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Evaluation of diagnostic aids of mid face esthetics of anterior malar projection by photographs and Comparsion of relibility of two angular measurements on lateral cephalograms

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Abstract

Aim: The aim of this study is to determine whether visual classification of anterior malar projection using vector relationships is supported by cephalometric analysis and comparsion of relibilty of two angular measurements.

Materials and Methods: Normal, healthy 30 subjects aged 10–15 years with no history of orthodontic treatment, craniofacial syndromes, or trauma formed the study group. These subjects based on the visual assessment of vector relationship (positive and negative) were divided into 2 groups (Group A and Group B), consisting of 15 subjects each. Vectors were drawn on the profile photographs. Sella–Nasion–Orbitale (SNO) angle were traced. The relationship of anterior malar projection obtained from profile photograph and lateral cephalogram were compared. And the comparsion of relibilty of two angular measurements between SNO AND BANO was done. The data obtained were subjected to statistical analysis.

Results: Skeletal differences between the positive and negative vector groups based on SNO angles were statistically significant ($P < 0.001$). SNO angulations in the negative vector group were smaller than the positive vector group by an average of 9°. BANO angulations mean difference of 8.46 degrees between 2 groups was statistically significant at $P<0.001$. BaNO measurement shows a significant moderate positive correlation [rho = 0.57] and a significant very strong positive correlation [rho=0.81] with SNO measurement at $P=0.03$ and $P<0.001$ respectively.

Conclusions: Visual assessment of vector relationship can be effectively used to classify anterior malar projection. This also helps in diagnosing maxillary hypoplasia and helps in different treatment modalities. And confirmation can be done with routine cephalometric analysis with two angular measurements either with SNO or BANO angle.

Keywords: malar projection, midface esthetics, lateral cephalograms

1. Introduction

To achieve an esthetic profile, there must be a balance among the facial promontories include nose, chin, and malar prominences. Any single promontory out of proportion with the rest would make the other promontories look more or less protrusive [1]. Despite the role of the midface in facial esthetics, there is a shortage of diagnostic criteria in orthodontic literature. Extensive records must be taken to evaluate maxillary soft tissue points relative to true vertical, and there are no readily available instruments.

Additionally, skeletal structures of the midface have been notoriously difficult to assess in lateral cephalograms, and this has led orthodontists to focus entirely on the premaxilla for classification of maxillary skeletal development. As a result, regional disharmonies in the anatomy of the maxilla have been neglected, and clinical understanding of the midface has devolved into the use of subjective descriptors.

Facial esthetics is of utmost importance to the orthodontist, of which midface is considered to be of prime importance. Pop culture emphasized that people with high malar prominences and angular faces appear to be beautiful. On the other hand, people with midface deficiency tend to have a gaunt or hollow midface leading to increased show of the sclera inferior to the pupil [3].

There is a shortage of diagnostic criteria in the orthodontic literature regarding the role of midface in facial esthetics. 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. Thus, the aim of this study was to determine whether visual classification of anterior malar projection using vector relationships is supported by cephalometric analysis. This was achieved by assessing and comparing the anterior malar projection obtained from the profile photograph and lateral cephalogram and comparing the reliability of two angular measurements on lateral cephalograms.

2. Materials and Methods

A sample of 30 patients clinically diagnosed with positive and negative vector using clinical photographs are taken. The pretreatment lateral cephalograms will be taken.

Inclusion criteria

1. Patients with skeletal class II and class III malocclusion.
2. Acceptable quality of lateral cephalogram.
3. Normal and healthy subjects aged 10–15 years

Exclusion Criteria

1. History of orthodontic treatment
2. History of maxillofacial or plastic surgery

3. Subjects with craniofacial syndromes
4. Subjects with craniofacial trauma

3. Methodology

30 subjects who fulfilled the criteria formed the study group. These subjects, based on their visual examination of the anterior cheek mass relationship to the anterior corneal plane, were divided into two groups (Group A and Group B). The anterior corneal plane is the line drawn from the most prominent part of cornea to the anterior cheek mass to determine the vector relationship.

If the anterior cheek mass was ahead of corneal plane, it was considered as positive vector (Group A) and if the anterior cheek mass was behind the corneal plane, it was taken as negative vector (Group B). Each group consisted of 15 subjects.

