Craniofacial morphology in children with Angle Class II-1 malocclusion with and without deepbite

Alf Tor Karlsen, DDS

The relationship between dental occlusion and craniofacial morphology has long been a popular topic among orthodontic researchers. Many have looked for craniofacial characteristics for Angle's various occlusion classes, particularly for Class II-1.[1-10] Others have tried to find a connection between varying degrees of overbite and craniofacial morphology.[11-17] The topic is therefore well documented, although there is not agreement on all points.

Suprisingly few researchers have compared the craniofacial patterns in Class II-1 with deepbite and Class II-1 without deepbite. A difference in the vertical incisor relation could be expected to reflect craniofacial differences, for instance - considering the anterior lower facial height.[11,16,18,19] This implies that Angle Class II-1, craniomorphologically speaking, is a rather heterogeneous occlusion class. The aim of the present study was to analyze the craniofacial morphology in Angle Class II-1 malocclusions with and without deepbite.

Material and methods

The material comprised 71 Swedish children placed into three groups. Group 1 (n=25) was

Abstract

The craniofacial morphology of children with Class II-1 malocclusion with and without deepbite was studied and compared with that of a control group of children with normal occlusion. Common for the Class II-1 children was a short mandibular corpus, which was probably the main reason these children had a distal basal jaw relationship.

The Class II children with deepbite differed from the control group in ways. They had: 1) a distal relationship between points A and B; 2) a distal relationship between points A and pogonion; and 3) a discrepancy in length between the corpora of the two jaws. These deviations discriminated nearly 95% correct between the deepbite group and the controls.

The most characteristic deviations in the Class II children without deepbite, in relation to the controls, were: 1) a distal relationship between points A and B; 2) a small angle between the nasal plane and the anterior cranial base; and 3) a long mental process. These deviations discriminated about 95% correct between the experimental group and the controls.

Many of the craniofacial differences between the Class II groups could, theoretically, be explained by the MP-SN angle being, on average, 9 degrees larger in the children without deepbite. Most typical was that this group has 1) a larger lower anterior face height, 2) larger maxillary and mandibular incisal heights, and 3) a more obvious distal relationship between points A and pogonion. In combination, these differences discriminated correctly between the Class II groups in 90% to 97% of the cases.

Key Words

Angle Class II-1 • Vertical incisor relationship • Cephalometrics • Children

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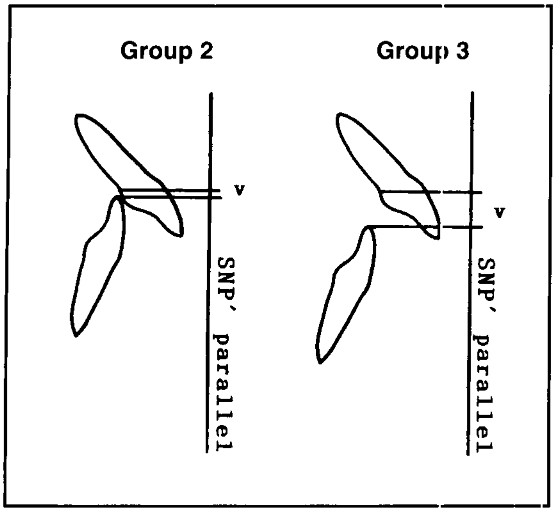

Figure 1
The difference in distance v between average cases. Mean values for distance v were 0.5 mm in group 2 and 5.7 mm in group 3, varying from -1.0 mm to 2.0 mm in the former and from 4.0 mm to 8.5 mm in the latter. In comparison, the distance v in the normal group averaged 6.1 mm, varying from 5.0 mm to 7.0 mm.

