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THE LONGITUDINAL GROWTH CHANGES OF CRANIOFACIAL STRUCTURE IN KOREAN ADULT (DURING THE AGE OF 24 TO 31)

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Recently, according to the increase of adult patient, it is neccessory to understand the growth changes of adult after cessation of active pubertal growth in clinical orthodontics. The purpose of this study was to investigate the growth changes of craniofacial structure after active growth period(adult) in order to use as reference in clinical orthodontics. Authors followed the 40 sample(male 25, female 15) from 24 to 31 years of age. By analyzing the serial cephalograms, authors could get the following findings.

- The mandible rotated clockwise in female, but not in male, and no incremental growth change in both genders.
- The anterior facial height and lower anterior facial height were increased in both genders, the increase of lower anterior facial height exceed the posterior facial height increase in female.
- The cranial base was stable throughout observation period.
- The upper incisors uprighted slightly in female.
- There were quite great the individual variation in the growth change of craniofacial structure in adult.

Key Words : Growth changes, adult, craniofacial structure

Until the development of the cephalometer[7], most studies concerning growth changes of craniofacial structure were cross-sectional, dealing with measurements on dry skull or cadavers, gross body measurements on living individuals. But longitudinal studies are more accurate and more efficient in expressing the growth changes of craniofacial structure and individual variation on growth. With the advent of the cephalometer, longitudinal studies became possible on living individuals.

The cephalometrics have been used to study the growth changes of craniofacial structure, to diagnose and establish the treatment plan, and to evaluate the result of treatment in orthodontic fields. Owing to the individual variability of the growth amount and growth direction of craniofacial structure, it is very important to predict the growth of individuals precisely, for accurate diagnosis, establishing treatment plan, and predicting prognosis.

Recently, according to the increase of adult patient,

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Table 1. Cephalometric landmarks used in present study.

1. S(sella): the center of sella turcica
2. Na(nasion): the most anterior point of the frontonasal suture
3. Or(obbitale): the lowest point of the lower margin of the bony orbit
4. A(subnasale): the most posterior point on the curvature from the anterior nasal spine to the crest of the mandibular alveolar process
5. B(supramentale): the most posterior point on the curvature of the mandible between pognoin and crest of mandibular alveolar process
6. Pog(pognion): the most anterior point on the contour of chin
7. Gn(gnathion): a point by bisecting line of angle which formed by facial plane and mandibular plane
8. Me(menton): the most inferior point on the symphyseal outline
9. Go(gonion): a point by bisecting line of angle which formed by ramal plane and mandibular plane
10. Ar(articulare): the point of intersecting of the inferior cranial base surface and the posterior surface of the mandibular condyle
11. Ba(basion): the most inferoposterior point on the anterior margin of the foramen magnum
12. Po(pognion): the most superior point of the external auditory meatus
13. Pt(pterygoid point): intersection of inferior border of foramen rotundum with posterior wall of pterygomaxillary fissure
14. PNS(posterior nasal spine): the most posterior point on the bony hard palate
15. ANS(anterior nasal spine): the most anterior point on the maxilla at the level of palate
16. UIRT(upper incisor root tip): the root tip of the maxillary central incisor
17. UIT(upper incisor tip): the incisal tip of maxillary central incisor
18. UMDS(upper molar distal surface): the most posterior point on the distal surface of upper first molar
19. UMMC(upper molar mesial cusp tip): the mesial cup tip of maxillary first molar
20. LMDS(lower molar distal surface): the most posterior surface on the distal surface of lower first molar
21. LMMC(lower molar mesial cusp tip): the mesial cusp tip of mandibular first molar
22. LIT(lower incisor tip): the incisal tip of lower incisor
23. LIRT(lower incisor root tip): the root tip of mandibular central incisor

it is neccessary to understand the growth changes of adult after cessation of active pubertal growth in clinical orthodontics. However, almost every studies concerning the growth using cephalometrics were concentrated on the growth changes during the period of active growth involving juvenile and adolescent growth, and only a few sudies dealt with the growth changes of adult.

Bishara[2-3] followed the 20 male and 15 female during the period of age 5 to age 25, and concluded that the growth changes of craniofacial structure were observed after the adolesent. Bishara[4] also noted that there were variability in growth amount and growth timing of craniofacial skeleton between genders. Love et al[18] stated that the growth change of the mandible was significantly greater than that of the maxilla during the period of age 16 to age 20, after adolescent growth, as result of the cephalometric study. Beherents[1] concluded that there were considerable growth changes after the age of 17, including the downward movement of menton, clockwise rotation of point B, and uprighting of upper incisors, in his longitudinal cephalometric study using Bolton materials. But Bjork[5] reported that there was no growth change in craniofacial structure during the age 21 to 22, although 3 mm growth increment was observed during age 16 to 17 in 45 dutch sample. There is no agreement between investigators whether the growth change exist during adult, or not.

