 inch size film with an anode to midsubject distance of 5 feet by the same operator. Natural head position was obtained by asking the subject to look straight ahead such that the visual axis was parallel to the floor. The age group of the patients between 18 and 30 years were selected irrespective of their sex. Ages twelve and above were selected only because nasal growth completes at age ten, if patients below twelve years are taken there is a chance that the length and prominence will change during the study. Selected patients were then examined to confirm that they had skeletal Class II and Class III based on some parameters like ANB angle,[26] Beta angle,[27] and Wits appraisal.[28] Patients having previous history of orthodontic treatment, craniofacial disorders such as cleft palate, syndromic patients, history of facial trauma and obvious nasal deformity were excluded from the study.

Planes and Parameters defined

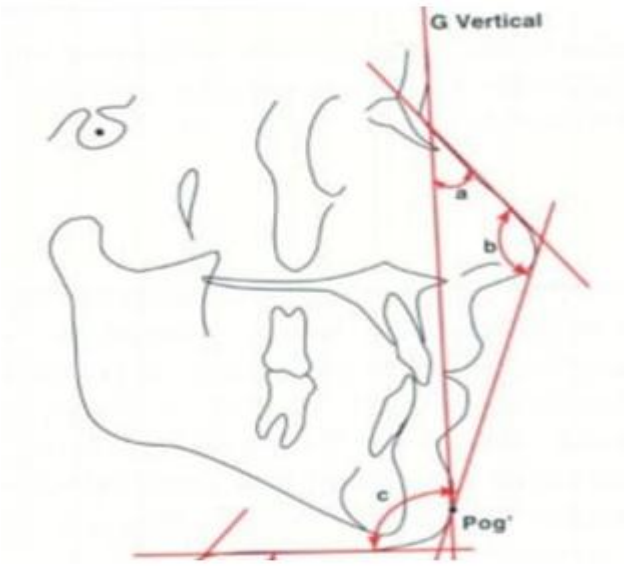


Fig(1) A measurement introduced by R. A. Holdaway to evaluate the relative prominence of the mandibular incisors, as compared to the size of bony chin. It is calculated as the ratio of the linear distance from the labial surface of mandibular central incisor to the NB line, over the linear distance of the chin to the same line.[16,25]

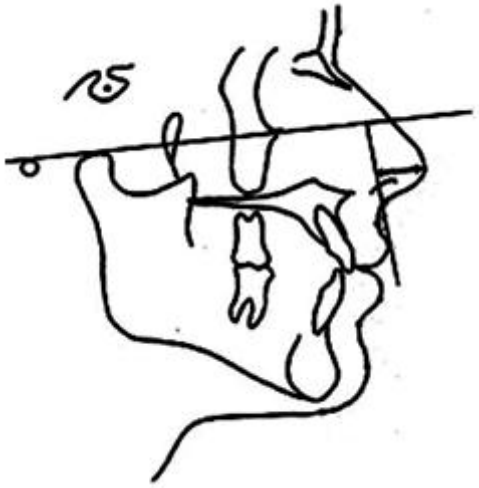
If the ratio is 2:1 it means that the lower incisors are more proclined as compared to chin prominence.
If discrepancy is 2mm = acceptable
If discrepancy is 3mm = less desirable
4mm= correction indicated



Fig(2) Mentolabial (labiomental) angle. This is the anterior angle formed by the intersection of a tangent to the lower lip (sublabiale to labrale inferius) and a tangent to the upper part of the soft tissue chin pad (sublabiale to soft tissue pogonion). Li (labrale inferius), the midline point representing the mucocutaneous vermilion border of the lower lip; Sbl (sublabiale), the midline point of greatest concavity on the facial contour of the lower lip between the labrale inferius and soft tissue menton. It is the deepest point of the mentolabial fold, also termed the soft tissue B point. Pog' soft tissue pogonion, the most prominent midline point of the soft tissue chin pad.[15,16]

