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CEPHALOMETRIC EVALUATION OF CRANIOFACIAL GROWTH PATTERN OF CLASS III MALOCCLUSION

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Abstract

Treatment of skeletal malocclusions is in direct correlation to the growth pattern of the craniofacial structures, so understanding of the normal growth, which is in down and forward direction, its spurts and proper diagnosis for the existing malocclusion are important factors for choosing the proper treatment method for different age groups.

This study was carried out to evaluate the criteria of growth (pattern) for the growing patients aged 3-15 years with mesial malocclusion. Pretreatment lateral cephalometric radiographs of fifty growing patients (23 males and 27 females) were examined, which were selected among patients with class III malocclusion with mean ANB (-2.4°) and mean Wits (-6.8mm), as these cephalometric measurements showed a significant positive correlation existed between dentoalveolar and skeletal malocclusion and evaluate the maxillofacial skeletal discrepancy.

This study showed that we have a vertical growth of the craniofacial region for the patients with skeletal class III malocclusion in the investigated groups and no gender differences in craniofacial growth pattern were observed. And as our both groups have more tendency for the vertical growth of craniofacial region, we have restriction in the orthodontic camouflage which is based on clockwise rotation of lower jaw and dentoalveolar compensation, while the patients have already long face as the main complaint, this makes the surgical orthodontic treatment an option even for the less severe cases to correct the malocclusion and improve the esthetics.

KEYWORDS: *class III malocclusion, growth pattern, vertical growth*

INTRODUCTION

Mesial malocclusion is one of the challenging anomalies in diagnosis, treatment and even retention. It is according to Angle classification, when lower molar is in mesial position relative to upper molar [*Proffit WR et al, 2007*]. Prevalence of Angle class III malocclusion varies greatly among and within populations. Chinese and Malaysian populations show a relatively higher prevalence of Angle class III malocclusion while Indian populations show relatively lower prevalence, as compared to other races [*Hardy DK et al., 2012*].

Adequate understanding for the normal growth pattern and proper diagnosis for the existing malocclusion are important factors for choosing the proper treatment method for different ages.

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The phenomenon of human craniofacial development includes both; pattern (the maintenance of the configuration of the face over time) and growth (the geometric changes in size and shape of craniofacial structures) [*Moyers RE et al., 1979*].

There is a "normal" craniofacial growth, in which a down and forward growth direction is maintained, however, the development of craniofacial components can occur at different times, rates and with predominance of one or another determined direction [*McCarthy J, 1990*]. Although growth is an orderly process there are times when spurts do occur. It is certainly time and sex linked [*Prasad PN et al., 2011*].

The greatest spurts of the craniofacial growth take place in the following periods: at 6-7 and 7-9 years (phase II) and at 11-12 and 14-15 years (phase III) for girls and boys, respectively.

To bring about maximum changes of craniofacial growth cases must be treated during these peak

THE NEW ARMENIAN MEDICAL JOURNAL, Vol.9 (2015), No 2, p.68-73 KORENKOV A.V., SIKORA V.Z.

periods. The crucial point is that girls mature earlier than boys.

Proper diagnosis and treatment planning can produce the most gratifying results during mixed dentition stage. In this period the criteria of growth are informative, as the hard tissue is highly responsive to the forces applied and the soft tissue shows higher degree of adaptability, thereby enhancing the stability of results. On the other hand lack of careful treatment planning can lead to unsatisfied results [*Prasad PN et al., 2011*].

Vertical growth tries to carry the pogonion downward while anterioposterior growth attempts to carry it forward; this battle ensues early in life and continues until growth is completed [*Schudy FF, 1964*].

The different patterns of growth are the results of how the entire craniofacial complex compensates the dominant genetic influence of the mandible in order to achieve facial harmony, and this information could be used to elaborate more accurate diagnosis and individualized treatment plans [*Araya-Díaz P et al., 2013*].

