https://doi.org/10.5933/JKAPD.2021.48.4.414
J Korean Acad Pediatr Dent 48(4) 2021
ISSN (print) 1226-8496 ISSN (online) 2288-3819

Evaluation of Skeletal and Dental Maturity in Relation to Vertical Facial Types and the Sex of Growing Children

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Abstract

The purpose of this retrospective study was to evaluate the skeletal and dental maturity according to the vertical facial type and sex in Korean children in the developmental stage.

In total, 184 participants aged 8 - 14 years were selected and divided into three groups based on the mandibular plane angle. For the comparison between the sexes, the three groups were each divided into male and female subgroups. The skeletal and dental maturity were assessed using lateral cephalograms, hand-wrist radiographs and panoramic radiographs.

The vertical growth group showed significantly greater cervical vertebral and hand-wrist maturity than that in the horizontal growth group. Dental maturity was the highest in the vertical growth group. Girls showed greater skeletal maturity than boys, and no distinct difference was observed between the dental maturity of the sexes.

Analysis of the vertical facial type in children can provide ancillary indicators that may help determine the optimal timing for orthodontic treatment initiation. Earlier initiation of orthodontic treatment may be considered for patients with vertical facial growth patterns.

Key words : Vertical facial type, Mandibular plane angle, Skeletal maturity, Dental maturity

Ⅰ. Introduction

Skeletal maturity in growing patients is an important factor influencing the decision to start orthodontic treatment and the selection of treatment modalities[1-4]. Accurate determination of growth on the basis of age is difficult owing to the considerable individual differences in growth. Therefore, parameters representative of physiological age, such as sexual, skeletal, and dental maturity, are conferred greater clinical importance. Skeletal and dental maturity evaluations are mainly performed in the field of dentistry[5,6].

Skeletal maturity is evaluated by observing ossification, such as changes in the bone shape, density, and size, and the maturation stages of the cervical and hand-wrist bones are correlated with skeletal development during puberty[7,8]. Dental maturity is evaluated by measuring the degree of eruption or calcification of the teeth. Evaluation of the tooth calcification stage is used more commonly because tooth eruption is in-

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Received May 10, 2021 / Revised July 30, 2021 / Accepted July 21, 2021

fluenced by local factors such as ankylosis or early or delayed exfoliation of the primary teeth and impaction and crowding of the permanent teeth[9].

Meanwhile, studies on the differences in the timing of skeletal growth according to the vertical facial type have been published. Nanda[10] observed the adolescent growth spurt in the facial structures began earlier in individuals with a skeletal open bite than in those with a skeletal deep bite. Verulkar *et al*.[11] also reported that skeletal maturity tended to be delayed in individuals with a horizontal growth pattern than in those with a vertical growth pattern. In South Korea, Lee *et al*.[12] investigated skeletal maturity according to the vertical facial types of the female participants and found that skeletal maturity was greater in females with a high mandibular plane angle than in those with a low mandibular plane angle.

Studies have also investigated the relationship between the vertical facial type and the degree of tooth development, based on the assumption that there is an association between the degree of tooth development and skeletal growth. Janson *et al*.[13] and Neves *et al*.[14] reported that vertical facial types were associated with a high degree of dental maturity, whereas Jamroz *et al*.[15] reported that the difference in dental maturity according to vertical facial types was not significant.

The aim of this study was to evaluate the skeletal and dental maturity, assessed using lateral cephalograms, hand-wrist radiographs, and panoramic radiographs, in relation to vertical facial type classified based on the mandibular plane angle and sex in Korean children in the developmental stage.

Ⅱ. Materials and Methods

This retrospective study was approved by the Institutional Review Board (IRB) of the Wonkwang University (WKDIRB202010-08).

1. Participants

This study retrospectively analyzed the dental records of 353 children and adolescents aged 8 - 14 years who visited the Wonkwang University Dental Hospital between February 2003 and February 2020 and for whom lateral cephalograms, hand-wrist radiographs, and panoramic radiographs were acquired on the day of the visit. Those with maxillofacial deformities that could affect growth and development, such as cleft lip and palate, and abnormalities such as impaction or dislocation, were excluded. The final analysis included 184 children and adolescents (96 boys and 88 girls) with all permanent teeth, except third molars, and skeletal Class I malocclusion.