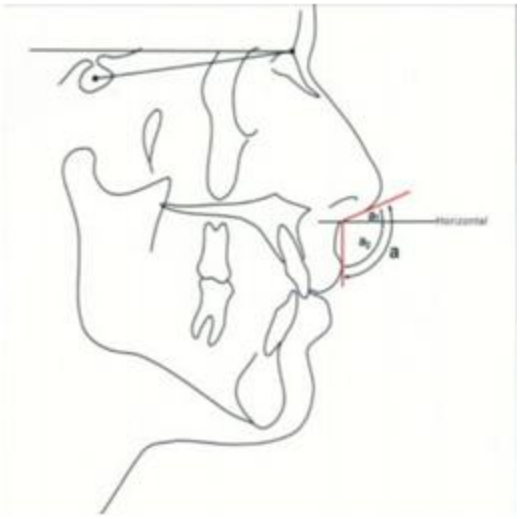


Fig(3) Nasofacial angle for esthetic balance averages 30 to 35 degrees. It is formed by the intersection of a line drawn from glabella to soft tissue pogonion with a line drawn along the axis of radix of nose. Nasomental angle is constructed by a line along the axis of radix of the nose and a line drawn from the tip of the nose to the soft tissue pogonion (E line). It ranges between 120 and 135 degrees. Mentocervial angle is formed by the intersection of E line and tangent to the submental area, it normal value ranges from 110 to 120 degrees.[16]



Fig(4)The nose prominence was described as the distance from a line perpendicular to Frankfort horizontal and running tangent to the vermillion border of the upper lip, to the tip of the nose as shown in (Figure 4) within the range of Holdaway norms (14–24 mm).[16]

Fig(5) Inclination of the nasal bone. The angle formed between true vertical (SnV) and the long axis of the nostrils varies from about 90 degrees in men to as much as 104 degrees in women.[16]



Fig(6) The nasolabial angle is formed by two lines, namely, a columella tangent and an upper lip tangent Fig (6). Legan and burstone report a mean value of 102±4 degrees.[17] This angle is influenced by both the inclination of the columella of the nose as well as the position of the upper lip. Schiedman et al drew a postural horizontal line through subnasale and further divided the nasiolabial angle into columella tangent to postural horizontal (25 degrees), and upper lip tangent to postural horizontal (85 degrees).[18]

IV. Results

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Data were expressed as Mean±SD and Student's independent t-test were employed for inter group analysis of data. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed. The p value for nasolabial angle and the inclination of the nose was found to be < 0.001 which was considered to be statistically significant. However, no statistically significant difference was found when other parameters were compared in two groups as shown in the tables (1 and 2).

Parameter	*Mean averages value*	*Mean class II group*	*SD class II group*	*P -value (class II vs class III)*
Nasal soft tissue structures				
Nasiofacial line angle	30-35°	33.5	2.95	0.185
Nasomental angle	120-135°	129.4	4.37	9.79
Mentocervical angle	110-120°	107.5	3.50	6.77
Nasolabial angle	102±4°	86.6	5.36	<0.001*
Inclination of nose	90-104°	106.9	5.94	<0.001*
Nasal projection	12-14mm	13.35	2.78	0.185
Mentolabial angle	122 ± 11.7°	116.25	15.5	8.11
Holdaways ratio	1:1	0.132	0.07	0.696

Table no 1. Statistical analysis of nasal soft tissue parameters, mentolabial angle, and holdaway's ratio in skeletal class II group

Parameter	*Mean averages value*	*Mean class III group*	*SD class III group*	*P- value (class II vs class III)*
Nasal soft tissue structures				
Nasiofacial line angle	30-35°	40.2	3.78	0.185
Nasomental angle	120-135°	119.7	4.96	9.79
Mentocervical angle	110-120°	116.7	7.07	6.77
Nasolabial angle	102±4°	95.15	9.19	<0.001
Inclination of nose	90-104°	114.15	6.69	<0.001
Nasal projection	12-14mm	12.3	2.11	0.185
Mentolabial angle	122 ± 11.7°	91.8	14.41	8.11
Holdaways ratio	1:1	0.127	0.08	0.696

Table no 2. Statistical analysis of nasal soft tissue parameters, mentolabial angle, and holdaway's ratio in skeletal class III group

V. Discussion

Today, more so than at any other time in our specialty, we have the ability to provide esthetic results to our patients. We have a good understanding of the changes that occur in the soft tissues with growth and the changes produced by our treatment. There is probably no other aspect of orthodontic treatment that has caused as much controversy as the decision of whether to extract or not permanent teeth. Just like a pendulum, the

popularity of premolar extractions has swung between the option of nonextraction cases at any cost and extraction treatment to achieve arbitrary cephalometric norms especially in borderline cases. Borderline cases are those cases which are equally susceptible to both extraction and nonextraction treatment modalities.

