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A new way to predict horizontal growth of maxilla and mandible in children of age 9 to 18 years using lateral cephalograms

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Abstract

Introduction: The aim of this study is to predict the horizontal growth of maxilla and mandible by using lateral cephalograms.
Materials and Method: Lateral cephalograms of 30 skeletal class I patients (15 males and 15 females) were acquired from the records in Department of Orthodontics and named as Age group I - 9 to 11yrs. Lateral cephalograms of same patients requiring orthodontic treatment with minimal dental malocclusion were repeated at age 11 to 14yrs and at age 15 to 18yrs and named as Age group II and Age group III respectively. Lateral cephalograms were traced by only one examiner. The perpendicular was drawn from 7^0 up SN plane through point sella (S) downward to mandible. On this perpendicular line horizontal perpendiculars drawn from point A, point B and point Gnathion (Gn) to obtain point R, point G and point C respectively. Growth distance for maxilla – point R to point A, growth distance for mandible- point G to point B and point C to point Gn were measured and compared statistically.
Results: Growth distance variables for maxilla and mandible compared between all three age groups were statistically highly significant. While comparing between males and females highly significant difference found only for maxillary growth variable i.e. point R to point A.
Conclusions: Measuring Growth distance using lateral cephalograms can be used to predict horizontal growth of maxilla and mandible. Study on larger sample is required to test the accuracy of this growth prediction method.

Keywords: Horizontal Growth Prediction, Maxilla and Mandible

Introduction

The prediction of facial growth potential is an essential part of orthodontic treatment planning. Starting orthodontic treatment without estimating growth prediction in growing individuals can lead to improper orthodontic treatment. The direction, amount, and timing of growth affect the treatment as well as retention phase of orthodontic treatment.

Major growth sites in craniofacial skeleton are sphenooccipital synchondrosis for cranial base, nasal septal cartilage for nasomaxillary complex, and the condylar cartilage for mandible.(1) Among all these sites the condylar cartilage acts as the greatest growth center in the craniofacial complex.(2) Growth of the mandibular condyle leads to transposition of the mandible as well as it contributes to increase in mandible size.(3)

The maxilla becomes larger due to bone opposition at the sutures, whereas entire anterior surface of maxilla is an area of resorption.(4) The position of point A in relation to reference plane of skull base is commonly used to assess the degree of maxillary prognathism.(5) The maxilla grows forward and downward in two ways i.e. growth at the sutures and by a push from behind which is created by cranial base growth.(6)

Commonly used growth prediction methods includes cephalometric growth prediction and growth prediction based on statistical data derived from populations. The aim of this study is to predict the horizontal growth of maxilla and mandible by using lateral cephalograms.

Materials and Method

The study sample consists of lateral cephalograms of 30 skeletal class I patients (15 males and 15 females) which were acquired from the records in Department of Orthodontics and named as Age group I - 9 to 11yrs. Lateral cephalograms of same patients requiring orthodontic treatment with minimal dental malocclusion were repeated at age 11 to 14yrs and at age 15 to 18 yrs and named as Age group II and Age group III respectively. The criteria for sample selection were orthodontic adolescent patients having skeletal ANB angle between 0 and 2. In this manner, subjects with skeletal Class II and skeletal Class III were excluded. Furthermore, patients should not have any syndromes or missing teeth, cleft lip or cleft palate, or any pathology and individuals should not use any type of medication that could affect growth. All subjects had a skeletal class I pattern. The patients had underwent treatment for minor orthodontic problems such as mild to medium crowding and spacing which were treated with removable appliances.

Lateral cephalogram head films taken for each individual were in normal centric occlusion and natural head position (Fig. 1). All lateral cephalograms were manually traced by one examiner. This study used the following cephalometric landmarks: The perpendicular was drawn from 7^0up SN plane through point sella (S) downward to mandible. On this perpendicular line again horizontal perpendicular lines were drawn from point A, point B and point Gnathion (Gn). Thus, the points obtained on this vertical line by this geometric method were named as point R, point G and point C respectively (Fig. 2). The distance from point R to point A was measured and named as growth distance for maxilla. Similarly, the distance from point G to point B was measured and named as growth distance for mandible. And the distance from point C to point Gn was measured and named as growth distance for mandible. All these growth distance values for three age groups i.e. 9 to 11, 12 to 14 and 15 to 18 for both males and females were recorded in millimeters and comparisons were done between different age groups and also between males and females. Intra-examiner study error correction was done with 16 lateral cephalogram films that were randomly chosen and were retraced bythe same examiner.