Reportedly, there is differences in the growth changes of craniofacial structure between races. Despite there were many studies concerning the growth changes of craniofacial structure, using korean sample [11,22], there was no study using adult as study materials. Almost every studies are mainly conducted on the period of juvenile, childhood, and adolescent.

Authors, therefore, studied the craniofacial growth changes during adult period in purpose of using the measurement as reference in clinical orthodontics.

Materials and Methods

1. Sample

The sample used in present study consisted of 40 longitudinal cephalometric radiographs(male 25, female 15) from who are available at the end of study among the original 90 sample(male 69, female 21). The mean age of sample was 24 years old at first taking of radiographs, and 31 years old at the taking of final radiographs. The target film distance was 5 feet, and the subject film distance was 14 cm(magnification rate 8%).

2. Methods

Films were traced on tracing paper by one orthodontist through superimposing cephalometric radiographs for improving accuracy. If both sides of image were not coincided, the midpoint was selected for tracing. The cephalometric landmarks(Fig.1 and Table 1.) were inputted into personal computer by pointing the landmarks, by utilizing the analysis program, angular and linear measurements were calculated the nearest 0.01 degrees, 0.01 mm respectively.

Six categories of measurements were calculated, the measurements concerning the cranial base, the measurements on anteroposterior relationships of maxilla and mandible, the measurements on vertical relaionships of maxilla and mandible, the measurements regarding the growth direction and length of mandible, the measurements on dentition, and other measurements.

The arithmetic mean(M), standard deviation(S.D.) were calculated in each measurements at each groups. Differences of variables between the measurements at first cephalograms and final cephalograms were tested for statistical significance with paired t-test. Differences of variables for growth increments between males and females were tested with student's t-test.

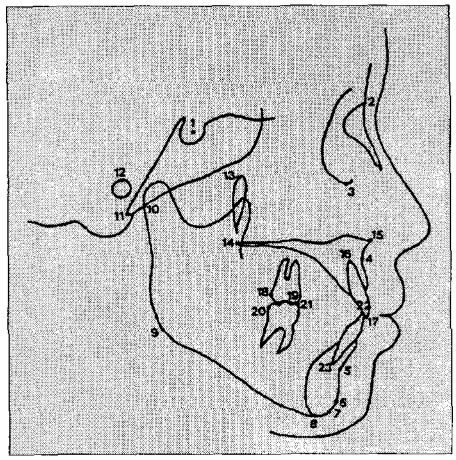

Fig. 1 Cephalometric landmarks used in present study.

Measurements concerning the cranial base

- S-Na(mm)
- S-Ba(mm)
- Na-S-Ar(Saddle angle)

Measurements on anteroposterior relationships of maxilla and mandible

- ∠SNA
- ∠SNB
- ∠ANB

Measurements on vertical relaionships of maxilla and mandible

- FH/PP
- FH/MP(FMA)
- FH/OP(FH/Occlusal plane)
- AFH(Anterior facaial height: Na-Me)
- PFH(Posterior facial height: S-Go)
- UAFH(Upper anterior facial height: Na-ANS)
- LAFH(Lower anterior facial height: ANS-Me)

Measurements regarding the growth direction and length of mandible

- Facial angle
- Y-axis
- Gonial angle
- Ar-Gn(mm)
- Ar-Go(mm)
- Go-Me(mm)

Measurements on dentition

- Interincisal angle

Table 2. Mean values of measurements and significance in male.

