The long face syndrome: Vertical maxillary excess

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A clinically recognizable facial morphology, the long face syndrome, is manifested primarily by excessive lower vertical facial height. Although this dysmorphology has been most commonly classified as a skeletal type of open-bite, it is apparent that the syndrome has been discussed under numerous other titles.[1-13] Extreme clockwise rotation, high angle type, adenoid faces, idiopathic long face, total maxillary alveolar hyperplasia, and vertical maxillary excess all have excessive vertical growth of the maxilla as their common denominator.[14-21]

The multipilicity of names describing this syndrome partially arises from the difficulty in describing vertical skeletal dysplasias by the traditional anteroposterior classifications and failure to direct enough effort toward describing the frontal or full-face esthetic aspects of dentofacial deformities. Because the previously mentioned facial types have many similar esthetic and cephalometric features, we have used the term *long face syndrome* to unify the various more specialized descriptive titles under one facial type.

Examination of the affected individual's frontal facial esthetics reveals that

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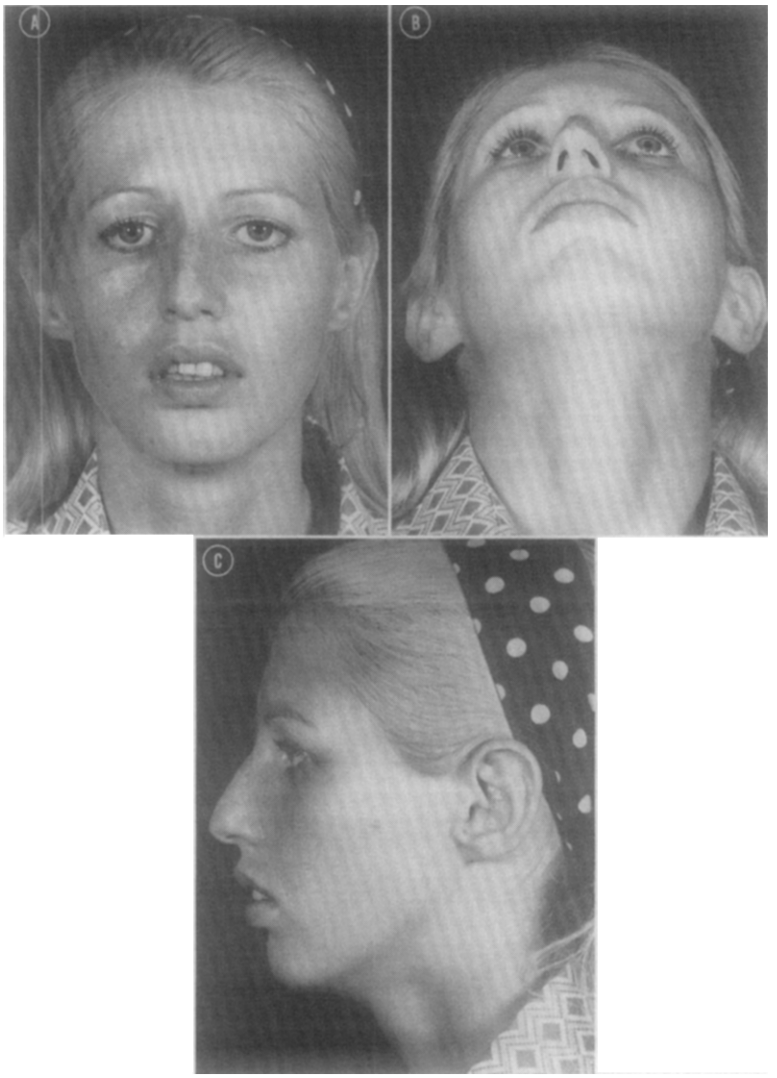

Fig. 1. Variable clinical manifestations of the long face syndrome.

the upper third of the face is usually within normal limits. Analysis of the middle third of the face reveals a narrow nose, narrow alar bases, and depressed nasolabial areas. A study of the lower third of the face commonly reveals excessive exposure of maxillary anterior teeth, poor upper-lip-to-tooth relationship, large interlabial distance, long lower third of the face, and inordinate exposure of the maxillary teeth and gingiva upon smiling (Fig. 1, *A* and *B*).

