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Dentofacial Morphology of Class II Division 1

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SUMMARY

In this study dentofacial morphology was compared in the age groups: up to 12 years; 12-16 years and older than 16 years. The sample comprised 212 randomly selected lateral cephalograms of orthodontically untreated patients (80 males and 132 females). Patients were divided into 3 groups based on the mandibular plane angle. Differences in the sagittal, vertical and cranial measurements between the groups were analyzed with ANOVA test. Linear regression analysis was used to calculate association between the dentofacial morphology and age. Mean values of both maxilla and mandible showed retrognathic position. The male subjects comparing with females had greater anterior and posterior cranial base measurements and larger lower jaw body in all of the age groups. Anterior and posterior cranial base increased with age, except in the patients with high mandibular plane angle. Mandibular plane angle and articular angle increased significantly ($p < 0,05$) only in males us they became older, that could be reason to assume growth modification to be more effective for them.

Key words: dentofacial morphology, cephalograms, growth pattern.

INTRODUCTION

Previous studies have shown changes of dentofacial morphology of Class II division 1 related to growth tendencies of maxilla and mandible and their significance in the development of skeletal variability [1-7].

The comparison of the longitudinal study of mandibular and maxillar growth indicated that there were several different growth features in skeletal and dentoalveolar morphology between the untreated Class II division 1 and normal subjects [6-10].

That is the reason for wide variations of skeletal and dentoalveolar imbalance in cases Class II division 1 considering the treatment planning.

A better understanding of dentofacial morphology of Class II division 1 in age groups corresponding the orthodontic treatment times could greatly contribute to clinical consideration. The aim of this study was to evaluate dentofacial morphology of Class II division 1 malocclusion related to age and gender.

MATERIALS AND METHODS

212 randomly selected lateral cephalograms of orthodontically untreated patients were evaluated. The subject selection was based on the following criteria:

Angle II Class molar relationship and overjet no less than 5 mm.

The sample was divided in three age groups:

Group I – patients up to 12 years;

Group II – patients from 12-16 year

Group III – patients older than 16 years.

The groups included:

Group I – 30 males, 46 females with the mean age 10 ± 1,1 year

Group II – 28 males, 50 females with the mean age 13,6 ± 1,1 year

Group III – 22 males, 36 females with the mean age 20,0 ± 3,9 year

All lateral cephalometric tracing was digitized on a digitizer and processed with software program Dentofacial Planner 7.0. Conventional analyses were used to describe the dentofacial morphology. Twenty five randomly selected cephalograms were retried with the interval of 6 weeks, and method errors were calculated.

The following cephalometric measurements were obtained and analyzed for each of the 212 lateral cephalograms:

- sagittal measurements – SNA angle, SNB angle, ANB angle A and Pg point to facial perpendicular.
- vertical measurements – nasal plane angle (ANS – PNS to S-N), mandibular plane angle (Me – Go to NS), gonial angle, PFH/AFH, mandibular ramus height in mm, mandibular body length in mm.
- cranial measurements – anterior cranial base (N-S), posterior cranial base (S – Ba), basal angle (N – S – Ba), saddle angle (N – S – Ar), articular angle (S-Ar – Go).
- Incisor inclination – upper incisors (U_1 – SN), lower incisors (L_1 – GoGn); interincisal angle.

For the further analysis patients were divided into groups based on the mandibular plane angle: low angle group (ML/NSL < 27°), average angle group (27° to 36°) and high angle group (ML/NSL > 36°).

Statistical analysis

ANOVA analysis was used to compare the dentofacial parameters of the patients in the groups in respect of the age and growth pattern. Linear regression analysis was implemented to describe the connection between the dentofacial morphology and age. Data analysis was performed with SPSS for Windows 10.0 software. Method errors were calculated with Microsoft Excel.

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RESULTS

Mean values of the different measurements of dentofacial morphology in the three groups are shown in Table 2. The results of ANOVA analysis indicate that younger patients had a tendency to smaller sagittal projection of the maxilla ($p < 0.1$) and more retrognathic lower jaws ($p < 0.1$). The gonial angle decreased significantly in older patients ($p < 0.001$) with age the lower jaw rotated upwards and the mandibular plane angle decreased ($p < 0.05$), although the saddle and basal angles showed no diversity between the age groups. Mandibular height and length were larger in the older patients ($p < 0.0001$), which determined increased posterior and anterior face height ratio.