Profile photograph was taken for each subject using a digital camera. Profile photographs were standardized by orientation of the patient's head in the Frankfurt horizontal position. Lateral cephalogram was taken using cephalostat machine. With the subject standing upright, relaxed lip posture, and Frankfort horizontal plane parallel to the floor. In order to quantify skeletal support for each subject, Sella–Nasion–Orbitale (SNO) angulations and BaNO angle were used to evaluate the anteroposterior position of the malar eminence relative the cranial base. This measurement was selected according to the previous works of Leonard and Walker and Walker. Orbitale was identified to coincide with Walker's cephalogram point 109.The key ridge and the maxillary sinus were used as guides to consistently locate this landmark.

4. Statistical analysis

Statistical Package for Social Sciences [SPSS] for Windows, Version 22.0. Released 2013. Armonk, NY: IBM Corp., was used to perform statistical analyses.

Descriptive analysis includes expression of SNO & BaNO measurements in terms of mean and standard deviation for each study group.

Mann Whitney U test was used to compare the mean SNO & BaNO measurements between Group 1 & Group 2.

Spearman's correlation test was used to assess the relationship between SNO & BaNO measurements in Group 1 & Group.

The level of significance [P-Value] was set at $P<0.05$.

5. Discussion

Various two dimensional facial analysis studies have been carried out to evaluate and diagnose malar deficiency. Hinderer placed different size malar implants on the plaster cast of a patient's face to evaluate and determine the level of deficiency. Wilkinson drew a line from the outer canthus to the border of the mandible and stated that the malar eminence was located just posterior to that line, at a location one third the distance from the outer canthus to the border of the mandible. This technique was criticized as it could not define the relationship between the vertical line from the canthus and the intersection point with the mandible and thus allowed for large variability in the reference line placement on the face. Bell in 1992 related the malar prominence position to the cornea and supraorbital rim

A comprehensive dentofacial analysis is central to the achievement of functional and cosmetic excellence in orthodontic treatment, and vector relationships provide the orthodontist with another useful diagnostic reference. Assessment of malar support will help enhance esthetic orthodontic outcomes and improve surgical orthodontic planning. In addition to determining the hard tissue contributions to nasolabial contours, vector relationships can assist the practitioner in evaluating the need for alloplastic augmentation of the inferior orbital rim and selecting the appropriate maxillary surgery.

Whitaker in 1986 described the division of the malar complex into three areas. These were (1) the paranasal or medial midface fullness, (2) the malar prominence, and (3) zygomatic arch projection laterally and posteriorly. The malar prominence was the average of the two, creating anterolateral fullness and depth to the face.

Similar study by Prendergast and Schoenrock defined the malar eminence as the point below the lateral canthus that gives the impression of being the most prominent point of the malar mound in any view. They believed the oblique view was the most valuable in the assessment of the projection of the malar eminence.

The type of malar defect varies from patient to patient and can vary from one side of the face to the other. Therefore, there is no single method developed which can identify the malar eminence accurately. Deficient malar and midfacial projection leaves the soft tissues poorly supported, resulting in premature lower lid and cheek descent as well as visible bags, scleral show, and a more aged appearance. Though scleral show has been a traditional hallmark of maxillary hypoplasia, greater attention must be focused on regional hypoplasias within the maxilla, including those presenting in the absence of malocclusion.

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Assessment of malar support will help enhance esthetic orthodontic outcomes and improve surgical orthodontic planning. In addition to determining the hard tissue contributions to nasolabial contours, vector relationships can assist the practitioner in evaluating the need for alloplastic augmentation of the inferior orbital rim and selecting the appropriate maxillary surgery.

Using vector relationships as part of a dentofacial analysis provides the orthodontist with a convenient means of classifying malar support to the midface and will help to better inform treatment decisions.

In the present study, SNO angulation in the negative vector group was smaller than the positive vector group by an average of 9° and the difference was statistically significant. These findings suggest that vector relationships are an effective means of classifying anterior malar support during macroesthetic evaluation of the patient. The stability of these vector relationships has been demonstrated using derived growth curves of sagittal orbital relationships from preadolescence to adulthood, allowing early identification of malar hypoplasia.Frey found that the SNO angulations in the negative vector group were smaller than the positive vector group by an average of 60. He concluded that individuals displaying a negative vector relationship had significantly reduced malar support when compared to the subjects exhibiting a positive vector relationship and the difference was highly significant.