2. Methods

1) Data collection

Data regarding the sex, age, skeletal malocclusion, and the vertical facial type were collected from electronic medical records and radiographs of all participants. The craniofacial complexes were evaluated using lateral cephalograms. The lateral cephalograms were digitized using Vceph™ 6.0 (Osstem Implant, Seoul, Korea) for analysis. One examiner observed all images of the lateral cervical region of the participants and identified children and adolescents with skeletal Class I malocclusion and an A point-nasion-B point (ANB) angle of 2.0 - 4.0°. The mean mandibular plane angle was set as 37.0 ± 4.0° in accordance with studies on the growth and development of normal Korean children[16,17]. Participants were subsequently divided into three groups based on the mandibular plane angle formed by Sella-Nasion plane and mandibular plane (SN-GoMe; Fig. 1) : normal growth group (33.0° ≤ mandibular plane angle < 41.0°), vertical growth group (mandibular plane angle ≥ 41.0°), and horizontal growth group (mandibular plane angle < 33.0°). Each of the growth groups were further divided into male and female subgroups to facilitate comparison between the sexes.

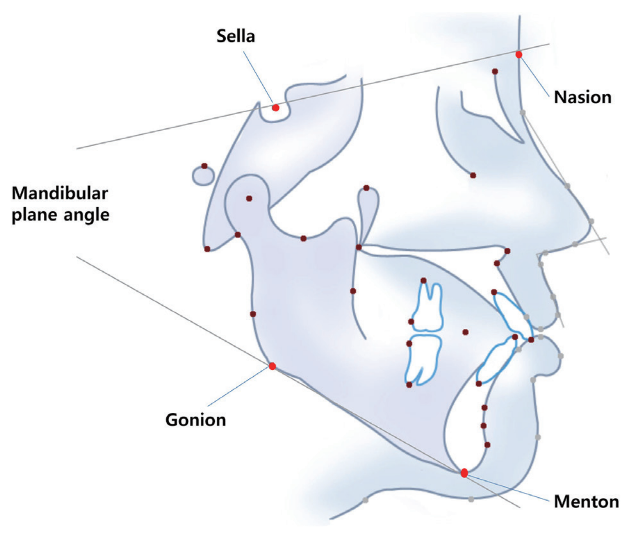

Fig. 1. Mandibular plane angle formed by sella-nasion plane and the gonion-menton plane.

2) Cervical vertebral maturity evaluation

The 2nd, 3rd, and 4th cervical vertebral bodies were evaluated on the lateral cephalograms, and cervical vertebral maturation stages (CVMS) 1 to 5 were assigned according to the classification method of Baccetti[18].

3) Hand-wrist maturity evaluation

For hand-wrist radiographs, skeletal maturation indicators (SMI) proposed by Fishman[19] was used. Participants were categorized under SMI 1, SMI 2, SMI 4, SMI 6, SMI 8, or SMI 10.

4) Dental maturity evaluation

The panoramic radiographs of all participants were evaluated from the mandibular left central incisor to the mandibular left 2nd molar. The dental maturity of each tooth was classified into 8 stages from stage A, when calcification starts in the crown, to stage H, when the apex closes, using the Demirjian index (DI) proposed by Demirjian *et al.*[20] (Table 1). The different stages were identified with the help of Demirjian's maturation stage charts using the overall score of the different point values. Following addition of the scores for the 7 teeth, the total score was converted to dental age using the Demirjian table[20].

5) Intraobserver reliability

After one examiner observed all the lateral cephalograms and hand-wrist and panoramic radiographs, 10 participants were randomly selected for each growth group and re-evaluated after 1 month for the assessment of the intraobserver reliability. All intraclass correlation coefficients calculated for the measured cervical vertebral maturity, hand-wrist maturity, and dental maturity values were 0.9 or higher.