In profile the upper third of the face is normal, whereas the middle third of the face often reveals a somewhat prominent nasal dorsum and recessed nasolabial areas. In assessment of the lower third of the face, the nasolabial angle is essentially normal; there is excessive exposure of the maxillary anterior teeth,

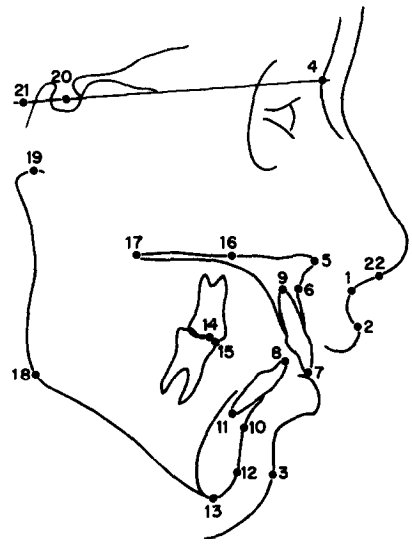

Fig. 2. Twenty-two anatomic points of the facial polygon. **1,** Subnasale; **2,** vermilion border; **3,** soft-tissue pogonion; **4,** nasion; **5,** ANS; **6,** A point; **7,** maxillary incisor tip; **8,** mandibular incisor tip; **9,** apex maxillary incisor; **10,** B point; **11,** apex mandibular incisor; **12,** pogonion; **13,** menton; **14,** mesial cusp tip $\underline{6}$; **15,** mesial cusp tip $\overline{6}$; **16,** superior palatal cortex, perpendicular to occlusal plane at point 14; **17,** PNS; **18,** gonion; **19,** summit of condyle; **20,** sella point; **21,** perpendicular from point 18 to SN line; **22,** S point.

a large interlabial distance, and a retropositioned chin (Fig. 1, *C*). Occlusal analysis of these persons most often reveals a Class II malocclusion, with or without open-bite deformity. Consistently, there is a high palatal vault with a large distance between the root apices and the nasal floor. Although the syndrome presents with these general features, it must be remembered that they are variably manifest.

Recent research by Kim[4] has confirmed our clinical experience that open-bite is not necessarily associated with the long face syndrome; indeed, some persons have open-bite, while others do not. The present study was carried out to distinguish between the two groups and to elucidate the frequency and essential cephalometric differences between the two groups. A knowledge of these differences might lead to a better understanding of the pathogenesis, diagnosis, and treatment of vertical facial imbalances. Sophisticated computer morphometric techniques based on two-dimensional spatial averaging of anatomic points were employed to derive composite multiperson facial polygons.

Methods and materials

Thirty-one white patients, 17 to 25 years of age, with vertical maxillary excess and the typical dento-facio-skeletal esthetic features of the long face syndrome were identified from the dentofacial deformity records at the Parkland Memorial and John Peter Smith Hospitals for study. Fifteen patients constituted an open-

bite group; the remaining sixteen made up the non-open-bite group. All cephalometric radiographs used for soft-tissue analysis were taken with the patient's lips in repose.

The following linear cephalometric values were measured, using a twenty-two-point facial polygon as diagrammed in Fig. 2:

1. *Angular measurements*
   MP to SN—Mandibular plane to sella nasion angle
   OP to SN—Occlusal plane to sella nasion angle
   OP to MP—Occlusal plane to mandibular plane angle
   PP to SN—Palatal plane to sella nasion angle
   SNA—Sella nasion to A point angle
   SNB—Sella nasion to B point angle
   ANB—A point nasion to B point angle
2. *Linear measurements*
   S to $\underline{6}$—Horizontal-linear distance of the mesiobuccal cusp tip of $\underline{6}$ from sella along SN
   TFH—Linear total facial height, menton-nasion, measured along a perpendicular to SN
   UFH—Linear upper facial height (anterior nasal spine—nasion) measured along a perpendicular to SN
   LFH—Linear lower facial height (anterior nasal spine–menton) measured along a perpendicular to SN.
   Ramus height—Linear height of the ramus (summit of condyle to gonion) measured perpendicular to SN.
   OP to PP—Occlusal plane to palatal plane. Height of $\underline{6}$ measured perpendicular to the occlusal plane through the mesiobuccal cusp to the *superior* cortex of the palate.
   OP to MP—Occlusal plane to mandibular plane. Height of $\overline{6}$ measured as a perpendicular to the mandibular plane through the mesiobuccal cusp to the occlusal plane.
   Anterior dental height—Linear distance from ANS to the incisal edge of the maxillary incisor along a perpendicular to SN.
   Lower incisor tip to MP—Linear distance from the mandibular incisor tip to MP along a perpendicular to MP.
   Overbite—Linear distance between the incisal edges of the maxillary and mandibular central incisors along a perpendicular to the occlusal plane.

