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Assessment of Anterior Malar Projections Using Cephalometrics and Clinical Photographs in a South Indian Population

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Abstract

Objectives: This study aimed to evaluate gender dimorphism in anterior malar projections using clinical photographs and lateral cephalograms.
Methods: Thirty subjects aged 18 - 25 years were taken for the study. Based on the gender they were divided into two groups group A (15 subjects) male and group B (15 subjects) female. On the profile photographs positive and negative vectors were labelled. Sella-nasion-orbitale (SNO) angle was delineated with the aid of Nemoceph™ software. The data was then statistically analysed.
Results: Skeletal differences between the positive and negative vector groups on basis of SNO angles were statistically significant ($P < 0.001$). The angulation value obtained for SNO was smaller in the negative vector when compared to the positive vector on an average by 5.9°. No difference in values between males and females was seen.
Conclusions: The projections of anterior malar can be effectively categorized by mere visually assessing the vector relationship (by photographs). This method can be used to diagnose maxillary hypoplasia and can help plan different treatment alternatives.

Keywords: Malar Process, Photographs, Cephalometrics

1. Background

The facial structure has an oval shape and many factors influence its aesthetic features (1). The malar eminence located below the infraorbital ridge affords protection to orbits laterally. In young adults, the prominence of cheek should ideally be approximately (2) mm beyond the anterior surface of the cornea in the sagittal plane and along the Frankfort horizontal plane (2). A negative vector relationship is seen in cases of maxillary hypoplasia where the globe of the eye positioned ahead of the malar eminence. Age-related facial changes can affect the malar complex (3). The aging process results in normal malar eminence assuming a more inferior position. These changes include sagging facial skin, loss of vertical facial height secondary to dental and alveolar erosion, and ptosis of the buccal fat pad (4, 5). The relationship of anterior cheek mass to the anterior corneal plane functions to act as an indicator of bony support along with the malar eminence (6, 7). The lateral cephalometric radiograph does not show the malar eminence but it is, in fact, always lateral and inferior to the orbitale (8). Hence, if the position of the orbitales was known to nasion and A point, this would tell us the relationship of the malar eminence to these latter positions.

Midface plays a very important role in contributing to facial aesthetics, in spite of this there prevails a scarcity in orthodontic literature for specific diagnostic criteria. Arnett's soft tissue facial analysis currently caters us with the most comprehensive analysis in both the frontal and sagittal planes. He being one of the first author to put forward such a descriptive method for assessing the soft tissue in greater detail (9, 10). However, the limitation with this analysis being that its primarily designed for surgical treatment planning contributing little to clinical ease. To bring some clarity on this topic there is a need to evaluate the projections of the malar prominence to assess the positive or negative vectors in individuals with different skeletal mal-relationships.

2. Objectives

Thus, this study was done to assess the anterior malar projection vectors using cephalometric parameters and profile photographs and also to see if there was any gender dimorphism present. This was achieved by assessing and comparing the anterior malar projection obtained from the profile photographs and lateral cephalogram.

3. Methods

Thirty healthy subjects (15 males and 15 female's Dravidian origin) who visited the department for orthodontic treatment were screened for the study purpose. Informed consent from each subject was taken before conducting the study. Ethical clearance to carry out this study was obtained from the Institutional Review Board. The selected subjects were equally distributed into groups of 15 males and 15 females subjects. The age group taken for this study ranges from 18 - 25 years.

Assessment of anterior malar projection was done by using the Sella-nasion-orbitale (SNO) measured on the lateral cephalogram and clinical lateral profile view photographs.

Inclusion criteria:

Class I skeletal base

Patients who required lateral cephalogram for treatment

Exclusion criteria:

Previous history of orthodontic treatment

History of maxillofacial or plastic surgery

Subjects with craniofacial syndromes

Subjects with craniofacial trauma

Thirty subjects who fulfilled the criteria formed the study group. These subjects, based on their gender, were divided into two groups (group A males and group B females). 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 1). If the anterior cheek mass was ahead of the corneal plane, it was considered to be a positive vector and if the anterior cheek mass was behind the corneal plane, it was taken as a negative vector.