The aim of this study was to evaluate and compare the role of nasal soft tissue structures, lip and chin position in deciding the treatment plan of borderline class II and class III whether to be treated with extraction or nonextraction modalities and to identify those parameters which can act as guidelines to differentiate between these two treatment modalities in these cases. The aim of the orthodontic treatment is to improve the facial esthetics of the patients.[19] Albrecht Durer maintained that disproportionate faces are unaesthetic and proportionate faces acceptable, if not considered beautiful.[20] Nasal soft tissues play a pivotal role in deciding the desired treatment modality for a particular patient. According to studies, the growth of nose is in a downward and forward direction with increase in length of 1.5 mm every year.[21] It has been confirmed that hard tissues (i.e., nasal bones) and ligaments determine the shape of the nose.[22] Like all other parts of the face, nasal features are characteristic of every individual and region.[23]

In our study the role of nose in the treatment planning was studied by using parameters like nasofacial angle which was within the normal range in class II subjects but it was increased in class III subjects, and nasomental and mentocervical angles were within the normal range in both groups, however the nasolabial angle was decreased in class II subjects but within normal range in class III subjects and inclination of nose was increased in both groups. So during treatment planning in class II subjects, retraction of the upper incisors can be carried out by extraction of upper first bicuspids when there is excess overjet in borderline class II cases and when nasolabial angle is acute but in class III subjects in our study, nasolabial angle was within the normal range, so it should be maintained same through the treatment of borderline class III cases without worsening the facial profile, since the inclination of nose was increased in both groups, treatment should be done without further increasing the inclination of nose further in both groups by backward movement of upper lip. The nasal projection was within the range of holdaway's norms in both groups. The mentolabial (or labiomental) region is evident in frontal and profile views and forms the transition from the lower lip to the soft tissue chin. The morphology of this region is one of the most important aesthetic parameters of the facial profile, and an observer's visual perception of the lower face is often drawn to this region.[15] The mentolabial angle, also termed the labiomental angle, is a potentially important factor in the perception of facial profile. The mentolabial region and angle must be carefully evaluated when planning orthognathic surgery, particularly mandibular surgery, osseous genioplasty or the placement of chin implants. The upper component of the angle may be affected by mandibular incisor proclination during class III decompensation, which will, to some extent, lead to concomitant proclination of the lower lip and thereby reduction of the mentolabial angle. Any surgical procedure that increases mentolabial height will increase the mentolabial angle and thereby open the fold, e.g. mandibular advancement, to a three-point (tripod) landing, anteroinferior advancement genioplasty or clockwise rotation of the mandible or maxillomandibular complex. The opposite is also true; any procedure that reduces attractiveness. Lower face height tends to deepen the mentolabial fold and decrease the angle. Therefore, the aesthetics of this region are vitally important both in terms of dentofacial surgical diagnosis and treatment planning.[24] In our study the mentolabial was decreased in class III patients due to prominent chin but not due to mandibular incisors which can either increase or decrease the mentolabial angle by concomitant retroclination or proclination respectively, so during camouflage therapy in borderline class III cases, excessive retraction of lower anteriors should be avoided because it will increase the chin prominence and make the mentolabial angle less attractive, in class III camouflage, excessive chin prominence can be corrected by adjunctive orthognathic surgical procedures like reduction genioplasty, but the mentolabial angle was within the normal range in class II subjects in our study. The relationship between the lower incisor position and chin was determined based on the holdaway's ratio.[25] In our study the holdaway's ratio suggests that lower incisors are upright in class III cases while as they are slightly forwardly placed in class II cases. So treatment planning should be carried out in such a way so as to maintain the normal lower incisor to chin position with respect to the NB line within the acceptable ratio without the excessive retroclination or proclination of lower anteriors with respect to the chin in order to produce acceptable facial attractiveness.

VI. Conclusion

The decision of whether or not to extract the permanent teeth in planning the treatment of an orthodontic case is a crucial moment for the clinician, especially when facing a borderline case. From the above results of the study, it can be concluded that the soft tissues play a major role in deciding between extraction and non extraction treatment modality especially in borderline cases. Nasolabial angle and inclination of the nose are deciding factors whether to go for retraction or protraction of upper incisors in class II and class III camouflage respectively, while as mentolabial angle and holdaway's ratio are the determining factors in the position of lower incisor while maintaining the facial balance, harmony and facial attractiveness in class II and class III camouflage.

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