The measured values differed from those of Isaacson and associates[17] in two respects. First, in measuring OP-PP, the superior palatal cortex was used instead of the inferior cortex. Second, open-bite and non-open-bite were separated with reference to the occlusal plane. If the incisors overlapped the occlusal plane, the patient was categorized as having a non-open-bite; when the incisors did not cross the occlusal plane, the patient was classified as having an open-bite. The linear amount of overbite or open-bite was measured perpendicular to the occlusal plane (Fig. 3).

Twenty-two anatomic points were used to obtain the pertinent measurements. Landmarks were identified by conventional definition, except where noted otherwise.

The sets of twenty-two points were fed into a DEC system-10 computer from paper tape by the following method. A tracing was made of each lateral cephalometric radiograph. The tracing was then placed on a flat grid and each point

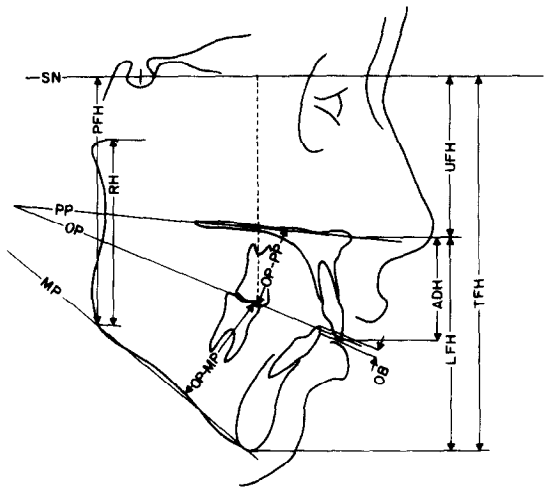

Fig. 3. Cephalometric measurements.

entered by a sonic digitizer pen.* The coordinates of each point were then computed with respect to a new set of axes (S-N being horizontal) which was standard for all patients.

The coordinates of each point were averaged over the two groups and the resulting mean coordinates were viewed interactively on a Tektronix 4012 computer graphics display or cathode-ray tube (CRT) and plotted on a Calcomp digital drum plotter with an 11-inch bed. Additional lines were then drawn (by the plotter), forming a facial polygon so that planes and angles could be easily identified for the open-bite and non-open-bite groups (Figs. 4 and 5). Linear numerical values were also derived directly from the computer files. All angular measurements were made by hand with a protractor. Means and standard deviations for most cephalometric measurements were computed (Table I).

The average maxillary lip length and amount of exposed teeth were measured in the relaxed lip position according to the method of Burstone.[22] The upper lip was measured from subnasale to stomion (lowest point of the upper lip). The amount of maxillary anterior tooth exposure was measured from stomion to the maxillary incisor cusp tip perpendicular to the palatal plane.

Results

The vectorial parameters of antero-posterior and vertical relations for the two groups of patients are shown in Table I. The average mandibular plane angle (MP-SN†) was greater in the open-bite group (48.61 degrees) than in the non-open-bite group (39.78 degrees); both, however, were significantly greater than normal (31.75 degrees). The standard deviation for the open-bite group MP-SN

*The authors are grateful to the Division of Cardiology, The University of Texas Southwestern Medical School, for allowing the use of their Graf pen sonic digitizer.

†The MP-SN angle, OP-SN angle, ANB angle, PFH, and RH between the open-bite group and the non-open-bite group were significantly different at the $P = 0.05$ level.