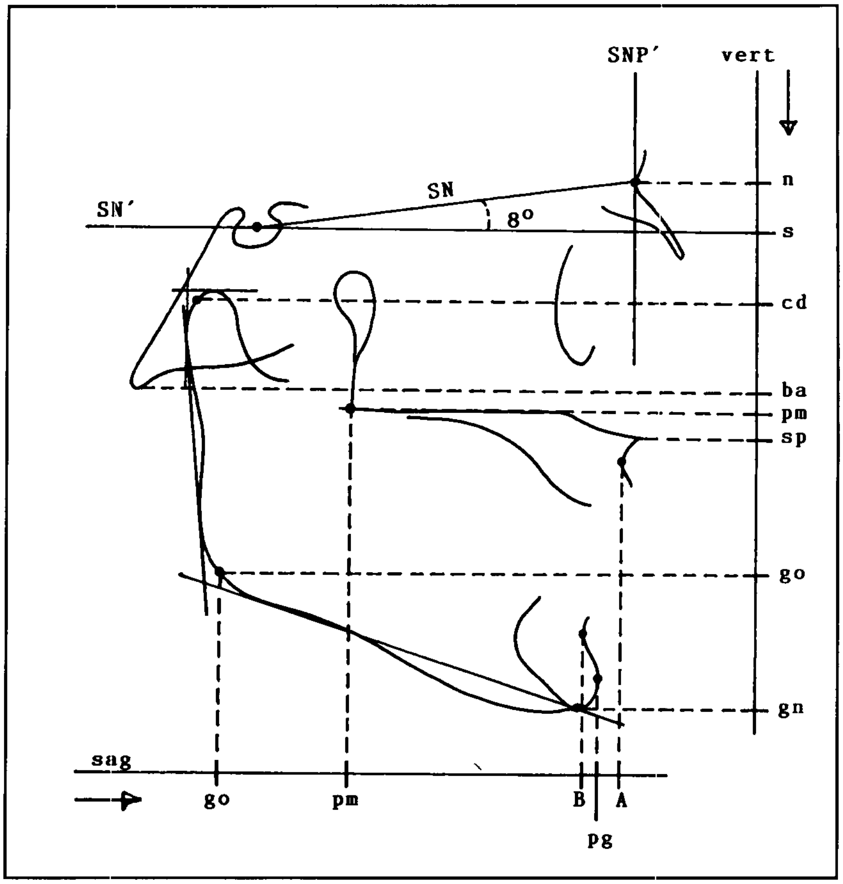

Figure 2
Reference points were projected on parallels to sagittal axis SN' and vertical axis SNP'. Sagittal distances were read from left to right, vertical distances from top to bottom (Table 2, vv 1-11.)

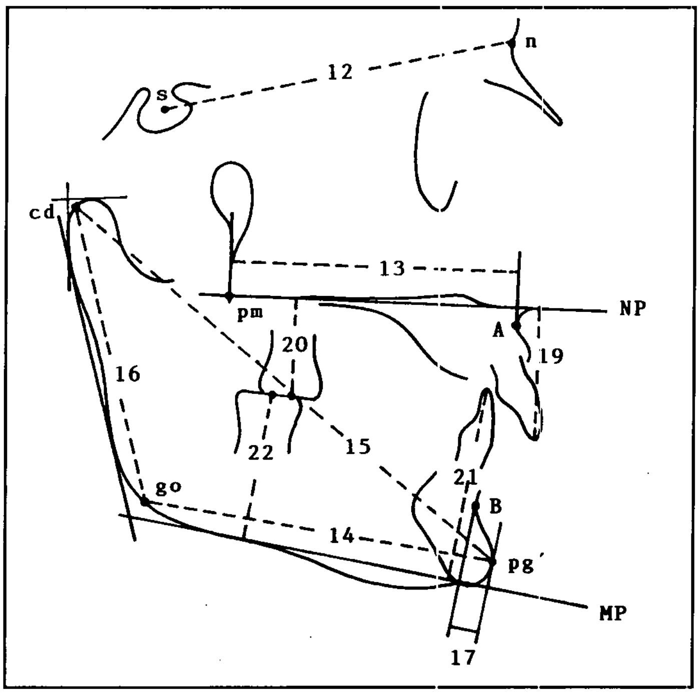

Figure 3
Linear variables within cranial base and jaws. Variables numbered according to Table 2 (vv 12-17 and 19-22).