When treating class III patient, whether they are growing children or mature adults, anterioposterior and vertical position of facial components as well as dental relationship must be considered, so that the excess or deficiency may be treated where they actually exist [*Guyer EC et al., 1986*].

Depending on the age of the patient and the severity of the malocclusion we can consider the treatment type. For the growing patient we can get the benefit of the growth modulation for correction of the malocclusion. However, for the adult patient whose growth has ceased the treatment is limited to camouflage and surgical intervention [*Guyer EC et al., 1986; Mcnamara JA, 1987; Stellzig-Eisenhauer A et al., 2002; He S et al., 2013*].

Various etiologic factors, including dentoalveolar development, growth of the maxilla and mandible, function of the tongue and lips, and eruption of the teeth and the respiratory function, may cause abnormal growth during the growth period. The ultimate vector of mandibular growth is a consequence of the competition between horizontal and vertical growth [*Ucara FI; Uysal T, 2011*].

Consideration of both the anterioposterior and vertical dimensions leads to a more precise diagnosis that will allow for a more specific treatment that could be planned [*Kim JY et al, 2005*].

Determination of maturation and subsequent evaluation of growth potential during preadolescence or adolescence is extremely important, because it can have a considerable influence on diagnosis, goals, planning and the eventual outcome of orthodontic treatment. Growth stages can be identified by chronological age, sexual maturation pattern, dental development, body height, weight, and skeletal development of the hand and wrist, and vertebral maturity [*Singer J, 1980; Hägg U, Taranger J, 1982; Fishman LS, 1987*].

Up till now a number of different measurements have been developed to evaluate the maxillofacial skeletal discrepancy, like: ANB angle, AXB angle, AXD angle, FABA angle, PABA angle, SGn/AB angle, APDI angle, AB/TH angle, Beta angle and linear measurements like Wit's Appraisal, AB/PP, AB/SN, AD/SN, AB/FH and AB/TH distances. More recently in 2009 a new measurement named YEN Angle was proposed [*Doshi JR et al., 2012*].

The aim of this study is to provide information regarding the prevalence of vertical or horizontal craniofacial growth pattern by using lateral cephalometric analysis among the Armenian population with mesial malocclusion.

MATERIALS AND METHODS

The study was based on a sample of 50 pretreatment Lateral Cephalometric Radiographs of patients who were examined and treated at the pediatric dentistry and orthodontics department at Yerevan State Medical University and at Alfa Stom dental clinic in Yerevan, Armenia; the patients consisted of 23 males (mean age: 10.2 y.o.) and 27 females (mean age: 11.3 y.o.).

The selected criteria of class III malocclusion samples were with mean ANB (-2.4°) and mean Wits (-6.8 mm), as they showed a significant positive correlation existing between dentoalveolar and skeletal malocclusion [*Shrikant S et al., 2011*].

Cephalometric analysis of all films was conducted by the same operator using Dolphin imaging and management solutions software at Alfa Stom Clinic.

The cephalometric measurements used were as following (Fig.):

- ANB angle: the angle between the NA line and NB line.
- Wits appraisal: the distance between perpen-