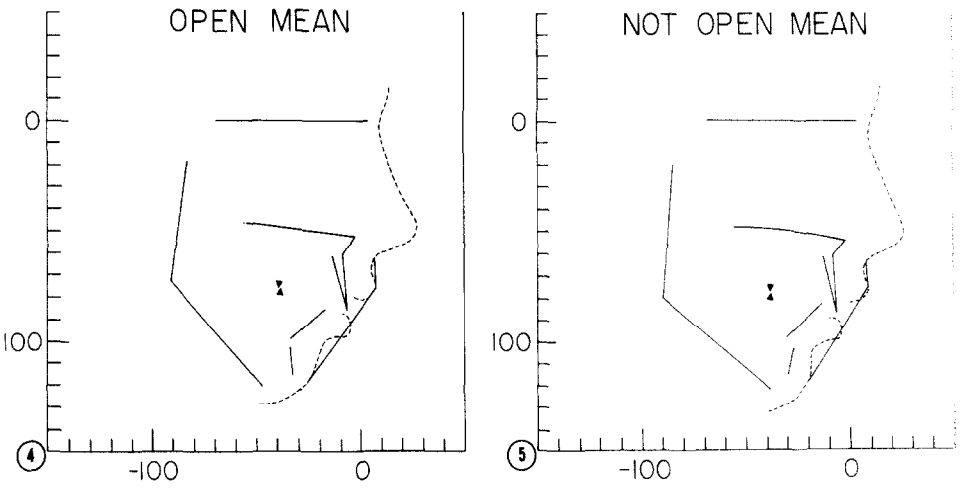

Fig. 4. Open mean.
Fig. 5. Not open mean.

angle was large (7.90 degrees) and this quite variable. The occlusal plane angle (OP-SN) followed the same trend. The open-bite group has a steeper occlusal plane angle (20.6 degrees) than the non-open-bite group, which was essentially normal (14.39 degrees versus 15.70 degrees for the norm). There were no significant differences among the OP-MP angles in the two groups.

The SNA in both the open-bite and overbite groups was within normal limits (81.18 degreees). This suggests that the anteroposterior relation of the maxilla to the cranial base was normal in both patient populations. The SNB measurement was significantly decreased in both study groups (more so in the open-bite cases), indicating the relative spatial retrodisplacement of the mandible. Similary, the ANB difference was significantly increased in both study groups—8.54 in the open-bite group and 6.02 in the non-open-bite group versus 3.20 in the normal MP-SN angle group.

The linear distance from a perpendicular to SN through the mesial cusp of the upper first molar to sella was used to describe the horizontal placement of the maxillary denture. This measured the anteroposterior relationship of the maxilla to sella and was also within normal limits in both study groups.

The lower portion of Table I lists the linear values. The total facial height (TFH) were greater than the norm in both study groups. The upper face height (UFH) was not increased in either of the study groups. The lower face height (LFH), however, was significantly increased in both of the study groups—68.13 mm. open-bite and 68.06 mm. non-open-bite versus 62.05 mm. in the controls. When lower facial height is measured parallel to the facial plane, the open-bite is approximately 5 mm. greater than the non-open-bite group. Total facial height in the open-bite group is several millimeters longer also. Characteristic face height ratios are shown in Table III.

The largest vertical difference between the two study groups was in posterior facial height (PFH); the average open-bite group was 72.87 mm., compared to

Table I. Cephalometric values

Measurements	*VME Open-bite*		*VME Not-open-bite*		*Isaacson's average group**	
	Mean	*1 S.D.*	*Mean*	*1 S.D.*	*Mean*	*1 S.D.*
Angular (degrees)						
MP-SN	48.61	7.90	39.78	4.93	31.75	1.36
OP-SN	20.06	5.33	14.39	5.33	15.70	2.33
OP-MP	28.55	6.71	25.39	5.50	16.05	2.48
PP-SN	6.19	3.73	6.65	4.13	—	—
SNA	78.86	3.38	79.50	2.75	81.18	2.35
SNB	70.45	4.01	73.48	2.41	77.98	2.12
ANB	8.54	2.04	6.02	2.81	3.20	3.32
Linear (mm.)						
Sella-6 horizontal	30.92	5.35	31.45	7.59	32.50	3.91
TFH	120.87	7.68	122.25	6.65	115.30	5.39
UFH	52.73	3.75	54.19	3.76	53.25	2.60
LFH	68.13	6.57	68.06	5.56	62.05	3.72
PFH	72.87	11.19	80.13	8.09	—	—
Ramus height	54.53	9.28	60.88	6.58	56.30	3.92
Palatal height (OP-PP)	23.94	3.23	25.45	3.05	19.63	1.73
Mandibular height (OP-MP)	36.11	4.05	34.15	3.78	28.20	2.26
Anterior dental height (maxillary)	33.19	3.26	33.13	3.64	28.70	1.87
Overbite	3.10	2.47	2.72	2.34	3.38	2.09
Lower incisor tip to MP	46.14	4.78	46.13	4.16	—	—

*Isaacson, J. R., Isaacson, R. J., Speidel, M. T., and Worms, F. W.: Angle Orthod. 41: 219-229, 1971.

the non-open-bite group average of 80.13 mm. The ramus height of the open-bite group (54.53 mm.) was essentially normal (56.30 mm.), while the ramus height of the non-open-bite group was long (60.88 mm.).