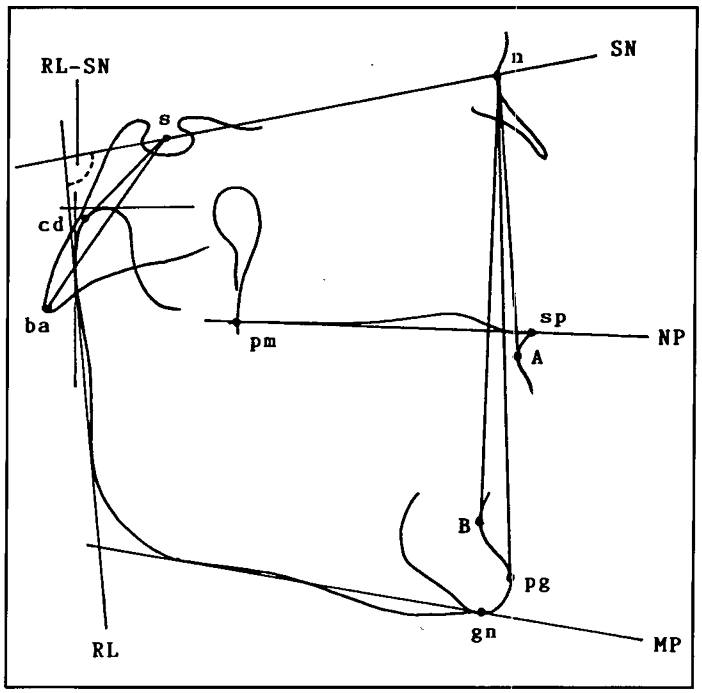

Figure 4
Reference points and lines used (Table 2, vv 25-33). An unusual angle, RL-SN, is marked.

a normative group composed of children that, clinically speaking, essentially met Angle's[20] requirements for an ideal occlusion. In groups 2 and 3 the children had Angle Class II -1 malocclusion with at least 8 mm overjet. In addition, group 2 (n=22) had deepbite, while group 3 (n=24) was required to not have deepbite.

In groups 1 and 3 sex distribution was as even as possible. Group 2, on the other hand, had a clear majority of boys (18 boys and 4 girls). The children were from 10 to 15 years old. The mean ages for groups 1, 2, and 3 were 12.9 years, 12.4 years, and 12.3 years, respectively.

Roentgenocephalometric analysis

A lateral cephalogram was taken of each child with the teeth in occlusion. Each cephalogram was traced and measured twice. The uneven sex distribution in group 2 suggested that a direct comparison of linear variables between the groups should be avoided (boys are generally larger than girls). Instead, most of the linear variables were placed together in indices, or they were expressed as a ratio to the length of the anterior cranial base (distance S-N), the latter as recommended by Schwarz.[21]

Some craniofacial dimensions were measured in a coordinate system with sagittal and vertical axes. The sagittal axis was constructed through sella at an angle of 8° to SN and referred to as SN marked (SN'). The vertical axis was the perpendicular to SN' through nasion, in the following referred to as SNP marked (SNP'). The background for choosing this coordinate system is described elsewhere.[22]

The vertical incisor relation was measured on the cephalograms along the vertical axis of the face from the cementoenamel junction of the most prominent maxillary central incisor to the incisal edge of the most prominent mandibular incisor (Figure 1, distance v). If the incisal edge lay superior to the cementoenamel junction, the distance v was given a negative value. Wylie[11] suggested a similar method when measuring vertical incisor relationships. For selection to group 2 the distance v was to be 2 mm or less, for selection to group 3 it was to be 4 mm or more.

The reason for not measuring vertical overbite in the traditional manner is that this dimension gets smaller when the maxillary incisors procline. A vertical overbite can give an unrealistic impression of the vertical incisor relation. This was also pointed out by Prakash and Margolis.[12] In the present study both group 2 and group 3 contained children with, in many cases, strongly proclined maxillary incisors. In one child in group 2, for example, there was deepbite with lesions of the palatine gingiva and a vertical overbite of just under 5 mm. Even distance v is affected when the maxillary incisors procline, though to a lesser degree than the vertical overbite.

Figure 2 shows how reference points were projected on parallels to SN' and SNP'. Lin-