A profile photograph was taken for each subject using a digital camera (Canon EOS 550D™ 18 megapixels). 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 lips relaxed. On the digital profile photographs, vectors were drawn for all subjects using Microsoft Paint™ (Windows 10) by drawing a line from the most prominent part of the cornea to the anterior cheek mass. A lateral cephalogram was taken using a cephalostat machine (PLANMECA™ Extraoral Radiograph Machine) with the subject standing upright, relaxed lip posture, and Frankfort horizontal plane parallel to the floor. To measure the skeletal support for each subject, Sella-nasion-orbitale (SNO) angulations were computed. The anteroposterior location of the malar eminence was studied in regard with the cranial base. This method of measurement was adopted according to the earlier studies of Leonard and Walker (11) and Walker (12). On the digital lateral cephalogram, using Nemoceph™ software, cephalometric landmarks (Sella, nasion, and orbitale) were traced. SNO angles were measured for both positive and negative vector groups. All measurements were measured by the same investigator to avoid the inter examiner error. Cephalograms were traced by the examiner maintaining a gap of a minimum of three weeks between tracings. Before the cephalometric analysis for the study, 15 lateral cephalograms from subjects which formed a part of the study were selected randomly, and SNO angles were reproduced and calculated twice within a week by the same operator to rule any error. No differences in measurements were seen.

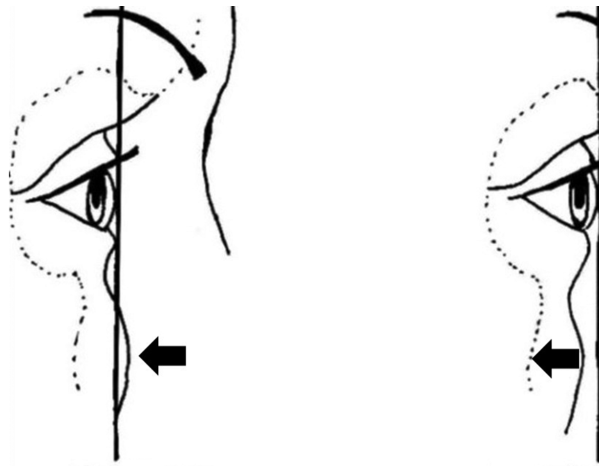

Figure 1. Positive and negative vector relation

3.1. Statistical Analysis

The intra-class correlation coefficients (ICC) indicated a remarkable intra-observer accordance for SNO values (ICC 5.98) by adopting the peculiar requirement for identification of landmarks. Angular measurements of group A and group B was subjected to descriptive statistics, significant differences for SNO measurements between the two groups were assessed with a Mann-Whitney U test. Analysis using the Kolmogorov-Smirnov test, the data was calculated.

4. Results

This comparison showed a highly significant malar projection protrusion value of 6.8 degrees in the subject with a positive vector relationship (Tables 1 and 2). No significant difference was found in malar prominence between males and females (Table 3). No significant difference was found in the SNO angulations of a positive and negative vector (P > 0.05) (Table 4).

Table 1. Group A malar Process Measurement

Patient Number	Lat. Ceph. Value SNO Deg.	Photograph Profile Photo Vector
1	55	+ Vector
2	45	+ Vector
3	45	+ Vector
4	51	+ Vector
5	42	+ Vector
6	49	+ Vector
7	51	+ Vector
8	53	- Vector
9	45	+ Vector
10	42	+ Vector
11	47	+ Vector
12	50	+ Vector
13	52	- Vector
14	45	+ Vector
15	43	+ Vector

Table 2. Group B Malar Process Measurement

Patient Number	Lat Ceph Value SNO Deg	Photograph Profile Photo Vector
1	55	+ Vector
2	35	- Vector
3	60	+ Vector
4	45	+ Vector
5	52	+ Vector
6	54	+ Vector
7	34	- Vector
8	44	+ Vector
9	51	+ Vector
10	49	+ Vector
11	52	+ Vector
12	55	+ Vector
13	47	+ Vector
14	45	- Vector
15	53	+ Vector

Table 3. Mean and Standard Deviation (SD) of SNO Angle and its Comparison Between Male and Female for Positive and Negative Vector

Vector	Male (N = 15)	Female (N = 15)
Positive	47.66 ± 1.20	53.45 ± 1.36
Negative	35.3 ± 2.00	55.1 ± 1.81

[a]Values are expressed as mean ± SD.