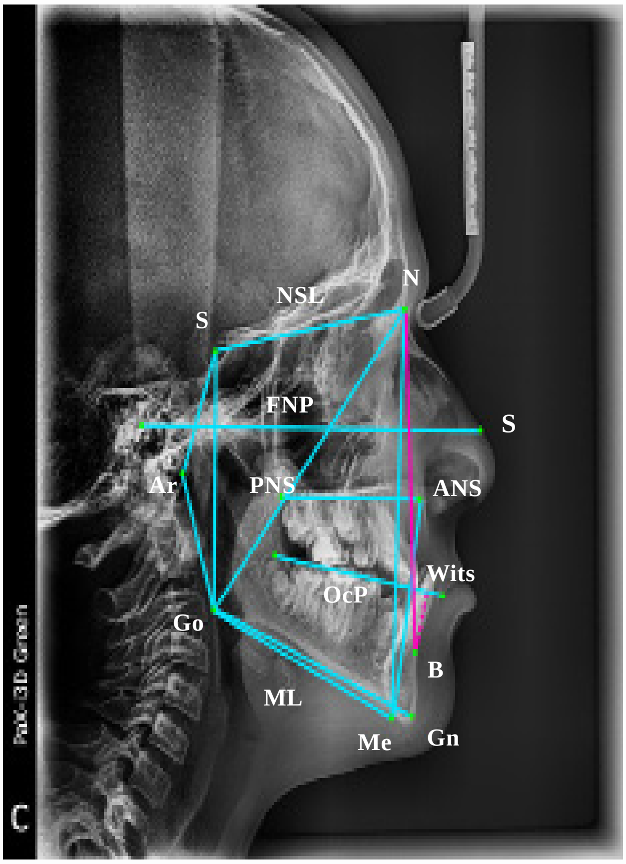

FIGURE. Landmarks used for the cephalometric analysis

diculars drawn from point A and point B onto an occlusal plane.

- Mandibular plane angle NSL/ML: the angle between NSL and mandibular plane ML.
- Basal plane angle NL/ML: the angle between mandibular plane ML and Palatal plane NL.
- Gonial angle ArGoMe: the angle between the mandibular plane ML and the line drawn from the articular to the posterior-inferior border of the ramus.
- Lower Gonial angle NGoMe: the angle between the lines N-Go and Go-Me.
- Bjork sum: the sum of the saddle angle NSAr, articular angle SArGo, and gonial angle ArGoMe.
- Upper anterior facial height/Lower anterior facial height: the ratio between N-ANS/ANS-Me.
- Posterior facial height /Anterior facial height×100: percentage ratio of S-Go/N-Me.
- Y-Axis NSGn: angle formed by the intersection of the lines N-S and S-Gn.
- Occlusal plane angle: the angle between the occlusal plane OcP and NSL.
- Frankfort-mandibular Plane Angle FHP/ML: the intersection of the Frankfort horizontal plane FHP to the Mandibular Plane ML.

Statistical analysis was run using SPSS v.19 (IBM SPSS statistics for Windows 7, version 19.0 Inc.®, Chicago, Illinois, USA). The arithmetic mean and standard deviation were calculated for each variable. One Sample T-Test was performed to evaluate the craniofacial growth pattern with skeletal Class III malocclusion.

RESULTS

In the girls group (table 1), the mean of the angle NSL/ML is more than the normal value by 3.2 degrees, i.e. 10% ($p < 0.05$). The mean of the angle NL/ML does not have significant differences with the normal value. The mean of the angle ArGoMe is more than the normal value by 7.7 degrees, i.e. 6.39% ($p < 0.001$). Also the mean of the angle NGoMe is above the normal value by 2.6 degrees, i.e. 3.58% ($p < 0.05$). In addition, the mean of the Bjork Sum angles does not have significant differences with the normal value. The mean of the ratio N-ANS/ANS-Me is more than the normal value by 0.03 degrees, i.e. 3.75% ($p < 0.05$). The mean of the percentage ratio S-Go/N-Me does not have significant differences with the normal value.

Moreover, the mean of the angle NSGn (Y-Axis) does not have significant differences with the normal value. The mean of the angle NSL/OcP does not have significant differences with the normal value. The mean of the angle FHP/ML is greater than the normal value by 4.7 degrees, i.e. 21.3% ($p < 0.001$).

In the boys group (table 2), the mean of the angle NSL/ML is greater than the normal value by 2.1 degrees, i.e. 6.5% ($p < 0.05$). The mean of the angle NL/ML does not have significant differences with the normal value. The mean of the angle ArGoMe is greater than the normal value by 8.3 degrees, i.e. 6.88% ($p < 0.001$). The mean of the angle NGoMe is greater than the normal value by 2 degrees, i.e. 2.7% ($p < 0.05$). The mean of the Bjork Sum angles does not have significant differences with the normal value. The mean of the ratio N-ANS/ANS-Me does not have significant differences with the normal value. The mean of the percentage ratio S-Go/N-Me does not have significant differences with the normal value.