Measurements	Age 24 M(SD)	Age 32 M(SD)	Increment M(SD)	p-value
S-Na(mm)	72.58(3.24)	72.60(3.31)	0.11(0.59)	0.334
S-Ba(mm)	54.16(3.37)	53.77(3.32)	-0.39(0.86)	0.133
Na-S-Ar	121.63(4.83)	122.00(4.63)	0.36(0.64)	0.079
SNA	82.52(3.74)	82.39(3.53)	-0.13(0.66)	0.335
SNB	80.40(3.59)	80.20(3.52)	-0.20(0.48)	0.45
ANB	2.12(2.29)	2.19(2.35)	0.07(0.41)	0.375
FH/PP	-0.28(2.68)	-0.28(2.63)	0.00(0.48)	0.994
FMA	26.02(7.42)	25.96(7.41)	-0.05(0.63)	0.67
FH/OP	5.72(3.85)	5.47(4.27)	-0.25(1.22)	0.313
AFH(Na-Me)	137.12(6.68)	137.63(7.11)	0.52(0.86)	0.006**
PFH(S-Go)	93.73(6.27)	94..18(6.12)	0.45(0.84)	0.013*
UAFH(Na-ANS)	60.47(2.95)	60.60(3.04)	0.05(4.52)	0.952
LAFH(ANS-Me)	77.55(5.01)	77.95(5.25)	0.41(0.68)	0.006**
Facial angle	88.57(3.36)	88.40(3.38)	-0.16(0.59)	0.175
Y-axis	62.19(3.69)	62.32(3.76)	0.16(0.44)	0.095
Gonial angle	123.73(7.28)	123.47(7.27)	-0.02(1.55)	0.951
Ar-GN(mm)	120.40(4.96)	120.43(4.75)	0.04(0.88)	0.844
Ar-Go(mm)	54.79(5.76)	54.92(5.37)	0.15(1.19)	0.539
Go-Me(mm)	78.94(3.99)	79.07(3.86)	0.14(0.50)	0.183
Inrterincisal angle	123.71(7.34)	123.56(8.23)	-0.16(2.79)	0.781
FH/U1	118.83(6.55)	118.45(7.71)	-0.39(1.86)	0.311
(A-Pog)-U1(mm)	12.74(8.68)	12.87(8.87)	0.13(0.92)	0.290
(A-PoG)-L1(mm)	7.36(8.31)	7.56(8.50)	0.20(0.91)	0.328
A-Pog/U1	31.53(5.74)	31.41(6.15)	-0.11(1.77)	0.749
A-Pog/L1	24.76(4.17)	25.03(4.21)	0.27(1.71)	0.435
IMPA	91.43(6.60)	92.03(6.35)	0.54(1.66)	0.115
Overbite	4..03(1.42)	4.16(1.46)	0.13(0.53)	0.219
Overjet	5.04(1.35)	4.93(1.14)	-0.11(0.54)	0.288
ODI	69.11(4.98)	69.39(4.96)	0.28(0.87)	0.100
APDI	84..31(5.07)	84..08(5.32)	-0.23(0.85)	0.190

* P 〈 0.05; ** P 〈 0.01

- FH/U1
- (A-Pog)-U1(mm)
- (A-Pog)-L1(mm)
- A-Pog/U1(Degree)
- A-Pog/L1(Degree)
- IMPA(Mandibular plane to lower incisor)
- Overbite
- Overjet

Other measurements.

- ODI(Overbite depth indicator)
- APDI(Anteroposterior dysplasia indicator)

Findings

The mean, growth increments and standard deviation of each measurements were shown in table 2(male) and table 3(female). The differences of growth increments of each measurements between male and female were

Table 3. Mean values of measurements and significance in female..

Measurements	Age 24 M(SD)	Age 32 M(SD)	Increment M(SD)	p-value
S-Na(mm)	68.72(2.77)	68.88(2.77)	0.16(0.24)	0.102
S-Ba(mm)	48.83(3.65)	48.75(3.42)	-0.08(1.14)	0.795
Na-S-Ar	123.97(4.36)	124.29(4.17)	0.32(0.71)	0.101
SNA	80.55(3.65)	80.25(3.76)	-0.30(0.48)	0.027*
SNB	77.87(2.87)	77.39(2.93)	-0.48(0.44)	0.001*
ANB	2.68(2.19)	2.86(2.23)	0.18(0.46)	0.151
FH/PP	-0.57(2.09)	-0.50(1.98)	0.07(0.39)	0.443
FMA	27.43(4.41)	27.65(4.43)	0.24(0.48)	0.069
FH/OP	7.00(3.61)	7.36(4.15)	0.36(1.24)	0.279
AFH(Na-Me)	127.79(5.53)	128.99(5.54)	1.20(1.24)	0.002**
PFH(S-Go)	81.05(5.69)	81.80(5.31)	0.75(1.20)	0.029*
UAFH(Na-ANS)	56.37(2.47)	56.64(2.54)	0.27(0.77)	0.196
LAFH(ANS-Me)	72.45(4.31)	73.45(3.86)	0.99(0.96)	0.001**
Facialangle	88.42(2.83)	88.03(2.82)	-0.39(0.26)	0.000**
Y-axis	61.32(2.87)	61.79(2.82)	0.46(0.42)	0.001*
Gonialangle	122.87(5.21)	122.37(5.36)	0.50(0.66)	0.012*
Ar-Gn(mm)	111.41(4.80)	111.43(4.79)	0.02(0.71)	0.903
Ar-Go(mm)	47.60(4.10)	47.74(3.87)	0.14(0.72)	0.475
Go-Me(mm)	76.44(4.38)	76.70(4.51)	0.25(0.36)	0.015*
Interincisalangle	120.37(6.56)	121.51(7.78)	1.14(3.14)	0.180
FH/U1	118.74(4.90)	116.96(6.18)	-1.78(2.04)	0.004**
(A-Pog)-U1(mm)	14.39(6.88)	14.56(6.72)	0.17(1.23)	0.593
(A-Pog)-L1(mm)	10.12(5.86)	10.49(5.84)	0.37(0.83)	0.102
A-Pog/U1	32.57(4.47)	31.36(4.77)	-1.21(2.14)	0.046*
A-Pog/L1	27.06(3.99)	27.13(4.43)	0.07(1.85)	0.887
IMPA	93.47(6.17)	93.88(6.73)	0.41(1.86)	0.408
Overbite	2.97(2.09)	2.95(1.99)	-0.13(0.51)	0.341
Overjet	3.81(1.66)	3.56(1.66)	-0.24(0.59)	0.130
ODI	68.15(6.38)	68.62(6.32)	0.47(0.81)	0.141
APDI	83.28(4.91)	82.74(4.73)	-0.54(1.10)	0.080

