A Cephalometric Study of the Relationship Between the Malar Bones and the Maxilla in White American Females

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The last twenty-five years have seen vast strides made in the surgical treatment of developmental jaw deformities. Surgery for the correction of the prognathic and retrognathic mandibular deformities antedates this period but the contributions of Obwegeser[1] have radically transformed the approach to treatment of these deformities. Attention has in more recent times been directed to treatment of the retrognathic maxilla.

These operations are usually described in terms of "Le Fort Lines." Le Fort,[2] in a series of ingenious but macabre experiments, dropped weights on the faces of cadavers and then dissected them to discover the lines of fracture. Figure 1 illustrates these lines. The advancement of the maxilla at the Le Fort I level, a frequent procedure to correct cleft palate in which diminution in the growth of the maxilla at this level occurs, was first described by Axhausen[3] with later modification by Paul.[4] Tessier[5] gave fresh impetus to the surgical treatment of the more gross deformities associated with Crouzon, Treacher-Collins and Apert's syndromes by procedures at the Le Fort III level; he also introduced techniques to ameliorate the frequent hypertelorism which accompanies these syndromes.

Obwegeser[6] suggested that in patients who suffered from the "dish-face" deformity characterized by retruded nasal base, midfacial concavity, lack of malar eminences and, often, cleft palate, a maxillary osteotomy at the Le Fort II level to advance the midportion of the face would be the treatment of choice. Henderson[7] devised such an operation, though Converse[8] had earlier described a limited Le Fort II procedure.

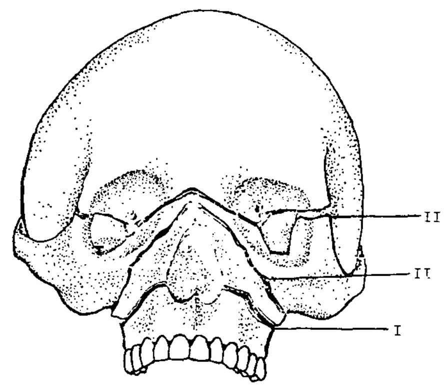

Fig. 1

As time passes we can expect to see more of these operations performed, especially those described by Henderson, in the treatment of patients suffering from hypoplasia of the midface. Figure 2 shows such a condition.

Although the condition is recognized clinically, there is no record of any studies to show the normal relationship of the malar bone to the maxilla. Cephalometrics has concerned itself with the study of the relationship of the maxilla to the SNA angle, as well as the relationship of the mandible to the SNB angle, and the relation of the mandible to the maxilla. The malar eminence not only affords protection to the orbit laterally but cosmetically is the "high point" of the face, high "cheekbones" being regarded as esthetically pleasing. The lateral cephalogram radiograph

Fig. 2

does not show the malar eminence but it is, in fact, always lateral and inferior to the orbitale or point 109 on Walker's[9] mathematical model (Fig. 3). Thus, we realized that if the position of orbitale was known in relation to nasion and A point, this would, in effect, tell us the relationship of the malar eminence to these latter positions.

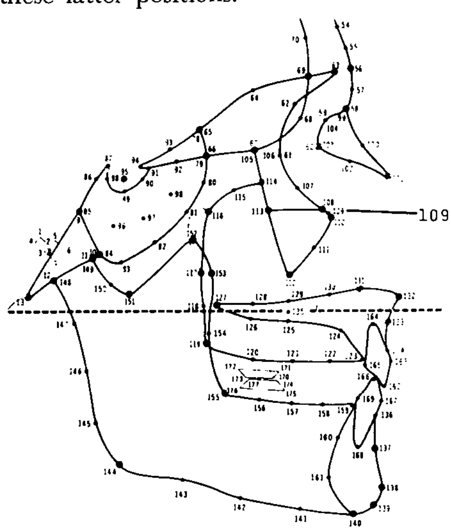

Fig. 3

The measurements used to provide information concerning the position of the malar eminence and orbital rim were computed from the extensive files of craniofacial and cephalometric data in the Biometrics Laboratory, University of Michigan.[10] Many of these records originated in the Philadelphia Growth Research Center, collected by Dr. W. M. Krogman between the years 1948 and 1968. From previous work we have found that the mid- and upper face is not markedly different when comparing boys and girls, whereas this is not true for the lower face and mandible.[11]

In this study a sample of white American females, from 15 years to 30 years, was analyzed to provide the relative position of the malar eminence to the maxilla and other cephalometric landmarks. The subjects were divided into three groups using the angle SNA as our criterion. In essence these groups represented those with retrognathic maxillae, a normal or average position of maxilla,[12] and those with some degree of maxillary protrusion. By choosing Downs' point A as a convenient forward part of the maxilla, we have tended to avoid errors introduced by an unusually long anterior nasal spine, or the effect of protruding upper incisors.