6) Statistical analysis

All statistical analyses were conducted using Windows SPSS 25.0 (IBM, Ar-monk, NY, USA). Differences in skeletal and dental maturity among the three growth groups were assessed using the Kruskal-Wallis test and post-hoc with Bonferroni correction. Differences in skeletal and dental maturity according to sex were compared using the Mann-Whitney U test.

Spearman's rank correlation analysis was performed to investigate the relationship of the mandibular plane angle with the cervical vertebral and hand-wrist maturity and dental maturity.

Ⅲ. Results

1. Distribution and characteristics of participants

In total, 184 children, 96 (52.2%) boys and 88 (47.8%) girls were included. Based on the mandibular plane angle, 93 (50.5%), 49 (26.6%), and 42 (22.8%) participants were included in the normal growth, vertical growth, and horizontal growth groups, respectively (Table 2). The mean mandibular plane angle showed significant differences among the 3 groups. The mean ages at the time of image acquisition were similar, with no significant differences among groups (Table 3).

Table 1. Demirjian index used in the study

Stage A:	Cusp tips are calcified but have not yet fused.
Stage B:	Calcified cusps are united so an outlined occlusal surface is well-defined.
Stage C:	Enamel formation is complete at the occlusal surface. Dentinal deposition has commenced. The outlines of the chamber are curved.
Stage D:	Crown formation is complete to the cemento-enamel junction. The pulp chamber is curved, being concave toward the cervical region. The pulp horns are beginning to differentiate. Root formation is seen.
Stage E:	The walls of the pulp chamber are straight and the pulp horns are more differentiated. The root length is less than the crown heights.
Stage F:	The walls of the pulp chamber now form an isosceles triangle. The apex ends in a funnel shape. The root length is equal to or greater than the crown height.
Stage G:	The walls of the root canal are now parallel and its apical end is still partially open.
Stage H:	The apical end of the root canal is completely closed. The periodontal membrane has a uniform width around the root and the apex.

Table 2. Distribution of the participants with respect to sex and the vertical facial type

Vertical facial type	Sex		Total (%)
	Male	Female	
Normal growth group	44	49	93 (50.5)
Vertical growth group	25	24	49 (26.6)
Horizontal growth group	27	15	42 (22.8)
Total (%)	96 (52.2)	88 (47.8)	184 (100)

Table 3. Age and mandibular plane angle of the participants

	Sex	Normal growth group	Vertical growth group	Horizontal growth group	*p* value
Age (year) Mean ± SD	Male	11.3 ± 1.5	11.8 ± 1.6	12.0 ± 1.3	
	Female	11.0 ± 1.9	11.3 ± 1.7	11.1 ± 2.1	
	Total	11.2 ± 1.7	11.6 ± 1.7	11.7 ± 1.7	0.177
	p value	0.519	0.217	0.246	
Mandibular plane angle (°) Mean ± SD	Male	37.1 ± 2.4	44.6 ± 2.9	31.1 ± 1.8	
	Female	37.3 ± 2.4	43.8 ± 2.7	31.5 ± 2.3	
	Total	37.2 ± 2.4[a]	44.2 ± 2.8[b]	31.2 ± 1.9[c]	< 0.001
	p value	0.622	0.327	0.135	

p values from one-way ANOVA test in the rows.
a,b,c: Different letters indicate significant differences by Bonferroni's post-hoc test
p values from independent t-test in the columns.
SD = standard deviation

2. Comparison of cervical vertebral maturity according to the vertical facial type

The vertical growth group showed the greatest cervical vertebral maturity, whereas the horizontal growth group showed the least cervical vertebral maturity (Table 4). Compared with that in the normal growth group, the cervical vertebral maturity in the vertical growth group was significantly greater ($p < 0.001$), whereas that in the horizontal growth group was significantly lesser ($p = 0.010$, Table 5).