* $P < 0.05$; ** $P < 0.01$

shown in table 4. The average growth changes of facial skeleton in male and female, were shown in Fig. 2 and Fig. 3 respectively. 11 samples out of 25 in male showed distinct changes, 8 had clockwise growth rotation, and 3 had anteroinferior growth. 7 samples out of 15 in female showed discernable changes, 5 had clockwise growth rotation, and 2 had inferoanterior growth. Finally we showed the profilograms of samples who express the large amount of growth changes and typical growth direction change during experimental period(Fig. 4-8).

Measurements concerning the cranial base

There was no significant growth changes in both male and female.

Measurements on anteroposterior relationships of maxilla and mandible

∠SNA and ∠SNB showed significant decrease in

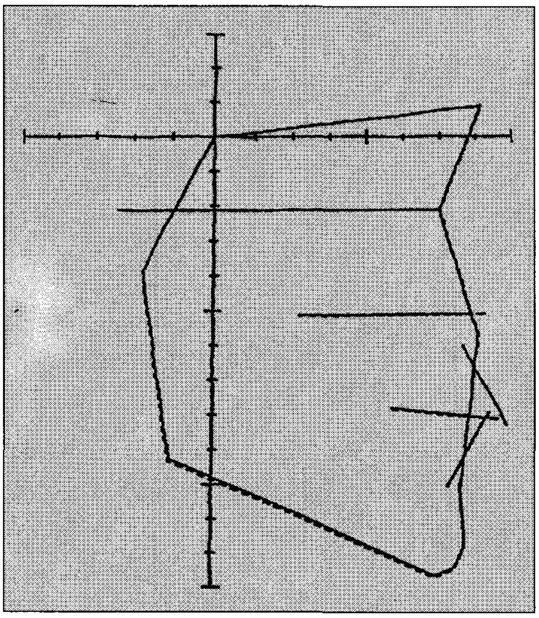

Fig. 2. Average growth changes from 24 to 31 years of age in male. straight line, 24 years of age; dotted line, 31.

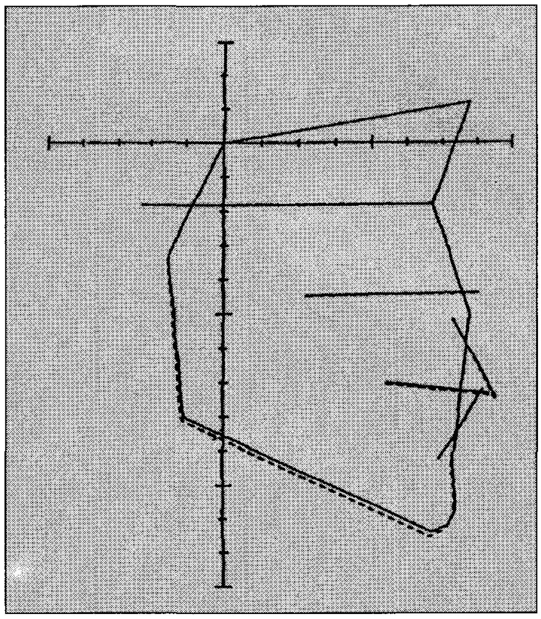

Fig. 3. Average growth changes from 24 to 31 years of age in female. straight line, 24 years of age; dotted line, 31.