Table 1
Definition of reference points and lines

Reference points (in alphabetical order)	
A-point	The deepest point on the contour of the maxillary alveolar process, measured in relation to the sagittal axis SN'.
B-point	The deepest point on the contour of the mandibular alveolar process, measured in relation to the sagittal axis SN'.
Basion (ba)	The lowest, most posterior point on the anterior contour of the foramen magnum.
Condylion (cd)	Point on the contour of the condyle obtained by bisecting the angle formed by tangents to the upper and posterior borders of the condyle, the tangents being parallels to the sagittal and vertical axes of the face, respectively.
Gnathion (gn)	The deepest point of the symphysis, measured in relation to the vertical axis SNP'.
Gonion (go)	Point on the contour of the mandible obtained by bisecting the angle between the mandibular plane and the tangent to the posterior border of the mandible.
L6	Mid-point of the occlusal surface of the mandibular first permanent molar.
Nasion (n)	Anterior limit of the nasofrontal suture.
Pogonion (pg)	The most prominent point of the symphysis, measured in relation to the sagittal axis of the face (SN').
Pogonion marked (pg')	The most prominent point of the symphysis, measured in relation to the mandibular plane (MP).
Pterygomaxillare (pm)	Point of intersection of hard palate, soft palate and pterygopalatal fissure.
Sella (s)	Center of sella turcica.
Spinal point (sp)	Apex of the anterior nasal spine.
U6	Mid-point of the occlusal surface of the maxillary first permanent molar.
Reference lines	
SN Anterior cranial base	The line between sella and nasion.
NP Nasal plane	The line between pterygomaxillare and the spinal point.
MP Mandibular plane	The tangent to the lower border of the mandible through gnathion.
RL Ramus line	The tangent to the posterior border of the mandible.

Table 2

Variables measured along the sagittal axis 'SN' (Figure 2)		
1.	B-A sag	Sagittal distance between points A and B.
2.	pg-A sag	Sagittal distance between A-point and pogonion.
3.	go-pm sag	Sagittal distance between the posterior borders of the mandibular (go) and maxillary (pm) corpora
4.	B-pg sag	Sagittal distance between B-point and pogonion. Inclination of the symphysis
Variables measured along the vertical axis 'SNP' (Figure 2)		
5.	n-gn vert	Anterior facial height
6.	n-sp vert	Anterior upper facial height
7.	sp-gn vert	Anterior lower facial height
8.	s-go vert	Posterior facial height
9.	s-pm vert	Posterior upper facial height
10.	pm-go vert	Posterior lower facial height
11.	$\frac{\text{cd-ba vert}}{\text{s-cd vert}} \cdot 100$	Vertical relationship between the condyles and the medial cranial base.
Linear variables within the cranial base and jaws (Figure 3)		
12.	s-n	Length of the anterior cranial base
13.	pm-A	Distance between pterygomaxillare and A-point, measured along the nasal plane (NP). Length of the maxillary corpus.
14.	go-pg'	Length of the mandibular corpus
15.	cd-pg'	Length of the mandibular base
16.	cd-go	Height of the mandibular ramus
17.	B-pg'	Distance between B-point and pogonion marked, measured along the mandibular plane (MP). Length of the mental process.
18.	$\frac{\text{pm-A}}{\text{go-pg'}} \cdot 100$	Ratio between the lengths of the maxillary and mandibular corpora.
19.	NP-is	Vertical distance between incision superius and nasal plane (NP). Maxillary incisal height.
20.	NP-U6	Vertical distance between point U6 and nasal plane (NP). Maxillary molar height.
21.	ii-MP	Vertical distance between incision inferius and the mandibular plane (MP). Mandibular incisal height.
22.	L6-MP	Vertical distance between point L6 and the mandibular plane (MP). Mandibular molar height.
23.	$\frac{\text{NP-is} - \text{NP-U6}}{\text{NP-U6}} \cdot 100$	Difference between maxillary incisal and molar heights, measured in relation to the maxillary molar height.
24.	$\frac{\text{ii-MP} - \text{L6-MP}}{\text{L6-MP}} \cdot 100$	Difference between mandibular incisal and molar heights, measured in relation to mandibular molar height.
Angles (Figure 4)		
25.	SNA	Maxillary prognathy.
26.	SNB	A measurement of mandibular prognathism.
27.	SNpg	A measurement of mandibular prognathism.
28.	NP-SN	Nasal plane angle.
29.	MP-SN	Mandibular plane angle.
30.	RL-SN	Inclination of mandibular ramus.
31.	MP-RL	Jaw angle.
32.	ba-s-n	Medial cranial base angle.
33.	cd-s-n	Lateral cranial base angle.

ear variables measured sagittally were marked sag, while those measured vertically were marked vert. Figure 3 illustrates linear variables within the cranial base and jaws. Points and lines used for measurement of angular variables appear in Figure 4. Reference points and lines are defined in Table 1. Linear variables, indices, and angles are explained in Table 2.