Table 4. Cervical vertebral maturation stages, skeletal maturation indicators and dental age according to vertical facial type

	CVMS	SMI	Dental age (year)
	Mean ± SD	Mean ± SD	Mean ± SD
Normal growth group	3.06 ± 1.150[a]	5.00 ± 3.065[a]	12.70 ± 2.224[a]
Vertical growth group	3.98 ± 0.803[b]	6.88 ± 2.412[b]	13.67 ± 1.942[b]
Horizontal growth group	2.57 ± 0.914[c]	4.19 ± 1.838[a]	12.11 ± 1.830[a]
p value	< 0.001	< 0.001	0.001

p value: Kruskal-Wallis test
a,b,c: The same letter means no statistical difference by Mann-Whitney's U test as post-hoc test.
CVMS = cervical vertebral maturation stages, SMI = skeletal maturation indicators, SD = standard deviation

Table 5. Multiple comparisons of cervical vertebral maturation stages

	Normal growth group	Vertical growth group	Horizontal growth group
Normal growth group			
Vertical growth group	< 0.001		
Horizontal growth group	0.010	< 0.001	

p values from the Mann-Whitney U test ($p < 0.017$).

3. Comparison of cervical vertebral maturity according to sex

In the normal growth group, there was not statistically significant difference in cervical vertebral maturity according to sex (p = 0.053, Table 6). The same result was observed in the vertical growth (p = 0.162) and horizontal growth groups (p = 0.410, Table 6).

4. Comparison of hand-wrist maturity according to vertical facial type

The vertical growth group showed significantly greater hand-wrist maturity than did the normal growth group (p < 0.001, Table 4, 7). The difference in hand-wrist maturity of the horizontal growth group and the normal growth group was not statistically significant (p = 0.216, Table 4, 7).

5. Comparison of hand-wrist maturity according to sex

Hand-wrist maturity was significantly greater in girls than in boys in the normal growth (p = 0.001) and the vertical growth groups (p = 0.030). In the horizontal growth group, hand-wrist maturity showed no statistically significant difference according to sex (p = 0.255, Table 8).

Table 6. Relationship between the cervical vertebral maturation stages and sex

		CVMS Mean ± SD	*p* value
Normal growth group	Male	2.89 ± 0.868	0.053
	Female	3.22 ± 1.263	
Vertical growth group	Male	3.84 ± 0.746	0.162
	Female	4.13 ± 0.850	
Horizontal growth group	Male	2.52 ± 0.849	0.410
	Female	2.67 ± 1.047	

p values from the Mann-Whitney test
CVMS = cervical vertebral maturation stages, SD = standard deviation

Table 7. Multiple comparisons of skeletal maturation indicators

	Normal growth group	Vertical growth group	Horizontal growth group
Normal growth group			
Vertical growth group	< 0.001		
Horizontal growth group	0.216	< 0.001	

p values from Mann-Whitney's U test (p < 0.017)

Table 8. Association between the skeletal maturation indicators and sex

		SMI Mean ± SD	*p* value
Normal growth group	Male	3.89 ± 2.626	0.001
	Female	6.00 ± 3.109	
Vertical growth group	Male	6.16 ± 2.304	0.030
	Female	7.63 ± 2.337	
Horizontal growth group	Male	3.96 ± 1.427	0.255
	Female	4.60 ± 2.414	

p values from Mann-Whitney test
SMI = skeletal maturation indicators, SD = standard deviation

6. Comparison of dental maturity according to vertical facial type

The vertical growth group showed significantly greater dental maturity than the normal growth group ($p = 0.008$, Table 4, 9). The difference in dental maturity of the horizontal growth and the normal growth groups was not statistically significant ($p = 0.164$, Table 4, 9).

7. Comparison of dental maturity according to sex

In the normal growth group, there was no statistically significant difference in dental maturity according to sex ($p = 0.423$, Table 10). The same result was observed in the vertical growth ($p = 0.566$) and horizontal growth groups ($p = 0.597$, Table 10).

8. Correlation of the mandibular plane angle with cervical and hand-wrist maturity and dental maturity

The mandibular plane angle showed a significant weak correlation with skeletal maturity and dental maturity (CVMS, $r = 0.368$; SMI, $r = 0.273$; Dental age, $r = 0.186$; Table 11).