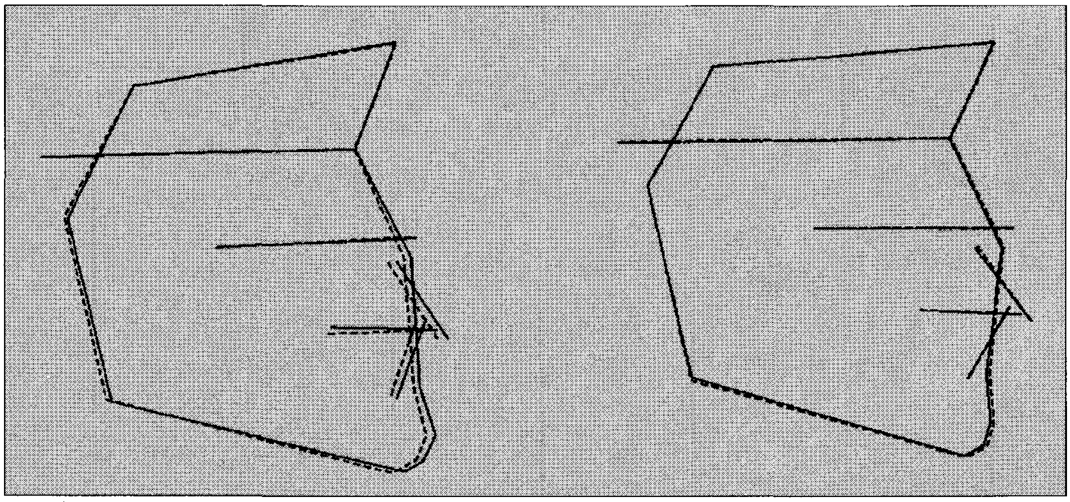

Fig. 4. Profilograms of male samples, who had similar brachyfacial pattern (sample No. 7 and sample No. 11), showed different growth changes in terms of growth direction. straight line, 24 years of age; dotted line, 31.

female, but not in male.

Measurements on vertical relaionships of maxilla and mandible

AFH, PFH, and LAFH showed significant increase in both genders, but other measurements didnot show any significant growth changes.

Measurements regarding the growth direction and length of mandible

In female, significant increase was observed on Y-axis and Go-Me, but Gonial angle and Facial angle decreased.

Measurements on dentition

FH/U1 and A-Pog/U1 showed significant decrease in female. Other measurements in female and all measu

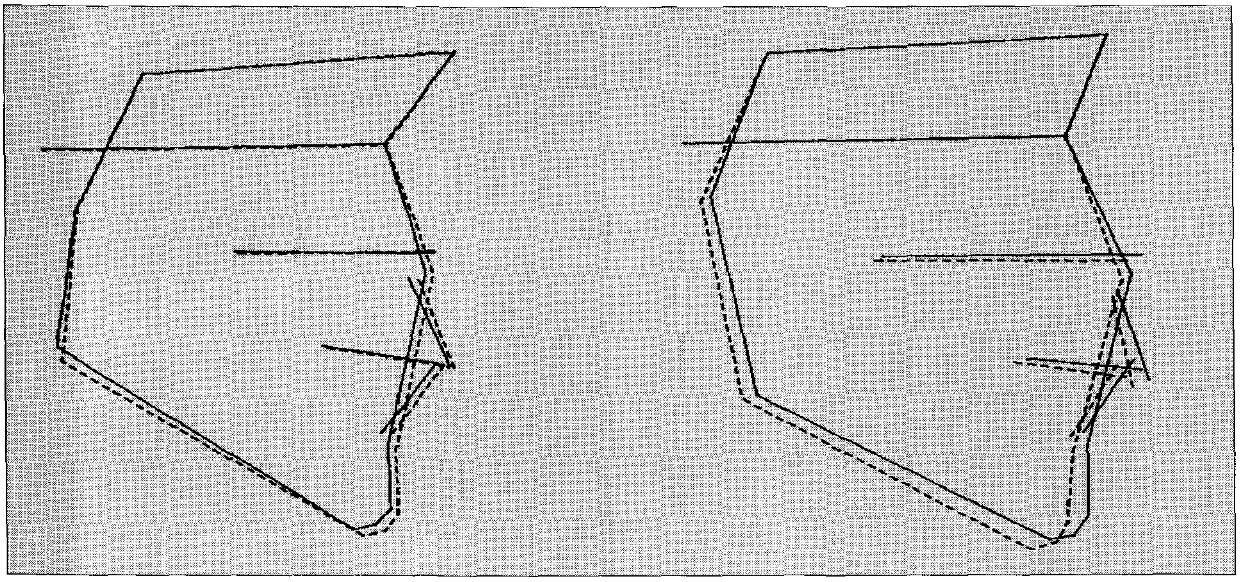

Fig. 5. Profilogram of sample No. 14 who had Class Ⅰ skeletal pattern showed the anteroinferior growth, and sample No. 24 who had Class Ⅱ skeletal pattern demonstrated the clockwise growth rotation. Both were male who had mesofacial pattern. straight line, 24 years of age; dotted line, 31.