Statistical method

Craniofacial differences between groups 1, 2, and 3 were tested with the Student's t-test. The significance level was set at $P=0.05$. Multiple testing of the same data sets required Bonferroni adjustment to $P<0.015$ for each single test ($\approx 0.05/3$).[23] In a subsequent stepwise discriminant analysis, only variables that showed at least one significant group difference were included. The discriminant analysis was done with program 7M in the statistical package BMDP[24] and run on a VAX 6330 (Digital Equipment Corporation - Maynard, Mass) computer at the University of Oslo. The 7M program prints out two different classification matrices, an ordinary and a so-called Jackknifed matrix. In the former, the classification formula is calculated from data from all cases, in the latter from all cases except the one that is in the process of classification. The Jackknifed matrix therefore provides the most correct portrait of the classification formula's ability to classify new cases correctly.

Results

The findings are presented in Table 3.

Prognathy

Both group 2 and group 3 had a mandibular retrognathy measured at the B-point (v 26). If, however, pogonion was used as a reference point, mandibular retrognathy was significant only in group 3, and not in group 2 (v 27). In group 3 the chin had a somewhat recessive appearance, while the opposite was true for group 2 (v 4).

Sagittal jaw relations

Groups 2 and 3 had a distal relationship between A-point on the one side and point B and pogonion on the other. This distal reationship was more notable in group 3 than in group 2 (vv 1 and 2).

Size of the mandible

In groups 2 and 3 the mandibular corpus was shorter than in the normal group (v 14). Not surprisingly, therefore, the index that displays the relationship in length between the maxil-

Table 3
Craniofacial differences between groups 1 and 2, 1 and 3 and 2 and 3 were tested with Student's t-test. In the table are listed mean values of variables that showed at least one significant group difference. P-values for the significances are also noted.

	Variables	$\bar{x}1$	$\bar{x}2$	$\bar{x}3$	1 vs 2	1 vs 3	2 vs 3
1.	B-A sag (mm)	3.9	8.9	11.1	.0000	.0000	.0076
2.	pg-A sag (mm)	2.5	5.9	10.7	.0009	.0000	.0001
4.	B-pg sag (mm)	1.4	3.0	0.4	.004	NS	.0001
5.	$\frac{\text{n - gn vert}}{\text{s - n}} \cdot 100$	160.3	152.7	164.9	.0018	NS	.0000
6.	$\frac{\text{n - sp vert}}{\text{s - n}} \cdot 100$	79.3	70.6	71.6	.012	NS	NS
7.	$\frac{\text{sp - gn vert}}{\text{s - n}} \cdot 100$	86.5	82.0	93.4	NS	.0006	.0000
10.	$\frac{\text{pm - go vert}}{\text{s - n}} \cdot 100$	48.2	45.6	42.6	NS	.002	NS
11.	$\frac{\text{cd - ba vert}}{\text{s - cd vert}} \cdot 100$	60.5	64.3	73.0	NS	.016	NS
14.	$\frac{\text{go - pg'}}{\text{s - n}} \cdot 100$	108.4	101.4	101.7	.0006	.0002	NS
15.	$\frac{\text{cd - pg'}}{\text{s - n}} \cdot 100$	163.1	154.6	159.2	.0011	NS	NS
17.	B-pg' (mm)	6.6	8.1	8.3	NS	.0000	NS
18.	$\frac{\text{pm - A}}{\text{go - pg'}} \cdot 100$	65.2	69.3	69.2	.0005	.0002	NS
19.	$\frac{\text{NP - is}}{\text{s - n}} \cdot 100$	37.0	37.8	41.3	NS	.0003	.0094
20.	$\frac{\text{NP - U6}}{\text{s - n}} \cdot 100$	30.6	28.4	32.4	NS	NS	.0001
21.	$\frac{\text{ii - MP}}{\text{s - n}} \cdot 100$	55.9	56.0	59.2	NS	.004	.0092
23.	$\frac{\text{NP - is - NP - U6}}{\text{NP - U6}} \cdot 100$	21.5	33.5	27.7	.004	NS	NS
24.	$\frac{\text{ii - MP - L6 - MP}}{\text{L6 - MP}} \cdot 100$	22.4	29.0	28.9	.0003	.0001	NS
26.	SNB (°)	80.8	77.4	76.4	.0008	.0000	NS
27.	SNpg (°)	81.8	79.8	77.5	NS	.0000	NS
28.	NP-SN (°)	8.8	7.4	6.4	NS	.006	NS
29.	MP-SN (°)	28.7	28.0	37.0	NS	.0000	.0000
31.	MP-RL (°)	123.0	123.6	130.5	NS	.0000	.0003

Significance level set to 5%. Bonferroni adjustment for multiple testing requires that $P \leq 0.015$.
NS = not significant.

lary and mandibular corpora showed a higher value in the two former groups than in the latter (v 18). The mental process, however, was longer in group 3 than in group 1 (v 17). In group 2 the distance from condyle to chin was shorter than normal (v 15). In group 3 this distance was approximately equal to that of the normal group, probably due to the relatively large jaw angle (v 31) in group 3.