6. Results

Group 1 – Positive Vector Group & Group 2 – Negative Vector Group Table no. 1 shows comparison of the mean SNO measurements [in degrees] between 2 groups using Mann Whitney Test. The test results demonstrate that the mean SNO Measurement in Group 1 [56.13 ± 3.83] was significantly more as compared to Group 2 [47.13 ± 2.50]. This mean difference of 9.00 degrees [95% CI, 6.58 – 11.42] in the SNO Measurement between 2 groups was statistically significant at P<0.001.

Table 1: Comparison of mean SNO measurements [in degrees] between Group 1 & Group 2 using Mann Whitney Test

Groups	N	Mean	SD	Mean Diff	95% Conf. Interval		P-Value
					Lower	Upper	
Group 1	15	56.13	3.83	9.00	6.58	11.42	<0.001*
Group 2	15	47.13	2.50				

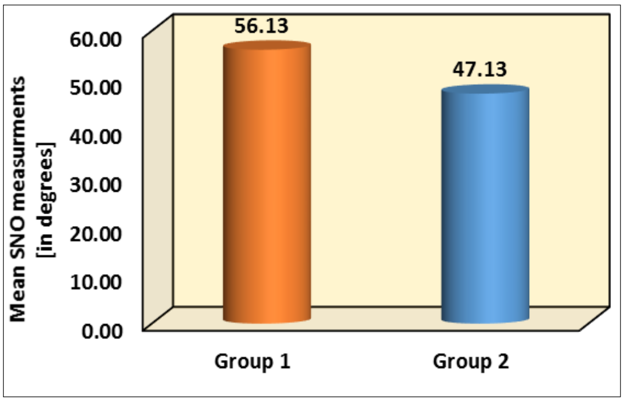

Fig 1: Mean SNO measurments [in degrees] between Group 1 & Group 2

Group 1: Positive Vector Group & Group 2 – Negative Vector Group
Table no. 2 shows comparison of the mean BaNO measurements [in degrees] between 2 groups using Mann Whitney Test. The test results demonstrate that the mean BaNO Measurement in Group 1 [39.33 ± 2.87] was significantly more as compared to Group 2 [30.87 ± 6.08]. This mean difference of 8.46 degrees [95% CI, 4.91 – 12.02] in the BaNO Measurement between 2 groups was statistically significant at P<0.001. [*Refer Table no.2 & Graph no. 2*]

Table 2: Comparison of mean BaNO measurements [in degrees] between Group 1 & Group 2 using Mann Whitney Test

Groups	N	Mean	SD	Mean Diff	95% Conf. Interval		P-Value
					Lower	Upper	
Group 1	15	39.33	2.87	8.46	4.91	12.02	<0.001*
Group 2	15	30.87	6.08				

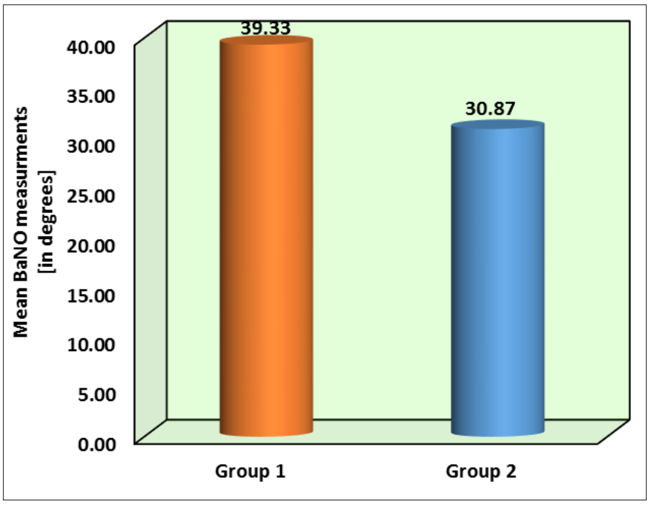

Fig 2: Mean BaNO measurments [in degrees] between Group 1 & Group 2

Table 3: Spearman's Correlation test to assess the correlation b/w SNO & BaNO measurements in Group 1 & Group 2