Table 4. Mean and Standard Deviation (SD) of SNO Angle Comparison Between Positive and Negative Vector

Parameter	Vector Positive	Vector Negative
SNO angle	48.5 ± 1.28	43.7 ± 1.95

[a]Values are expressed as mean ± SD.

5. Discussion

A comparison of SNO angulations between males and females has been done in this study. The vector relationships can be of help in classifying anterior malar support during the macro aesthetic evaluation of patients (13). No significant difference was found in SNO angulations of the positive and negative vector. Nemoceph™ software was used in the present study to digitally trace the lateral cephalograms and measure the SNO angle. According to the concept of growth put forward by Enlow and Hans (14), growth causes secondary displacement of the malar complex downward and forward by deposition occurring in an upward and backward direction. Further, the anterior maxilla and anterior zygoma undergo resorption. Remodelling of supraorbital rim and lateral nasal complex dictates its growth in a forward direction (1, 15, 16). Deposition occurs on lateral zygoma and zygomatic arch, thus contributing to increase the lateral malar bulge and maintaining the width of the face in consonance to that of the jaws (17). The nose, supra-orbital rim, and possibly the lateral malar complex become relatively more prominent, while the anterior portion of the malar complex grows relatively lesser prominent, thus allowing clinicians to identify malar retrusion during early stages of development (18).

In the present study, on the clinical photograph, a line was passed from the most prominent part of the cornea to the anterior cheek mass as an effective means of diagnosing malar deficiency. In the present study, SNO angulation in the negative vector group was smaller when corelated to the positive vector group by an average of 5.9° and the variation was statistically significant. This data indicates us that vector relationships can be employed as an effective means of categorizing anterior malar support during the macro aesthetic assessment of the patient. Frey (4) noticed that the SNO angulations in the negative vector group were smaller than the positive vector group by six degrees. He thus arrived at a judgement 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 which can identify the malar eminence precisely. The application of 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 to elect the appropriate maxillary surgery (5, 7, 9, 12). 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 visual assessment method. This further enables in diagnosing maxillary hypoplasia and thus helps to execute different treatment modalities (8, 14, 18). Future studies may 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 accurate results.

5.1. Conclusions

Based on the results attained from the existing study, the following conclusions are made:

No sexual dimorphism was seen in a patient with positive and negative vector relationship.

Analyses of skeletal differences between the positive and negative vector groups based on SNO angles were observed to be statistically significant.

SNO angulations in the negative vector group were smaller by an average of 5.9° than the positive vector group.

The subjects exhibiting a negative vector had significantly reduced malar support when compared to those with a positive vector.

Footnotes

Authors' Contribution: Amrita Basak, Pavan Kumar Vibhute carried out the research work in gathering the articles for the study, thought of the concept, and drafted the manuscript. Chetan Patil, Vinay Umale, and Rohit Kulshrestha participated in the structuring the article, defined the intellectual content, and performed the statistical analysis. Khusali Rathod and Rohit Kulshrestha both did the clinical work, gathered the data and participated in its design. Amrita Basak and Vinay Umale coordinated and helped to draft the final manuscript. All authors were part of the manuscript preparation, editing and reviewing. They all read and approved the final manuscript.

Clinical Trial Registration Code: None.

Conflict of Interests: None.

Ethical Approval: Ethical approval was not needed for this study as all the patients were going to start orthodontic treatment so their records were needed to be taken. As none of the photos or patients' identity is shown in the article the Ethical Committee did not state that any clearance is required as it can be shown as a retrospective study.

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Informed Consent: Consent for the same was taken from the patients before treatment started. The readings were taken on the lateral cephalogram and facial photos.

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