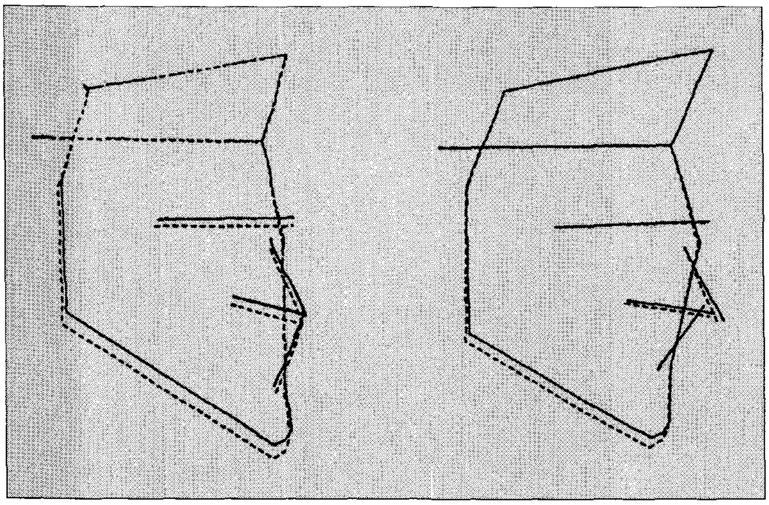

Fig. 6. Profilograms of female samples who showed inferior growth(sample No. 8 and 15). straight line, 24 years of age; dotted line, 31.

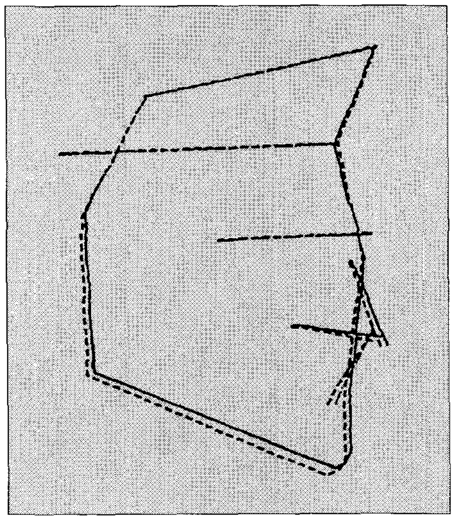

Fig. 7. profilograms of female sample(No. 11) showed downward backward growth rotation. straight line, 24 years of age; dotted line, 31.

rements in male showed no significant changes.

Other measurements.

There was no significant changes in ODI and APDI. The measurements which showed significant differences of growth increment changes between male and female were AFH, LAFH, and FH/U1. The growth change of AFH, LAFH, and FH/U1 in female were greater than that of male.

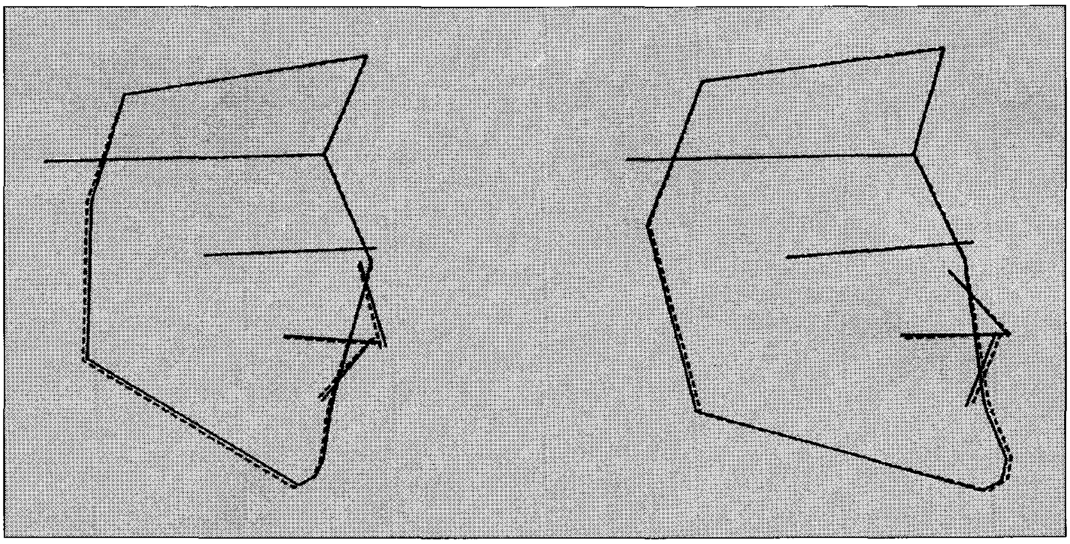

Fig. 8. Male sample(No. 9) who had Class II skeletal pattern showed the downward backward growth rotation, and male sample(No. 25) who had Class III skeletal pattern demonstrated the downward forward growth rotation. straight line, 24 years of age: dotted line, 31.