Vertical basal relationship

In group 3 the lower anterior facial height was larger than in groups 1 and 2 (v 7), and the lower posterior facial height was less than in group 1 (v 10). Furthermore, in group 3 the MP-SN angle was larger than in the two other groups (v 29), and the condyles had a higher position than in group 1 (v 11). (The latter difference was just on the limits of being significant with P=0.016). In the upper face, group 3 differed from the normal group by a smaller NP-SN angle (v 28). Group 2 had a smaller upper anterior facial height than normal (v 6). Further, the total anterior facial height in group 2 was smaller than in either group 1 or group 3 (v 5)

Dental heights

In group 3 both the maxillary and the mandibular incisal heights were larger than in the two other groups (vv 19 and 21). In addition, the maxillary molar height was larger than in group 2 (v 20). In group 2 the index describing the relationship between the maxillary incisal and molar heights showed a higher value than in group 1(v 23). In the lower jaw the corresponding index had a higher value than normal not only in group 2, but in group 3 as well (v 24).

Discriminant analysis

The combination B-A sag (v 1), pg-A sag (v 2) and $\frac{pm-A}{go-pg'} \cdot 100$ (v 18) discriminated 93.6% correct between the normal group and group 2 (96% correct for the normal group and 90.9% correct for group 2). The percentages were the same in the ordinary classification matrix and in the Jackknifed matrix.

The combination B-A sag (v 1), NP-SN (v 28), and B-pg' (v 17) discriminated 95.9% correct between the normal group and group 3 (100% correct for the normal group and 91.7% correct for group 3). Here, as well, the percentages were identical in the two classification matrices.

The combination sp-gn vert (v 7), NP-is (v 19), ii-MP (v 21), and pg-A sag (v 2) discriminated 97.8% correct between the two Class II-1 groups in the ordinary classification matrix (100% correct for group 2 and 95.8% correct for group 3). In the Jackknifed matrix the values were somewhat lower (89.1% correct discriminance overall, 90.9% correct for group 2 and 87.5% correct for group 3).

Discussion

Group 2 (Class II-1 with deepbite)

There was almost no difference between group 2 and the normal group regarding the length of the maxillary corpus or the sagittal distance between gonion and pterygomaxillare. Neither was there any significant difference between these groups in the inclination of the mandibular plane. The mandibular corpus in group 2 was, however, shorter both in relation to the maxillary corpus (v 18) and facial development in general (v 14). The short mandibular corpus was probably the prime reason that children in group 2 had a distal relationship between A-point on the one side and B-point and pogonion on the other (vv 1 and 2). Characteristics associated with the sagittal basal jaw relationship and with the relative size of the jaws (v 18) were the strongest discriminators between group 2 and the normal group. The present findings are in agreement with Craig[4] who found that gonion lay approximately just as far forward with Angle Class II-1 and Angle Class I. With Class II-1, though, the mandibular corpus was shorter, so that the chin obtained a more posterior position than with Class I. Nelson and Highly[2] and Hunter[7] also reported the mandibular corpus to be short with Angle Class II-1 malocclusions.

In group 2 both the total anterior and the upper anterior facial heights were significantly smaller than in the normal group (vv 5 and 6). That the anterior upper facial height was underdeveloped in the group with deepbite is not in agreement with earlier studies. So, Björk[18] could see no connection between the anterior upper facial height and the vertical overbite. Atherton[19] found that the anterior upper facial height was overdeveloped with deep bite. Moyers et al.[9] described a type of Angle Class II-1 where the presence of a deepbite was partially due to the nasal plane being tipped down anteriorly. However, there is general agreement that the total anterior, and especially the anterior lower facial height, is underdeveloped with deepbite.[11,16,18,19] In group 2 the anterior lower facial height was not significantly smaller than in the normal group, but there was a clear tendency to such a difference with P=0.029. In comparison, the difference in the anterior upper facial height between group 2 and the normal group was significant with P=0.012. The two P-values lay near one another, though each on its own side of the significance border. With a slight approximation one could say that the underdevelopment of the total anterior facial height in group 2 spread itself fairly evenly over the upper and lower portions of the face.