Table 9. Multiple comparisons of dental age

	Normal growth group	Vertical growth group	Horizontal growth group
Normal growth group			
Vertical growth group	0.008		
Horizontal growth group	0.164	< 0.001	

p values from Mann-Whitney's U test ($p < 0.017$)

Table 10. Association between the dental age and sex

		Dental age (year) Mean ± SD	*p* value
Normal growth group	Male	12.91 ± 2.158	0.423
	Female	12.52 ± 2.288	
Vertical growth group	Male	13.54 ± 1.978	0.566
	Female	13.80 ± 1.938	
Horizontal growth group	Male	12.23 ± 1.736	0.597
	Female	11.91 ± 2.034	

p values from Mann-Whitney test
SD = standard deviation

Table 11. Correlation coefficients between the mandibular plane angle, cervical vertebral maturation stages, skeletal maturation indicators and dental age

		Mandibular plane angle	CVMS	SMI	Dental age
Mandibular plane angle	correlation (*r*)				
	p value				
CVMS	correlation (*r*)	0.368			
	p value	< 0.001			
SMI	correlation (*r*)	0.273	0.832		
	p value	< 0.001	< 0.001		
Dental age	correlation (*r*)	0.186	0.669	0.692	
	p value	0.012	< 0.001	< 0.001	

p values from Spearman's rank correlation test
CVMS = cervical vertebral maturation stages, SMI = skeletal maturation indicators

IV. Discussion

Assessing the maturational status is crucial when clinical considerations are strongly based on the increased or decreased rates of remaining craniofacial growth, such as the timing and need for extraoral traction and the use of functional appliances[11]. The facial type should be considered before orthodontic treatment planning and initiation if individuals exhibit differences in skeletal maturity depending on the anteroposterior or vertical facial types. Previous studies on facial types and skeletal or dental maturity have mainly focused on the anteroposterior facial type rather than the vertical facial type[17,21]. There is a scarcity of research on the relationship between the vertical facial type and skeletal and dental maturity, and most previous studies have been conducted in Western populations[10,13-15]. To our knowledge, only one study investigated the relationship between vertical facial types and skeletal maturity in a Korean population, which only included Korean girls[12]. Therefore, the present study was designed to evaluate the differences in the skeletal and dental maturity in relation to vertical facial types in Korean boys and girls aged 8 - 14 years.

Most previous studies classified patients on the basis of the ratio of the lower anterior facial height to the anterior facial height[10,14]. However, in the present study, we classified the participants on the basis of the mandibular plane angle, which is a clinically simple and widely used index, as used in a domestic study[12]. The direction of growth of the mandible affects the vertical facial type. Changes in the growth of the mandible cause forward or backward rotation of this bone, and the direction of the mandibular condyle and the rotation of the mandible are clearly related. The mandibular plane angle decreases and the mandible rotates forward in case of vertical condylar growth, causing deep bite, and the mandibular plane angle increases, and the mandible rotates backward, resulting in open bite in case of horizontal condylar growth[22]. Thus, a low mandibular plane angle may correspond to a deep bite and horizontal growth pattern. Similarly, a high mandibular plane angle can correspond to an open bite and vertical growth pattern[10,13].

In the present study, the maturity of the cervical vertebrae and hand-wrist bones were evaluated. Hassel and Farmen[4] developed a six-stage growth assessment method based on the second to the fourth cervical vertebrae, while Baccetti *et al*.[18] improvised the existing evaluation stages and proposed the cervical vertebral maturation (CVM) method, which presents five CVMS. Fishman[19] studied the relationship between the facial growth stage and the hand-wrist growth stage and proposed SMI representing 11 stages of hand-wrist maturity. In the present study, hand-wrist maturity was evaluated using only six of the 11 SMIs in order to reduce classification errors and to accurately evaluate the growth stage[23]. Although hand-wrist radiography is the predominantly used method for the accurate evaluation of pubertal growth spurts, other radiographic investigations are also used. Baccetti *et al*.[24] reported that the method for evaluating cervical vertebral maturity could predict the stage of mandibular growth to some extent, and Gu and McNamara[25] reported a strong correlation between cervical vertebral maturity and the timing of maximum growth velocity of the mandible. Since lateral cephalography is used to acquire diagnostic data for orthodontic treatment, the use of cervical vertebrae for growth assessment has the advantage of not requiring additional radiography. Therefore, studies investigated whether the evaluation of cervical vertebral maturity can replace the evaluation of hand-wrist maturity. Similar to previous studies that showed a high correlation between cervical vertebral and hand-wrist maturity[26,27], the present study also confirmed a strong correlation between CVMS and SMI (r = 0.832; p < 0.001, Table 11).