Measurements	Values	Group 1	Group 2
SNO vs BaNO	rho	0.57	0.81
	P-Value	0.03*	<0.001*

* - Statistically Significant

The correlation coefficients are denoted by 'rho'
Correlation coefficient range
0.0 - No Correlation
0.01 - 0.20 - Very Weak Correlation
0.21 - 0.40 - Weak Correlation
0.41 - 0.60 - Moderate Correlation
0.61 - 0.80 - Strong Correlation
0.81 - 1.00 - Very Strong Correlation

BaNO measurement shows a significant moderate positive correlation [rho = 0.57] and a significant very strong positive correlation [rho=0.81] with SNO measurement at P=0.03 and P<0.001 respectively. [Refer Table no. 3 and Fig. no. 3 & 4]

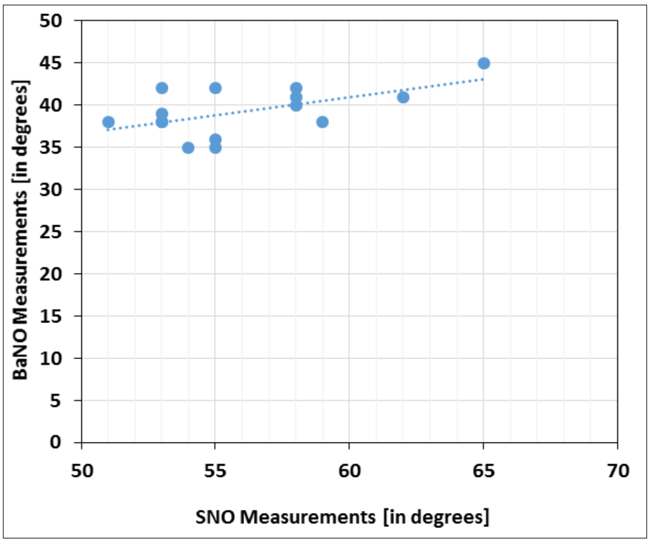

Fig 3: Scatter plot depicting the realtionship b/w SNO & BaNO Measurements in Group 1

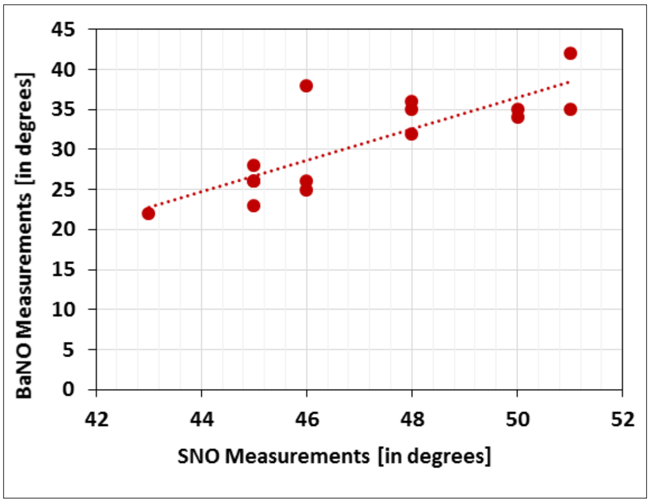

Fig 4: Scatter plot depicting the realtionship b/w SNO & BaNO Measurements in Group 2

7. Conclusion

Visual assessment of vector relationship can be effectively used to classify anterior malar projection. This also helps in diagnosing maxillary hypoplasia and helps in different treatment modalities. And confirmation can be done with routine cephalometric analysis with two angular measurements either with SNO or BANO angle.

Analyses of skeletal differences between the positive and negative vector groups based on SNO angles were statistically significant. SNO angulations in the negative vector group were smaller than the positive vector group by an average of 9°. The subjects exhibiting a negative vector had significantly reduced malar support when compared to those with a positive vector.

BaNO Measurements in negative were smaller than positive group by average 8.6 ˚.

So both the SNO AND BANO angulations are both reliable for cephalometric confirmation of anterior malar projection.

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