Fig. 1: **Lateral cephalogram head film in natural head position and normal centric occlusion**

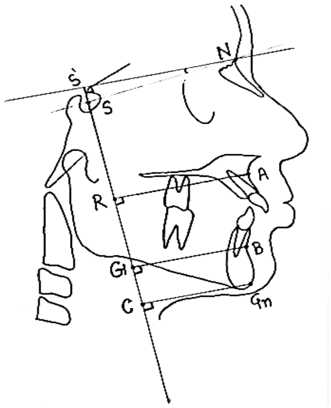

Fig. 2: **Cephalometric tracing method showing construction of point R, point G and point C**

Statistical analysis was performed using computer software i.e. statistical package for the social sciences version 15.0. One way anova test was performed to compare between all three age groups for all three variable measurements. T test was performed to compare between males and females for all three growth distance variable measurements.

Results

Maxillary and mandibular mean growth distance values in males and females for all three growth distance variables compared between all three age groups are shown in Table 1.

Both maxillary and mandibular growth distance values for all three growth distance variables i.e. (point R to point A, point G to point B and point C to point Gn) compared between all three age groups in both males and females were statistically highly significant (Table 2).

Table 3 shows comparison between males and females for growth distance variables among all three age groups.

While comparing between males and females among all age groups for all three growth distance variables comparable difference found but there was highly statistically significant difference found only for maxillary growth distance variable i.e. point R to point A in all three age groups.(Table 4).

Table 1: Descriptive Analysis showing mean growth distance values

Variables	Age Groups	N	Mean	Std. Deviation
R-Am	9-11	15	51.8000	1.47358
	12-14	15	53.2667	1.73068
	15-18	15	56.5000	1.74233
	Total	45	53.8556	2.55979
G-Bm	9-11	15	44.9000	2.22165
	12-14	15	47.0333	2.59441
	15-18	15	52.9333	2.52039
	Total	45	48.2889	4.18804
C-Gn, m	9-11	15	42.6667	2.41030
	12-14	15	45.1000	2.64035
	15-18	15	50.8333	2.43242
	Total	45	46.2000	4.23513
R-Af	9-11	15	49.9333	1.65688
	12-14	15	52.0333	1.79749
	15-18	15	54.2000	1.54458
	Total	45	52.0556	2.40081
G-Bf	9-11	15	43.7667	4.92757
	12-14	15	47.5000	4.67898
	15-18	15	52.9333	4.51136
	Total	45	48.0667	5.97114
C-Gnf	9-11	15	41.4667	4.85308
	12-14	15	45.3333	4.78714
	15-18	15	50.8000	4.51505
	Total	45	45.8667	6.02212

Age Groups – 9-11 yrs, 12-14yrs, 15-18yrs
m – Male, f - Female
Variables – R-A, G-B, C-Gn

Table 2: Comparative Analysis between age groups for different variables

Dependent Variables in males and females	p
R-Am	.000
G-Bm	.000
C-Gn,m	.000
R-Af	.000
G-Bf	.000
C-Gn,f	.000

m – Male, f - Female, Variables – R-A, G-B, C-Gn
P<0.01 – Highly Significant

Table 3: Paired Samples Statistics showing Comparison between males and females

		Mean	N	Std. Deviation
Pair 1	R-Am911	51.8000	15	1.47358
	R-Af911	49.9333	15	1.65688
Pair 2	R-Am1214	53.2667	15	1.73068
	R-Af1214	52.0333	15	1.79749
Pair 3	R-Am1518	56.5000	15	1.74233
	R-Af1518	54.2000	15	1.54458
Pair 4	G-Bm911	44.9000	15	2.22165
	G-Bf911	43.7667	15	4.92757
Pair 5	G-Bm1214	47.0333	15	2.59441
	G-Bf1214	47.5000	15	4.67898
Pair 6	G-Bm1518	52.9333	15	2.52039
	G-Bf1518	52.9333	15	4.51136
Pair 7	C-Gn, m911	42.6667	15	2.41030
	C-Gn, f911	41.4667	15	4.85308
Pair 8	C-Gn, m1214	45.1000	15	2.64035
	C-Gn, f1214	45.3333	15	4.78714
Pair 9	C-Gn, m1518	50.8333	15	2.43242
	C-Gn, f1518	50.8000	15	4.51505