As can be seen from the table 3, growth of the anterior and posterior cranial base and increase in mandibular height and length can be recorded as patients become older. There were statistically significant differences between females and males in some measurements of the dentofacial morphology. Males had overall greater anterior and posterior cranial base length ($p < 0.005$) and more acute basal angle ($p < 0.005$). Compared with the females, they also had increased A point distance to the facial perpendicular ($p < 0.05$) and larger lower jaw bodies ($p < 0.005$). In females change of the anterior and posterior cranial base was mainly recorded between the I and II age group. Significant mandibular height and length difference was observed in females among all the groups, but the ratio of the anterior and posterior face heights decreased significantly between the age groups I and II. Similar tendencies were observed in males. Additionally males had statistically significant difference between all three age groups in change of the mandibular plane angle. Articulare angle increased significantly ($p < 0.05$) in males as they became older, indicating some anterior movement of the mandible in association with the posterior cranial base. Analogous changes were not found in females.

Dentofacial morphology of the Class II patients was highly dependent on the growth type. Growth pattern had a great influence ($p < 0.001$) on the following dentofacial parameters: SNA, SNB, ANB and gonial angles, Pog distance to the facial perpendicular, incisor's inclinations as well as on the length and height of the mandible.

Table 1. Distribution of subjects by sex and age.

Age group	n	Male	Female
I - < 12 years	76	30	46
II – 12-16 years	78	28	50
III - > 16 years	58	22	36

Apart from the common growth changes (Table 4), patients from the low MP-SN angle group exhibited more pronounced changes of the gonial and articular angle ($p < 0.005$), especially in the older patients group, while in patients with high MP-SN angle the gonial angle remained the same in all age groups. Surprisingly there were no differences between the anterior and posterior cranial base lengths between the age groups in the patients with vertical growth type. Also posterior face height ratio did not increase, contrary to the changes observed in the other groups.

DISCUSSION

One of the most discussed subject in Class II division 1 cases is maxilla and mandible anterior-posterior relation.

The general finding of this study is retrognathia maxilla and mandible, which is consistent with previous report [5]. However Karlsen and Krogstad [11] found that the anterior – posterior distances between Pg and A to facial perpendicular decreased with age but in lesser degree in the distal jaw – base relationship group. Chung and Wong [12] found increase in the SNA and SNB angles with age, while Ngan et al [13] reported decrease of these angles. As shown by comparing mean values in this study no statistically significant differences between age groups in anterior-posterior relation of maxilla and mandible were noted, apparently, because they were masked by increase of the anterior cranial base with age, and all sagittal measurements related to the nasion point, which could not be the case in the high angle patients.

The significant increase in the mandibular height and length after 12 years of age could explain the equalization of maxilla and mandible sagittal relationship.

Table 2. Mean values and one standart deviation describing the dentofacial morphology of patients with Class II malocclusion.

Dentofacial variable	I age group (10.2 ± 1.1 y)		I age group (13.6 ± 1.1 y)		I age group (20.0 ± 3.9 y)	
	Mean	SD	mean	SD	mean	SD
Sagital measurements						
SNA angle	80.8	5.5	82.3	4.1	82.1	3.5
SNB angle	75.1	6.9	77.0	4.1	76.7	3.9
ANB angle	5.7	2.4	5.3	2.5	5.5	2.5
A point to facial perp.	0.4	7.0	-0.2	3.8	-0.8	4.4
Pg point to facial perp.	-8.4	6.8	-8.4	7.9	-8.6	9.3
Vertical measurements						
Nasal plane angle	7.9	16.7	6.6	4.7	5.1	3.7
Mandibular plane angle	34.3	13.2	32.1	7.4	29.9	8.0
Gonial angle	127.1	6.1	125.6	7.5	121.2	8.3
PFH / AFH	63.6	5.5	64.9	6.2	67.6	6.8
Mand. ramus height	42.9	3.7	46.6	4.8	51.7	6.8
Mand. body lenght	74.1	4.7	78.3	5.8	82.1	7.5
Cranial measurements						
Anterior cranial base	72.8	6.0	74.1	4.1	76.3	4.6
Posterior cranial base	34.5	6.9	34.9	4.8	36.9	4.3
Basal angle	129.0	4.5	129.6	6.4	128.8	5.4
Sadle angle	122.0	16.0	123.8	6.0	123.6	5.3
Articulare angle	140.4	15.5	142.7	8.9	145.2	7.7
Incisor inclinations						
Upper incisors	106.5	13.3	108.5	8.5	110.7	10.1
Lower incisors	97.3	6.9	98.1	8.3	97.7	8.1
Inter incisal angle	121.9	8.1	121.2	9.2	121.6	11.3

Table 3. Summary of standart regression analysis between the variables of dentofacial morphology and age.