The posterior height of the maxilla (OP-PP) was measured as a perpendicular from the occlusal plane to the palatal plane at the mesial cusp tip of the first molar. Both study groups were greater than the normal of 19.63 mm.; open-bite 23.94 mm. and non-open-bite 25.45 mm. The mandibular height at the molar (OP-MP) was increased in both of the study groups (open-bite 36.11 mm. and non-open-bite 34.15 mm.) when compared to the norm of 28.70 mm. Anterior mandibular height at the incisor was the same in both of the study groups (46.1 mm.) and greater than the reported norm (28.70 mm.). Anterior maxillary dental height in both study groups was the same (average, 33.2 mm.) and much greater than normal. Overbite was –3.12 mm. in the open-bite group and 2.72 mm. in the non-open-bite group.

While not all of the measurements are reported here, superimposition of the facial polygons demonstrated that the position of the maxilla and the angulation of PP and maxillary incisors were almost identical in the open-bite and non-open-bite groups (Fig. 6). Mandibular length (gonion-menton) was very similar in both groups.[8] However, the mandible in the open-bite group with a shorter ramus is spatially posteriorly displaced. Correlation coefficients were analyzed for vertical maxillary height (OP-PP) and mandibular height (OP-MP) as they related to

Table II. Upper lip relations

	Normal†				*VME*			
	Males		*Females*		*Males (3)**		*Females (23)**	
Length (mm.)	*Mean*	*1 S.D.*	*Mean*	*1 S.D.*	*Mean*	*1 S.D.*	*Mean*	*1 S.D.*
Upper lip length	23.8	1.5	20.1	1.9	23.50	‡	20.52	2.46
Maxillary incisor exposure	2.3	1.9	2.3	1.9	5.17	‡	6.26	3.01

*Number of patients fitting Burstone criteria.

†See Burstone.[22]

‡Too small for S.D. to be of value.

Table III. Vertical face height ratios

Ratio	*VME open-bite*	*VME not open*
LFH/TFH	0.564	0.557
PFH/TFH	0.603	0.656

total facial height. The correlation for OP-PP/TFH, was r = 0.75 in the open-bite group and r = 0.74 in the non-open-bite group. For OP-MP/TFH, the correlation was r = 0.82 in those with open-bite and r = 0.47 in those with a non-open-bite.

Lip measurements are compared to the Burstone norms in Table II.[22] There was no difference in lip length among the three groups. The amount of maxillary teeth exposed, however, was greater in both of the vertical maxillary excess groups. These data confirmed the clinical judgment that both study groups demonstrated excessive exposure of the upper teeth.

Discussion

The central skeletal dysmorphology of the long face syndrome is vertical maxillary excess.[9, 17, 18] Vertical height of the maxilla had a strong positive correlation with increased anterior facial height. The increased mandibular body height also correlated well with total facial height in the open-bite group. It did not correlate strongly in the non-open-bite group. Other investigations have reported similar results.[5, 17]

A difference in the posterior facial height (PFH) measurements was the primary difference between the two groups under study. The average PFH of the open-bite group was small (72.87 mm.) compared to the PFH of the overbite group (80.13 mm.). This was correlated with a shortened ramus height of the open-bite group (54.53 mm.) while the ramus height of the non-open-bite group was long (60.88 mm.), compared to the normal of 56.30 mm. These data suggest that there was greater vertical growth in the ascending mandibular ramus of the non-open-bite group which prevented the development of an open-bite. No conclusions as to why this occurs can be made from this study. Cephalometrically, open-bite and non-open-bite are variants of the long face syndrome having different mandibular development. Both groups had the same lower anterior dental