m – Males, f – Females, Variables- R-A, G-B, C-Gn

Table 4: Comparison between Males and females in each group for each variable

Pairs	Male-Female	p
Pair 1	R-Am911 - R-Af911	.000
Pair 2	R-Am1214 - R-Af1214	.000
Pair 3	R-Am1518 - R-Af1518	.000
Pair 4	G-Bm911 -G-Bf911	.157
Pair 5	G-Bm1214 -G-Bf1214	.459
Pair 6	G-Bm1518 - G-Bf1518	1.000
Pair 7	C-Gn,m911 - C-Gn,f911	.120
Pair 8	C-Gn,m1214 - C-Gn,f1214	.736
Pair 9	C-Gn,m1518 - C-Gn,f1518	.970

m – Males, f – Females, Variables- R-A, G-B, C-Gn
p - <0.01 = highly significant

Discussion

Functional appliances are more effective when used in the mandibular growth peak.[7,8] Considering this type of research, Evaluation of remaining growth in maxilla and mandible is most important part before starting myofunctional therapy in adolescent patients.

Availability of different types of bones in hand and wrist, the skeletal maturation can be determined by using ossification stages in those different bones.[9] Currently, the improved CVMI method is most commonly used cervical maturation evaluation method.[10] Whereas most appropriate method for skeletal maturation evaluation is the fishman maturation prediction method (FMP).[11] The present study demonstrates a simple method for prediction of horizontal growth in maxilla and mandible using lateral cephalograms.

This study was done in three age groups i.e. 9 to 11, 12 to 14 and 15 to 18 to predict the growth of maxilla and mandible by measuring the linear growth distance using lateral cephalograms. The lateral cephalograms of individuals having skeletal class I malocclusion were taken. The SN plane represents the anterior cranial base. It is easiest to establish in cephalometrics.[12] Cranial base undergoes very little change after the age of 6-7 years. The SN plane used in this study was one which is constructed as 7^0 up SN plane.[13] Results obtained in this study are reliable since the reference plane used for evaluation of growth distance is stable.

This study found that there was increase in mean growth distance in mandible and maxilla as age increases from 9 to 18 in both males and females. The growth distance values found in age group 12 to 14were greater as compared to age group 9 to 11. And growth distance values found in age group 15 to 18 were greater than age group 12 to 14 (Table 1). Statistical data from this study shows that, there was increase in growth as age advances from age group 9 to 11 years up to age group 15 to 18 years among all three age groups.

Both maxillary and mandibular growth distance values for all three growth distance variables compared between all three age groups in both males and females (point R to point A, point G to point B and point C to point Gn) were statistically highly significant (Table 2).

There are no differences in mandibular linear growth between sexes when individuals are considered as their maturational stages.[14] In this study while comparing between growth distance in males and females among all three age groups for all three variables there was highly statistically significant difference found only for maxillary growth distance variable i.e. point R to point A (Table 4).

Since the cephalometric landmark for maxilla, point A, is located on the anterior part of maxillary alveolar process and as it had undergone changes during growth, it could not be used to describe ''actual'' changes in the position of the maxillary body.[15] So, the results found during evaluation of maxillary growth distance in this study are controversial.

Thus, from this study, it is clear that both maxillary and mandibular growth amount is significantly different in the various age groups. And there was significant increase in growth as age advances from age group 9 to 11 years up to age group 15 to 18 years among all three age groups. Considering all these results, growth distance variables can be used to predict the future horizontal growth of maxilla and mandible.

Conclusions

There are comparable and statistically highly significant differences found between different age groups for measurements of maxillary and mandibular horizontal growth distance variables in males and females

Growth distance variables can be used to predict the future horizontal growth of maxilla and mandible.

Study on larger sample is required to test the accuracy of this growth prediction method.

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