Dentofacial variable	Coeficient	t	p value	95% confidence interval	
Sagitial measurements					
SNA angle	0.02	0.216	0.829	-0.10	0.12
SNB angle	0.06	0.88	0.378	-0.06	0.17
ANB angle	-0.08	-1.15	0.253	-0.11	0.03
A point to facial perp.	-0.06	-0.86	0.391	-0.16	0.06
Pg point to facial perp.	0.04	0.656	0.512	-0.15	0.31
Vertical measurements					
Nasal plane angle	-0.10	-1.405	0.162	-0.212	0.04
Mandibular plane angle	-0.166	-2.43	0.016	-0.48	- 0.05
Gonial angle	-0.281	-4.24	0.000	-0.703	- 0.257
PFH / AFH	0.257	3.86	0.000	0.172	0.530
Mand. ramus height	0.591	10.6	0.000	0.661	0.963
Mand. body lenght	0.421	6.72	0.000	0.445	0.815
Cranial measurements					
Anterior cranial base	0.348	5.34	0.000	0.208	0.450
Posterior cranial base	0.290	4.39	0.000	0.153	0.401
Basal angle	0.04	0.54	0.590	-0.122	0.215
Sadle angle	0.048	0.70	0.484	-0.107	0.224
Articulare angle	0.090	1.31	0.191	-0.078	0.388
Incisor inclinations					
Upper incisors	0.11	1.56	0.120	-0.54	0.46
Lower incisors	-0.04	-0.61	0.544	-0.31	0.16
Inter incisal angle	0.062	0.90	0.366	-0.15	0.42

Table 4. Summary of ANOVA analysis of the dentofacial measurements` changes between the age groups.

Dentofacial variable	Low mandibular plane angle patients (n = 59)		Average mandibular plane angle patients (n = 90)		High mandibular plane angle patients (n = 63)	
	F	p value	F	p value	F	p value
Sagital measurements						
SNA angle	0.333	0.718	0.830	0.439	2.563	0.085
SNB angle	0.291	0.749	2.651	0.076	0.991	0.377
ANB angle	0.255	0.776	0.659	0.520	0.947	0.394
A point to facial perp.	0.003	0.997	2.698	0.073	0.425	0.656
Pg point to facial perp.	1.644	0.202	2.323	0.104	2.014	0.142
Vertical measurements						
Nasal plane angle	0.332	0.719	0.717	0.491	0.643	0.529
Gonial angle	8.655	0.001	0.869	0.423	1.083	0.345
PFH / AFH	3.878	0.026	2.511	0.087	0.402	0.671
Mand. ramus height	20.543	0.000	2.491	0.000	8.285	0.001
Mand. body lenght	15.653	0.000	7.955	0.001	5.902	0.005
Cranial measurements						
Anterior cranial base	6.042	0.004	6.531	0.002	0.209	0.812
Posterior cranial base	5.107	0.009	3.482	0.035	0.045	0.956
Basal angle	3.075	0.054	0.271	0.763	0.837	0.438
Sadle angle	1.887	0.161	0.718	0.491	0.751	0.476
Articulare angle	6.812	0.002	1.747	0.180	1.246	0.295
Incisor inclinations						
Upper incisors	0.921	0.404	0.410	0.665	0.269	0.765
Lower incisors	0.694	0.504	0.404	0.669	0.689	0.506
Inter incisal angle	0.448	0.641	0.287	0.751	1.567	0.217

In the study of the growth of jaws comparing Class II cases with normal subjects, Class II subjects showed a relatively normal amount of mandibular forward growth that did not exceed that of the maxillary forward growth having almost the same amount of forward growth [7]. However there is some morphological difference between the growth of mandible. As showed in the literature [6;8] mandibular length (Ar – Pog) was significantly shorter in the Class II division 1 subjects than in normal subjects only in the earlier stages of development.

Statistically significant differences between females and males cephalometric measurements were found in the increase of articular angle in males which indicated the higher potential of their mandibular growth.

In predicting mandibular growth Isaacson [14;15] as a relevant factor indicated MP-SN angle: the larger MP-SN angle – the mandible tends to growth backward; the smaller angle – the mandible tends to growth forward. We observed that in high angle patients posterior and anterior height ratio, as well as the gonial angle, did not increase with age. In contrary Karlsen [16] who observed the rotation forward of the mandible also in all 15 patients with vertical growth type.

In conformity with this study low MP-SN and pronounced articular angle is a characteristic morphology feature of Class II division 1 in group of patients after 16 years of age. That could be in the connection of increasing incli-

nation of the upper incisors.

There should be noted that is was not possible to encompass the entire Class II and III where patients with early orthodontic treatment might not have been included.

CONCLUSION

Dentofacial morphology of Class II division 1 characteristics:

1. Retrognathia of maxilla and mandible.
2. Forward rotation of the mandible in low and average mandibular plane angle patients.
3. Increasing mandibular height and length with age.
4. Increasing anterior and posterior cranial base with age.
5. No significant differences between the age groups in the sagittal measurements were detected probably due to the increase of the anterior cranial base dimension.
6. Significant differences between females and males were mainly in the cranial measurements.
7. Increase of the articular angle in males with age could allow as to assume that growth modification could be more effective for them.

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