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Journal of Contemporary Orthodontics

Journal homepage: https://www.jco-ios.org/

Original Research Article

Assessment of anterior malar projections using cephalometric and clinical photographs in Gujarati population

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ARTICLE INFO

Article history:
Received 21-09-2023
Accepted 06-12-2023
Available online 28-12-2023

Keywords:
Malar prominence
cephalometry
facial esthetics
soft tissue
orthodontics

ABSTRACT

Background: Midface plays a vital role in contributing to facial aesthetics; despite this, there prevails a need for orthodontic literature to provide specific diagnostic criteria. We are blessed with ample literature to evaluate such, but due to some shortcomings, we lack to decide exact treatment plan. To clarify such limitations of various midface analysis, there is a need to consider the projections of the malar prominence in individuals with different skeletal mal-relationships.

Materials and Methods: 40 subjects between the ages of 10 and 12 years, were equally divided into groups based on visual assessment of negative and positive vector relationships. Groups A and B comprised 20 subjects (10 male, 10 female) displaying a positive and negative vector relationship respectively. For both groups, Sella-nasion-Orbitale angulations were measured to evaluate the subjects' anteroposterior position of the malar eminence relative to the cranial base.

Result: The angulation measurements obtained for SNO were smaller in the negative vector than the positive on an average of 5.9°, $P < 0.05$. No significant difference in values between males and females was observed.

Conclusion: Visual assessment of vector relationships can effectively classify anterior malar projection which can be utilized to decide different orthodontic treatment modalities.

1. Introduction

Attaining optimal amalgamation of facial esthetics and well-balanced occlusion is one of the primary goals of orthodontic treatment. The vitality of facial examination accomplishes this so that any orthodontic and orthopaedic correction will not adversely affect the standard facial traits of an individual. Orthodontic treatment on the primary platform involves two goals of dental correction and esthetics; hence treatment planning is complex. Sometimes in the process of correcting the bite or occlusion, there can be a decrease in facial attractiveness. This result, if it occurs, is either due to a lack of understanding of what is desirable as an aesthetic goal or a lack of attention to facial esthetics.[1] A person's facial attractiveness is determined by the skeletal mass of the face. The three main promontories that determine the facial features can be integrated with inclusion of nose, chin and the two malar eminences on either side.[2]

Malar prominence plays an essential role in the shape of the lateral segment.[3] Malar prominence is the zygomatic or malar process of the maxilla. Anatomically, it is a rough triangular-shaped eminence situated at the angle of separation of the anterior, zygomatic, and orbital surfaces where the skin forms a gentle contour between the lower eyelid and the zygomatic bone. A tangential line to the

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https://doi.org/10.18231/j.jco.2023.055
2582-0478/© 2023 Author(s), Published by Innovative Publication.

anterior surface of the eye's cornea referred to as an ACP has been suggested for assessing the malar eminence.[4] The ideal projection of the malar eminence should be approximately 2 mm beyond the ACP.[5]

Midface, despite playing a major role in facial esthetics, there has been an evidential shortage of diagnostic criteria in orthodontic literature related to midface deficiency. To qualify and quantify aesthetic facial profiles, various hard and soft tissue analysis have been developed with the advent of cephalometries. Apart from diagnosing and treatment planning, lateral cephalograms also aid in predicting hard tissue and soft tissue responses to the orthodontic treatment, as there is an ease in procuring, measuring, and comparing (superimposition) hard tissue structures. Currently, in literature, Arnett's facial soft tissue analysis has been proven to provide us with comprehensive frontal as well as sagittal soft tissue analysis. The only shortcoming with the analysis is that it has been specifically designed for surgical cases.[6–8]

When it comes to facial esthetics and soft tissue profile changes, it cannot be only done by cephalometry. The problem with cephalometry is inadequacy in evaluating facial disharmony depending on the amount of soft tissue covering, which can vary with the dento-skeletal pattern. Hence, to overcome this, a summative facial trait analysis should be used to enhance orthodontic diagnosis, treatment planning, and the quality of results for both surgical and nonsurgical patients. With a comprehensive analysis, esthetic problems can be optimally corrected.[9]

Generally, the skeletal structures of the midface are difficult to assess in lateral cephalograms, and there are no readily available instruments for making accurate, reproducible measurements of orbital rim relationships. This has led an orthodontist to focus entirely on the premaxilla for the classification of maxillary skeletal development. Furthermore, there is no agreement among the authors on the best method to assess and quantify midfacial hypoplasia. Thus, the main objective of this study is to determine whether the visual classification of anterior malar projection using vector relationships is supported by cephalometric analysis. This is achieved by assessing and comparing the anterior malar projection obtained from the profile photograph and lateral cephalogram.[10]

2. Materials and Methods

Forty wheatish subjects who fulfilled the criteria between the ages of 10 and 12 years, without craniofacial syndromes or previous orthodontic treatment, were equally divided into groups based on visual assessment of negative and positive vector relationships. Group A comprised 20 subjects (10 male, 10 female) exhibiting a positive vector relationship. Group B comprised 20 subjects (10 male, 10 female) displaying a negative vector relationship. Sella-nasion-orbitale (SNO) angulations were measured to evaluate the subjects' anteroposterior position of the malar eminence relative to the cranial base.