Table 4. Differences of growth increments between male and female

Measurements	Male	Female	p-value	Measurements	Male	Female	p-value
S-Na(mm)	0.02	0.16	0.075	Gonialangle	-0.25	0.10	0.284
S-Ba(mm)	-0.39	-0.08	0.334	Ar-Gn(mm)	0.04	0.02	0.963
Na-S-Ar	0.36	0.32	0.844	Ar-Go(mm)	0.14	0.14	1.000
SNA	-0.13	-0.30	0.377	Go-Me(mm)	0.14	0.25	0.437
SNB	-0.20	-0.48	0.073	Interincisa angle	-0.16	1.14	0.181
ANB	0.07	0.18	0.447	FH/U1	-0.39	-1.78	0.033*
FH/PP	0.00	0.08	0.594	(A-Pog)-U1(mm)	0.13	0.17	0.900
FMA	-0.05	0.22	0.149	(A-Pog)-L1(mm)	0.20	0.37	0.505
FH/OP	-0.25	0.36	0.135	A-Pog/U1	-0.11	-1.21	0.087
AFH(Na-Me)	0.52	1.20	0.047*	A-Pog/L1	0.27	0.07	0.727
PFH(S-Go)	0.45	0.75	0.353	IMPA	0.60	0.41	0.750
UAFH(Na-ANS)	0.13	0.27	0.501	Overbite	0.13	-0.20	0.421
LAFH(ANS-Me)	0.41	0.99	0.030*	Overjet	-0.12	-0.24	0.489
Facialangle	-0.17	-0.39	0.105	ODI	0.28	0.47	0.495
Y-axis	0.13	0.46	0.028*	APDI	-0.23	-0.54	0.326

* $p < 0.05$

Discussion

The increasing number of adult patient make the clinician get thorough understanding of growth changes after active growth of puberty. The most of the longitudinal study concerning the craniofacial growth were limited to active growing period. There were very limited studies regarding the longitudinal growth changes of adult, because of difficulty in gathering the data.

In spite of known knowledge that the growth was ceased after active growth, controversies still present. Scammon[20] noted that no growth changes in adult in growth curve, Krogman[17] and Graber[14] also stated no growth after 20 years of age. In addition, Bjŏrk and Helm[6] demonstrated that the growth stopped after the age of 20.

But Ranly[19] reported that the growth changes after adolescence were mostly soft tissue changes ,and the bony changes were observed only after loss of teeth. Buchi[9] suggested, in the study using sample 200 swiss adult, that increase of facial height in 20-28 age group in both genders and steady increase in the face as well as long bone. Tompson and Kendrick[24] reported, on serial cephalometric study of 71 male, 22-34 years of age, that vertical dimensions of face increased significantly. Beherents[1] also stressed that the contiuous growth changes during the period of adult, in his longitudinal cephalometric study using Bolton sample. It is, however, very difficult to compare one study with another study directly, because of differences of samples, age of sample, and races. It may be presumed that using the well controlled sample is vitally important.

As previously saying, it is very difficult to get good sample. In gathering the data, authors chose the sample from dental school students who had same age. Therefore the sample used in this study was quite homogenous.

Kendrick and Risinger[16] reported, on longitudinal study of 71 male 22-34 years of age, that increase of head length, lengthening of anterior and posterior cranial base were observed. Beherents[1] also noted that nasion point moved forward during entire period of observation(adult). But Brodie[8] found rapid growth of cranial base until 5 years of age and 13 years of age, the cranial base showed almost completion of growth after 13 years of age. Carlson and Persson found no growth changes of cranial base. Tallgren[23] also didn't observe the growth change of cranial base, and concluded that there was no real change in cranial vault and base except the length of sella to glabella. In this study, there was no discernable change on cranial base in both genders. It might be presumed that the cranial bse appears to be stable, the difference between investigators were mainly due to the difference of age, duration, and probably races.