The two indices that express the relationships between the incisal and molar heights of the respective jaws had a clearly higher value in group 2 than in group I (vv 23 and 24). The mean values for the incisal and molar heights show that the children in group 2 had a strong tendency toward underdevelopment of both the maxillary and mandibular molar heights with P=0.024 and P=0.018 respectively. Theoretically, this deviation could have been due to the absence of a stable incisal occlusion in group 2. Thus, Björk and Skieller[25] found that incisal occlusion could affect not only the mandibular rotation, but the dentoalveolar devlopment as well. When the incisal occlusion was stable, the mandible usually rotated anteriorly on a fulcrum at the mandibular incisors. Then the molars in both jaws would erupt more than the incisors as compensation for the jaw rotation. If, however, the incisal occlusion was unstable, the fulcrum for an anterior mandibular rotation could find its position more posterior in the mandibular dentition, resulting in the development of a skeletal deepbite. In such cases a differentiated eruption of incisors and molars failed to take place.

Group 3 (Class II-1 without deepbite)

Group 3, like group 2, had a distal relationship between A-point on the one side and points B and pogonion on the other (vv 1 and 2). There was no deviation from normal in gonion's sagittal position or in the length of the maxillary corpus. The distal basal relationship was, as in group 2, primarily due to a short mandibular corpus (v 14). In addition, group 3 had a steep mandibular plane (v 29) that accentuated the sagittal deviation, so that it became even clearer than in group 2 (vv 1 and 2). The steep mandibular plane was combined with larger anterior lower and smaller posterior lower facial heights than normal (vv 7 and 10). The total anterior and posterior facial heights displayed no significant deviations. There was, however, a tendency toward overdevelopment of the total anterior (P=0.078) and underdevelopment of the total posterior facial height (P=0.028). The latter tendency is probably due partially to a somewhat high condyle position (v 11), and partially to a tendency of the ramus to be shorter than normal (P=0.085). The posterior upper facial height in group 3 showed no signs of underdevelopment. Therefore the tendency toward underdevelopment of the total posterior facial height applied exclusively to the shorter lower part of the face and became more visible there. The vertical relations of the mandible in group 3 resemble those of individuals with skeletal openbite, as Sassouni and Nanda[15] described them.

Studying craniofacial growth between ages 6 and 15, Karlsen[26] found that the mental process increased more with high than with low MP-SN angle cases. That group 3 had a relatively long mental process (v 17) may be seen in light of this. The length of the mental process was an effective discriminator between group 3 and the normal group. So was the NP-SN angle, which was significantly smaller than normal in group 3 (v 28). Mean values for anterior upper and posterior upper facial heights show that the former tended to be smaller in group 3 than in the normal group (P=0.13), while the latter, as mentioned, showed no notable difference between the two groups. This suggests that the nasal plane in group 3 was tipped slightly up anteriorly. In comparison, Rothstein[27] reported the nasal plane in Angle Class II-1 to be tipped up anteriorly or down posteriorly, or both, but a cranial tipping of the nasal plane's anterior portion was the most common. Moyers et al.[9] differentiated between five different vertical types of Angle Class II-1, one of which was characterized by the nasal plane being tipped up anteriorly. This type could be combined with a steep mandibular plane and a frontal openbite.

Groups 2 and 3 – similarities and dissimilarities

Groups 2 and 3 had, as expected, many craniofacial traits in common. There were no significant differences between the groups in the skeletal relations of the upper face or in the position of gonion or the condyles. Underdevelopment of the mandibular corpus was much the same in both groups (v 14), and so was the height of the mandibular ramus. The latter finding coincides with the findings of earlier researchers who have been unable to correlate ramus height and the vertical incisor relation.[11,16] The ramus heights in groups 2 and 3 were not significantly smaller than in the normal group, but they tended to be, with P=0.088 in group 2 and P=0.085 in group 3. These tendencies can be seen in light of the findings of Drelich[1] and Mitchell[6] who both demonstrated a shorter ramus than normal in Angle Class II-1 malocclusions. According to some writers, Angle Class II molar relationship may be due to an open cranial base flexure, giving the mandibular condyles a posterior position.[29,30,31] In the present study, however, cranial base flexure was very much the same, not only in groups 2 and 3, but also in the normal group. This coincides with the findings of Menezes.[32]