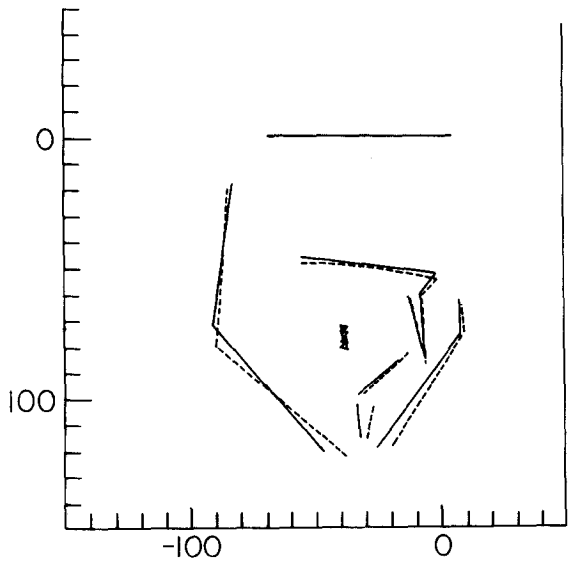

Fig. 6. Superimposition of the facial polygons. Solid line represents the open-bite polygon and dotted line represents the non-open-bite polygon.

height, indicating that the overbite was probably not achieved by an increase in anterior mandibular alveolar height. Overbite measured -3.12 mm. in the open-bite group and 2.72 mm. in the non-open-bite group. The palatal plane angle (PP-SN) was smaller in both study groups than the normal average reported by Nahoum[5] and close to his open-bite average of 5.14 degrees. Lower facial height was similar in both groups when measured perpendicular to the sella nasion plane. If a more direct measurement parallel to the facial plane from anterior nasal spine to menton is made, the open-bite group has a longer lower facial height. This is not reflected in measurements perpendicular to the sella nasion plane because the mandible is spatially retrodisplaced in the open-bite group while retaining essentially the same Y coordinate. The shorter ramus and increased occlusal plane angle and gonial angle allow this movement to occur. The open-bite group's total anterior facial height is only increased approximately 2 mm. when measured by this method, because of the slightly shorter upper facial height. In future studies, correlations would be more accurate if lower facial height were measured in relation to the facial plane.

Superimposition of the facial polygons demonstrates that the maxillary placement and angulation of PP and maxillary incisors was almost identical in both groups (Fig. 6). In addition, such studies demonstrate no significant difference in mandibular body length but do show graphically the two ramus heights and retrodisplacement spatially of the mandible with open-bite. Of interest is the shorter posterior maxillary dental height relationship with a shorter ramus height in the open-bite group. *The variation between the ramus and posterior facial heights constituted the principal difference between the two groups.* It must be remembered, however, that posterior facial height is also influenced by the vertical and horizontal position of the glenoid fossae.[23]

Actual measurements can be obtained from the facial polygons, or they may be used as templates when enlarged. A centimeter scale is included for this purpose. Means taken from these polygons are morphologically more accurate because of the x-y averaging, especially between nonhomogeneous groups.

Comparison of the amount of maxillary incisor exposed in VME patients and the normal population confirms the clinical experience that this group has more tooth exposure when the lips are relaxed. The average lip length in VME is not short, as often clinically stated, but of normal length when compared to Burstone's normal values.[22, 24]

The use of computerized techniques for both input (digitization of the cephalometric radiographs) and output (computer graphic display plots) greatly facilitated this study and augmented the use of the digital computer as a statistical tool. These techniques add to previous applications of the computer in dental research.[25, 26] The display of composite faces for the open-bite and non-open-bite cases and the presentation of the superimposed facial polygons were of particular value. The ability to review results immediately on the computer graphics CRT display, which could be done remotely from the computing faculty (via either telephone or hard-wired lines), permits the extension of such computer power to the laboratory, clinic, or office.

Conclusions

Cephalograms of patients clinically diagnosed as having the long face syndrome were analyzed by computer morphometrics and statistical analysis. Certain typical cephalometric features were identified:

1. The total anterior face height was increased, specifically, the lower face height.
2. The increased face height correlated with excess development of the maxilla in a vertical direction.
3. Open-bite and non-open-bite are two variants of the long face syndrome. (A) A normal ramus height existed in the open-bite patients. (B) An increased ramus height was seen in non-open-bite patients.
4. A high mandibular plane angle was characteristic of both groups.
5. A normal upper lip length with an excess display of the anterior maxillary teeth was found in both study groups.

Summary

There is a clinically recognizable facial morphology, the long face syndrome, which has been incompletely described in the literature. On the basis of the clinical summary in thirty-one adults with this syndrome, an analysis of esthetics, skeletal morphology, and occlusion was undertaken. Herein we report on these findings, which confirm that this basic dentofacial deformity is associated with excessive vertical growth of the maxilla. Dental open and closed bite are two variants of the syndrome. An increased mandibular ramus height is associated with the closed-bite group.

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