In regard to the anteroposterior growth change of midface, Forsberg[12] reported no observable change of anteroposterior jaw relations in male, but female showed mandibular decrease. Forsberg[13] concluded that there was no real growth change after 29 years of age, it's just result of mandibular backward rotation accompanying with uprighting of upper incisors. Beherents[1] noted, although A point moved forward consistently, angular relationship of A point to cranial base(∠SNA) was maintained because of concurrent forward movement of nasion. But he noted B point rotated backward with increase of age. But Sinclaire and Little[21] demonstrated just slight increase of ∠SNA in male, and remarkable increase of ∠SNB in both genders. Present study shows no change of nasion point, no discernable change of ∠SNA and ∠ANB in male, and significant decrease of ∠SNA and ∠SNB in female.

Beherents[1] reported successive uprighting of upper incisors in both genders. The forward tilting of lower incisor in female, but not in male. Sinclaire and Little[21] noted the forward tilting of lower incisors in female, uprighting of lower incisors in male. Present study showed there was no significant change in tooth axis except uprighting of upper incisors in female.

In the studies of vertical relation of facial structure, Most of studies agreed to the growth change of facial height. Israel[15] observed the increase of upper facial height in 23 caucascian female. Tompson and Kendrick [24] reported that total , upper, and lower facial height were increased. And Kendrick and Risinger[16] agreed. Forsberg[12] also observed the increase of total facial height, mainly increase of lower facial height, but Forsberg[13] stressed it was not real growth but backward rotation of mandible following tooth eruption. Love et al[18] demonstrated decrease of mandibular plane angle, he explained it was due to upward forward rotation of mandible, because the posterior vertical growth exceeded the anterior vertical growth. Sinclaire and Little[21] also observed the counterclockwise rotation of mandible. But Beherents[1] observed counterclockwise rotation of mandible in male, and clockwise rotation of mandible in female. Present study shows no incremental and directional change of mandible in male, but female shows identical results with Beherent, clockwise rotation of mandible. In this study, most of increase in total anterior facial height was increase in lower facial height. The Y-axis and facial axis showed no change in male, because the increase in posterior facial height and lower anterior facial height had very similar amount of growth. The growth direction(Y-axis and facial axis) in female opened backward, on account of exceeding increase of lower anterior facial height to posterior facial height.

In regard to the individual variation, however, some sample shows different growth changes, although both had similar skeletal pattern(Fig. 4-5). Among female sample, most of them shows slight growth changes, but some of them shows considerable amount of growth change(Fig. 6-7). The direction and amount of growth may not be predictable because of individual variation. Fig. 8 shows that the sample(No. 9) who had Class Ⅱ skeletal pattern demonstrate the downward backward growth rotation, and the sample(No. 25) who had Class Ⅲ skeletal pattern shows the downward forward growth rotation. It may cause relapse of orthodontic treatment and orthognathic surgery. Authors thus presumed that the growth change in adult have some relationship with skeletal pattern.

It will be needed to investigate precisely the growth change of craniofacial structure in adult using well controlled sample, and to study the changes according to the skeletal pattern.

Summary

The purpose of this study was to investigate the growth changes of craniofacial structure after active growth period(adult) in order to use as reference in clinical orthodontics. Authors followed the 40 sample (male 25, female 15) from 24 to 31 years of age. By analyzing the serial cephalograms, authors could get the following findings.

- The mandible rotated clockwise in female, but not in male, and no incremental growth change in both genders.
- The anterior facial height and lower anterior facial height were increased in both genders, the increase of lower anterior facial height exceed the posterior facial height increase in female.
- The cranial base was stable throughout observation period.
- The upper incisors uprighted slightly in female.
- There were quite great the individual variation in the growth change of craniofacial structure in adult.

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국문초록

성인 두개안면골의 성장변화(24세에서 31세까지)

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최근 성인환자의 증가에 따라 왕성한 사춘기성장이 완료된후 성인에서 일어나는 성장변화를 이해하는 것이 임상교정학에 있어서 매우 중요하게 되었으나 이에 대하여 알려진 바가 많지 않다. 따라서 저자등은 한국인 성인의 두개안면부의 성장변화를 관찰하기 위하여 성인 남자 25명과 여자 15명의 두부방사선규격사진을 촬영한 후 7년후에 추적하여 다시 촬영한 연속 두부방사선규격 사진을 분석하여 다음과 같은 결과를 얻었다.

. 여자에서 하악골은 시계방향으로 회전하였으나 남자에 있어서는 변화가 없었으며 하악골의 길이 변화는 없었다.
. 여자에서 상악전치는 설측경사 하였다.
. 남녀 모두에서 전안면고와 전하안면고의 증가가 있었고 여자에서 전하안면고의 증가가 후안면고의 증가보다 많았다.
. 두개저는 관찰기간동안 변화가 없었다.
. 성인 두개안면부의 성장은 개개인에 따라서 매우 큰 차이를 보이는 다양성을 가지고 있었다.

주요 단어 : 성장변화, 성인, 두개안면골