The mean of the angle NSGn (Y-Axis) does not have significant differences with the normal value. The mean of the angle NSL/OcP does not have sig-

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nificant differences with the normal value. Finally, the mean of the angle FHP/ML is more than the normal value by 3.2 degrees, i.e. 14.5% ($p < 0.05$).

Discussion

This study shows that we have a vertical growth for the growing patients with skeletal class III malocclusion in the investigated groups, in spite of the fact that class III malocclusion is supposed to be associated with horizontal growth pattern. So we suggest that this result depends on the natural compensation of the craniofacial region, like rotation of mandibular jaw in order to improve the masticatory function.

On the other hand, these patients who have class III malocclusion combined with increased lower facial height, long face, and open bite are more interested in seeking orthodontic treatment for esthetic purposes.

As the patients already had long face as the main complaint, we were limited in performing the orthodontic camouflage which is based on clockwise rotation of lower jaw and dentoalveolar compensation. This makes the surgical orth-

TABLE 1.

Results of cephalometric analysis for girls

Cephalometric measurement	Minimum	Mean	Maximum	Normal	SD	p
ANB (°)	-6.7	-2.29	-0.1	2°±2°	1.85	p < 0.001
Wits (mm)	-15.7	-6.5	-1.2	1 mm	3.02	p < 0.001
NSL/ML(°)	23.9	35.2	45.1	32°±2°	5.4	p < 0.05
NL/ML (°)	10.5	23.4	30.9	22°±4°	4.8	NS
ArGoMe (°)	115.8	128.2	137.7	120.5°±6.5°	6.02	p < 0.001
NGoMe (°)	66.1	75.1	84.7	72.5°±2.5°	4.63	p < 0.05
Bjork Sum (°)	383.9	395.3	405.1	396°±4°	5.4	NS
N-ANS/ANS-Me	0.69	0.83	1	0.7-0.9	0.06	p < 0.05
S-Go/N-Me × 100%	56.4	63.1	70.9	63.5±1.5 %	4.01	NS
NSGn (°)	57	66.3	75	66°±3°	4.2	NS
NSL/OcP (°)	7.4	16.1	28.3	14.5°	5.3	NS
FHP/ML (°)	20.4	26.7	37.8	22°±5°	4.7	p < 0.001

TABLE 2.

Results of cephalometric analysis for boys

Cephalometric measurement	Minimum	Mean	Maximum	Normal	SD	p
ANB (°)	-6	-2.69	0	2°±2°	1.8	p < 0.001
Wits (mm)	-17.7	-7	-1.9	1 mm	3.4	p < 0.001
NSL/ML (°)	24.7	34.1	43.3	32°±2°	4.99	p < 0.05
NL/ML (°)	15.1	24.4	35.7	22°±4°	6.39	NS
ArGoMe (°)	121.7	128.8	139.8	120.5°±6.5°	5.48	p < 0.001
NGoMe (°)	68.7	74.5	83.9	72.5°±2.5°	3.9	p < 0.05
Bjork Sum (°)	384.7	394.1	403.3	396°±4°	4.99	NS
N-ANS/ANS-Me	0.6	0.79	1	0.7-0.9	0.094	NS
S-Go/N-Me×100%	59.3	64	75	63.5±1.5 %	4.55	NS
NSGn (°)	59.7	65.2	72.2	66°±3°	3.28	NS
NSL/OcP (°)	8	15.4	21.6	14.5°	4.2	NS
FHP/ML (°)	17.4	25.2	36.5	22°±5°	4.69	p < 0.05

odontic treatment an option even for the less severe cases to correct the malocclusion and improve the esthetics.

Conclusion

In conclusion, the present study indicates that there are no gender differences in craniofacial growth pattern, and both study groups had a greater tendency for the vertical growth of the craniofacial system.

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