The inclusion criteria for the study were as follows-

1. Subjects who require lateral cephalograms as part of their orthodontic treatment
2. Subjects with informed written consent

The exclusion criteria for the study were as follows-

1. History of orthodontic treatment
2. History of maxillofacial or plastic surgery
3. Subjects with craniofacial syndromes
4. Subjects with craniofacial trauma

A profile photograph was taken for each subject using a digital camera Canon 1300D. To standardize the profile photographs patient's head was oriented in the Frankfort horizontal position. They were instructed to sit in an upright posture with their lips relaxed. On the digital profile photographs, vectors were drawn using Microsoft paint software Windows 10 by drawing a line from the most prominent part of the cornea to the anterior cheek mass.

The anterior corneal plane is the line drawn from the most prominent part of the cornea to the anterior cheek mass to determine the vector relationship (Figure 1and 2). If the anterior cheek mass was ahead of the corneal plane, it was a positive vector, and if the anterior cheek mass was behind the corneal plane, it was taken as a negative vector.

A lateral cephalogram was taken using a cephalogram machine. The anteroposterior location of the malar eminence was studied regarding the cranial base. This method of measurement was adopted according to the earlier studies of Leonard and Walker, and Walker.[11,12]

As shown in the figure 3, on the digital lateral cephalogram, cephalometric landmarks -Sella, nasion, and orbitale were traced on Nemoceph software. As previously mentioned in the works of Leonard and Walker,[11] orbitale was selected to coincide with the Sella and Nasion point. The key ridge and the maxillary sinus were used as guides to consistently locate this landmark. On the digital lateral cephalogram, using Nemoceph software, cephalometric landmarks (Sella, Nasion, and Orbitale) were traced. SNO angles were measured for both the positive and negative vector groups.

A well-trained and calibrated investigator carried out all the procedures of the study to avoid the inter-examiner error. Cephalograms were traced by the examiner three times with a minimum of 4 days between tracings. Prior to the cephalometric analysis, 20 random lateral cephalograms from subjects in the study were selected, and SNO angles were traced and measured at 2 times within a week by the same operator.

Descriptive statistics were calculated for angular measurements of Group A and Group B, and significant differences between SNO measurements for Groups A and B were assessed with a Unpaired t test.

Figure 1: Positiveand negative vector in male subject

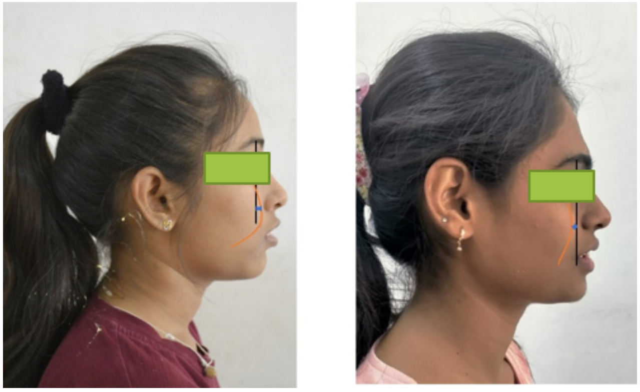

Figure 2: Positiveand negative vector in female subject

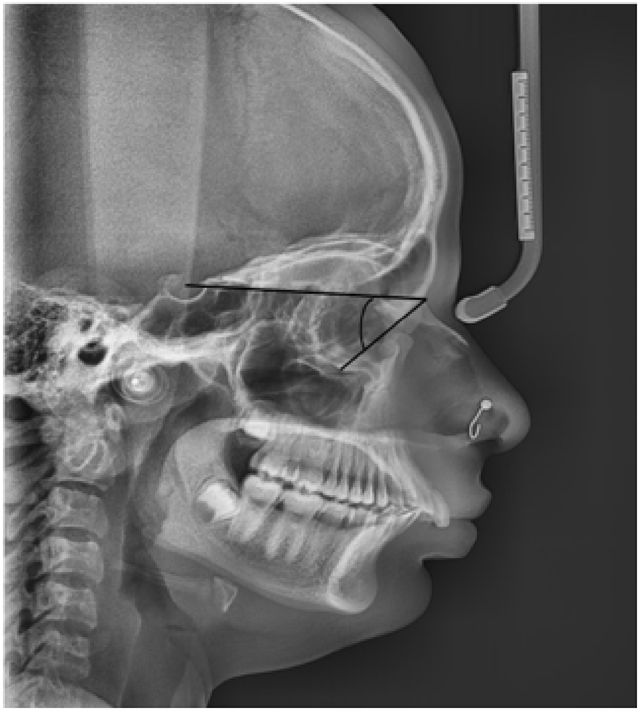

Figure 3: Sella-Nasion-Orbitale angulation

Table 1: SNO angle wise distribution

Gender	Vector	Number	SNO angle in Mean	SNO angle in SD	P Value
Male	Positive	10	53.90	12.32	> 0.05**
	Negative	10	46.00	3.55	
Female	Positive	10	56.20	5.92	≤ 0.05*
	Negative	10	44.40	4.32	
Male + Female	Positive	20	55.05	9.48	≤ 0.05*

Table 2: SNO angle wise distribution in vector negativepatients

Vector	Vector	Number	SNO angle in Mean	SNO angle in SD	P Value
Negative	Male	10	46.00	3.55	> 0.05**
	Female	10	44.40	4.32	

Statistically, no significant difference was present in SNO angle between male and female study subjects in vector negative group.