Thus Group I has an SNA angle less than 79.99, Group II an SNA angle of 80°-86°, and Group III an SNA angle of over 86. This population included 183 girls who had attended the orthodontic department either for case assessment or treatment and had a bias toward a skeletal Class II type of face. This becomes evident when the sample sizes of the various groups are examined, as Group I has 71 subjects compared with the average or orthognathic Group II with 97 subjects. For the present study, however, we are particularly interested in the retrognathic

TABLE I

71 patients with SNA less than 80°

	Min	Max	Mean	SD
SNO	46.2	64.40	54.45	3.7
NOA	113.7	154.29	132.38	8.4
SO:SN	0.74	0.90	0.81	0.33
SO:SA	0.63	0.79	0.71	0.30
O-NA (mm)	6.13	20.09	12.8	2.65

TABLE II

97 patients with SNA 80°-86°

	Min	Max	Mean	SD
SNO	46.01	65.34	57.83	4.12
NOA	103.5	146.99	128.90	8.13
SO:SN	0.75	0.91	0.85	0.34
SO:SA	0.62	0.77	0.67	0.27
O-NA (mm)	7.95	23.1	13.5	2.49

TABLE III

15 patients with SNA > 86°

	Min	Max	Mean	SD
SNO	50.69	68.91	58.63	4.21
NOA	112.59	136.11	123.09	6.46
SO:SN	0.81	0.94	0.85	0.30
SO:SA	0.62	0.71	0.67	0.23
O-NA (mm)	11.8	19.08	15.22	1.83

maxilla and the relative position of the malar eminence in such faces so the current sample is conveniently chosen.

The measurements computed were: angles sella-nasion-orbitale (SNO), nasion-orbitale-point A (NOA), ratios SO:SN, SO:SA and the distance, orbital rim line NA(ONA). Tables I-III give the above results for the three groups.

SNO is measured in a similar manner to SNA. The ratios sella-nasion to sella-orbitale (SN:SO) and sella-orbitale to sella-ptA (SO:SA) are size independent and help to evaluate the distance sella-orbitale relative to sella-nasion and sella-point A. Similarly, the NOA angle provides a measure of the "dished-in" condition of the orbital rim relative to nasion and point A. Finally, the perpendicular distance 0 to the line NA provides a direct measure of the retruded orbital rim.

Discussion

From the correlation Tables (IV and V) it will be seen that a retrusive maxilla (low SNA angle) is closely related to a backward situated orbital rim and malar eminence, but that a prominent point A does not carry with it a prominent malar or orbital rim. Clinical problems arise when a retrusive maxilla is to be advanced to restore a better esthetic balance to the profile. From the tables we would expect that the retruded maxilla occasionally carries with it a retruded or distally positioned malar eminence and orbital rim. In such a case, repositioning the palatal portion at the Le Fort I level leaves the malar and orbital rim relatively more distal or retruded and may not improve facial esthetics as much as desired. From the measurements provided, the orthodontist in conjunction with his oral surgeon colleagues can now make a more objective appraisal of the relative orbital rim position before an operation is planned, and should have better information in deciding whether or not an associated orbital rim advancement (Le Fort II operation) may be the operation of choice.

Conclusion

Data have been provided to show the relationship between the orbitale (and hence malar eminence) and the maxillary point A. This information is of importance to the orthodontist in that it establishes the normal range of relationships and also the relationships in patients who may be thought to have a retrusive maxilla and may be being considered for surgical procedures to advance the midface at the Le Fort I or II level.

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TABLE IV

Correlation coefficients in groups with SNA < 80°

	SNA	SNO	NOA	SO:SN	SO:SA
SNO	0.154				
NOA	—0.300*	0.831†			
SO:SN	0.192	0.992†	0.832†		
SO:SA	—0.409*	0.707†	0.809*	0.709*	
O-NA (mm)	0.266†	—0.846†	—0.958*	—0.852†	—0.883†

p = < 0.01 if R = > 0.301
p = < 0.05 if R = > 0.203
* indicates significance at 0.01 level
† indicates significance at 0.05 level

TABLE V

Correlation coefficients of SNA > 86°

	SNA	SNO	NOA	SO:SN	SO:SA
SNO	0.375				
NOA	0.676*	0.846*			
SO:SN	0.419	0.971*	0.874*		
SO:SA	—0.253	0.424	0.440	0.493	
O-NA (mm)	0.105	—0.662*	—0.891*	—0.746*	—0.6404*

p = < 0.05 if R = > 0.51
p = < 0.01 if R = > 0.64
* indicates significance at 0.01

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