On some points groups 2 and 3 were clearly dissimilar. Common for the strongest discriminators between the groups were that they, theoretically, could be related to the MP-SN angle being, on the average, 9° larger in group 3 (v 29). As a consequence of this, the children in group 3 had a large anterior lower facial height (v 7) and greater incisal heights of both jaws (vv 19 and 21), the latter probably being a compensation for the former. The steep mandibular plane also affected the symphysis by giving it a proclined position and the chin a rather recessive appearance, in spite of the mental process being longer than normal. In group 2, on the other hand, the symphysis was strongly retroclined (v 4). A distal basal relation, measured between A-point and pogonion, was therefore much more obvious in group 3 than in group 2 (v 2).

The craniofacial differences between groups 2 and 3 were, in many respects, similar to those described by earlier researchers for low and high MP-SN angle cases.[26,28] In group 3 the craniofacial pattern had traits indicating that the mandible only had a weak anterior or perhaps, in some cases, a posterior rotation. This could have been the reason why the children in that group did not develop skeletal deepbite despite the obvious unstable incisor occlusion.

Clinical implications

That the children in group 3 had a near normal vertical incisor relationship must be seen in light of the short mandibular corpus in this group. If the corpus had been longer, distance v would have been greater. Many of the children in group 3 were probably potential frontal openbite cases.

Distance v is clinically interesting because it may give an indication of the mandible's growth rotation in Angle Class II-1 malocclusions. When distance v is 4 mm or more, as in group 3, it is a sign of a slightly marked or absent anterior mandibular rotation. In such cases attention should be paid to anamnestic information about prolonged fingersucking or other parafunctions that can influence distance v. The MP-SN angle was not among the variables that discriminated best between the deepbite and the nondeepbite groups. This angle can only explain 60% of the variability in mandibular rotation.[33] A large MP-SN angle does not necessarily mean that the mandible has a slightly marked anterior rotation. Perhaps distance v is a better indicator of mandibular rotation with Angle Class II-1 than mandibular plane inclination, provided parafunctions are out of the question.

In treating Angle Class II-1 cases with openbite growth patterns, avoidance of molar extrusion should be one of the treatment objectives. In such cases, molar extrusion creates a posterior mandibular rotation which elongates an already overdeveloped anterior lower facial height and accentuates the Angle Class II-1 profile and the openbite tendency. This calls for caution with use of molar extruding arch bends and Class II elastics. Headgear traction should be of the high-pull type, permitting the traction force to have an intrusive effect on the maxillary molars. Dermaut et al.[34] treated Angle Class II-1 openbite cases with headgear-activator. To avoid molar extrusion, vertical grinding of acrylic in the molar area was not carried out. In this way, increase in the anterior facial height was kept to a minimum.

Conclusions

The craniofacial patterns in groups 2 and 3 deviated from the pattern in the normal group, though often in different ways. Common for the Class II-1 groups was a short mandibular corpus, which gave rise to a mandibular retrognathy and a distal relationship between the basal portions of the jaws.

In the deepbite group (group 2) the total anterior facial height was shorter than normal. The underdevelopment applied almost evenly to the upper and lower parts of the face. As for the dental condition, group 2 had a discrepancy in the relationship between the incisal and molar heights of the respective jaws. This occurred because both maxillary and mandibular molar heights tended to be smaller than normal.

Otherwise, vertical skeletal deviations involved primarily the nondeepbite group (group 3). Here the anterior lower facial height was larger, the posterior lower facial height smaller, and the mandibular plane steeper than in the normal group. In addition, the nasal plane in group 3 was tipped slightly upward anteriorly. Dentally, group 3 stood out by having larger maxillary and mandibular incisal heights than the normal group.

The craniofacial patterns in groups 2 and 3 also deviated internally. Several differences applied to conditions that, theoretically, could be related to the MP-SN angle being on average 9° larger in group 3. Craniofacial differences between the two Class II-1 groups, therefore, resemble the differences for low and high MP-SN angle cases reported by earlier researchers.

Author Address

Alf Tor Karlsen, DDS
Kjopmannsgt. 34
N-7500 Stjordal
NORWAY

A.T. Karlsen is in private practice in Stjordal, Norway.

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