Table 3: SNO angle wise distribution in vector positivepatients

Vector	Vector	Number	SNO angle in Mean	SNO angle in SD	P Value
Positive	Male	10	53.90	12.32	> 0.05**
	Female	10	56.20	5.92	

3. Results

The comparison between the SNO angle showed a highly significant malar projection variance with 5.9 degrees in the positive vector relationship significantly (Table 1). Statistically significant difference was present in SNO angle between vector positive and vector negative study subjects.

In female study subjects, SNO angle was more in vector positive study subjects (56.20 ± 5.92) than vector negative study subjects (44.40 ± 4.32). In female study subjects, statistically significant difference was present in SNO angle between vector positive and vector negative study subjects.

The study also showed that there was no significant difference found in malar prominence between male and female subjects as shown in Tables 2 and 3 respectively.

4. Discussion

A comparison of SNO angulations between males and females along with the vector relationship has been made in this study. The positive and negative vector relationships can be helpful in classifying anterior malar support during the micro and macro aesthetic evaluation of patients.[13] No significant difference in gender was found in SNO angulations of the positive and negative vectors. The lateral cephalograms were digitally traced for the present study. According to the concept of growth and development, put forward by Enlow and Hans in their theory,[14] growth causes secondary displacement of the anterior malar complex in downward and forward direction by deposition of new bone occurring in an upward and backward direction. Further, the anterior maxilla and anterior zygoma undergo resorption. Remodelling of the supraorbital rim and lateral nasal complex dictates its growth in a forward movement.[15,16] Deposition of new bone in the mid face region occurs on the lateral zygoma and zygomatic arch, thus this aid in increasing the lateral malar prominence and maintaining the width of the face in consonance with that of the jaws.[12]

Because of this bone deposition in mid-face region, the nose, supra-orbital rim, and possibly the lateral malar complex become relatively bulgy. In contrast to that, the anterior portion of the malar complex grows relatively lesser prominent, thus allowing clinicians to examine and justify malar retrusion or protrusion during the early stages of development.[17]

In the present study, on the clinical profile photograph, a perpendicular line was passed from the most prominent part of the cornea to the anterior malar mass as an effective means of diagnosing malar deficiency. In the present study, SNO angulation in the negative vector group was smaller when correlated to the positive vector group by an average of 5.9°, and the variation was statistically significant. In the present study, this data indicates that vector relationships can be employed as an effective means of categorizing anterior malar support during the macro aesthetic assessment of the patient. Scott T. Frey[18] noticed in his study that the SNO angulations in the negative vector group were smaller than the positive vector group by six degrees. He thus arrived at a judgment that individuals featuring a negative vector relationship had notably reduced malar support when compared to the subjects exhibiting a positive vector relationship, and the difference was highly significant.

The type of malar defect can individually vary from one side of the face to the other, from patient to patient.[19,20] Therefore, there is no single method developed that can identify the malar eminence precisely. The application of positive and negative vector relationships as part of a dentofacial analysis not only provides the orthodontist with a convenient means of categorizing the support of malar bone but also enables in making better treatment decisions, assists the practitioner in examining the necessity for alloplastic augmentation of the inferior orbital rim in future and in electing the appropriate maxillary surgery.

As the photographic findings correlated with the cephalometric findings obtained from this study, no difference between malar prominence was seen between males and females. Anterior malar projection can be effectively classified using the visual assessment method. This further enables diagnosing maxillary hypoplasia and thus helps to execute different treatment modalities. Future studies can be conducted using three-dimensional imaging techniques to measure facial dimensions as they exist and not as prominences of three-dimensional objects on two-dimensional surfaces giving better and more accurate results.

5. Conclusion

1. Based on the results attained from the existing study, the following conclusions are made:
2. No sexual dimorphism was seen in a patient with positive and negative vector relationships.
3. Analyses of skeletal differences between the positive and negative vector groups based on SNO angles were observed and were statistically significant.
4. SNO angulations in the negative vector group were smaller by an average of 5.9° than the positive vector group.
5. The subjects exhibiting a negative vector had significantly reduced malar support when compared to those with a positive vector.

6. Ethical Approval

Ethical approval was taken from the Ethical Committee before conducting the study.

7. Informed Consent

A written consent was taken from the patients for showing their photographs in this article. The consent also stated about the readings of photographs and cephalograms of the patients used in the study.

8. Source of Funding

None.

9. Conflict of Interest

None.

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Cite this article: Doshi AD, Soni K, Solanki A, Mahadevia S, Shah P. Assessment of anterior malar projections using cephalometric and clinical photographs in Gujarati population. *J Contemp Orthod* 2023;7(4):322-326.