We found that hand-wrist maturity was greater in individuals with a vertical facial growth pattern than in those with a horizontal facial growth pattern. Considering the close relationship between hand-wrist maturity and the maximum growth spurt during puberty[10,28,29], we may suggest that the trend in the present study was similar to that in the study by Nanda[10], who reported that the growth spurt during puberty was faster in subjects with an open bite than in those with a deep bite. In the study of Korean girls conducted by Lee *et al*.[12], it was reported that the group with vertical facial growth pattern showed the greatest hand-wrist maturity, similar to the finding in the present study. Among other similar studies, Verulkar *et al*.[11] did not find statistically significant differences between the cervical vertebral and hand wrist maturation of the vertical and horizontal growth groups, which was not consistent with the present study. This difference could be attributed to the fact that Verulkar *et al*.[11] included 60 participants while the present study included 184 participants. Therefore, it is necessary to consider the effect of the size of the study population on the accuracy of the results, and further longitudinal studies with a uniform sample size are necessary to eliminate this effect.

With regard to skeletal maturity, girls in the normal growth group and vertical growth group showed significantly greater hand-wrist maturity. Both cervical vertebral maturity and hand-wrist maturity in the horizontal growth group showed no statistically significant difference according to sex. The age at which the radiographs were acquired can be a reason for such a result. At the time of image acquisition, boys were 4 months older than girls in the normal growth group, and 6 months older than girls in the vertical growth group, whereas boys in the horizontal growth group were 11 months older than girls (Table 3). Thus, there was a larger difference in the timing of radiography in the horizontal growth group, which is likely to have affected the outcome.

Demirjian *et al*.[20] proposed the DI by classifying the period from the start of calcification of the tooth embryo until apical closure into eight stages, and studies that used this classification system reported a strong correlation between skeletal and dental maturity[15,16]. DI[20] is based on the root shape and the relative ratio of the root to the height of the crown, so there is little distortion due to enlargement or reduction of the image[23]. Olze *et al*.[30] reported high reproducibility in a study evaluating the maturity of the third molar using DI, and Dhanjal *et al*.[31] reported that dental maturity evaluation using DI showed high concordance among the examiners. In the present study, dental maturity was examined on the basis of the tooth age obtained using the Demirjian method[20]. Among previous studies examining vertical growth patterns and dental maturity, Jamroz *et al*.[15] did not find a link between tooth development and the vertical skeletal morphology. In contrast, Janson *et al*.[13] reported greater dental maturity in the open bite group than in the deep bite group, and Neves *et al*.[14] and Verulkar *et al*.[11] reported that maturation of the permanent teeth occurred more rapidly in subjects with a vertical growth pattern than in those with a horizontal growth pattern, consistent with the results of this study. These discrepancies in results could be attributed to differences in the target age and classification criteria among studies. The target age groups in previous studies were 7.5 - 10.9 years[13], 8 - 8.9 years[14], and 9 - 12.9 years[15], whereas the study by Verulkar *et al*.[11] and the present study attempted to reflect the effects of growth during puberty by including a wider age range of 8 - 14 years. In addition, Janson *et al*.[13] and Jamroz *et al*.[15] used the ANS-Me/N-Me ratio as a criterion for vertical growth pattern, whereas Neves *et al*.[14] classified vertical and horizontal growth pattern using SN-GoGn, SN-Gn, FH-MP, and the lower anterior facial height. On the other hand, the mandibular plane angle was used in the present study and the study by Verulkar *et al*.[11], and this may have affected the results. Therefore, we believe that additional studies with uniform participant group, age, and classification criteria are needed for accurate comparison.

When the correlation between the mandibular plane angle and the observed items was examined, there were strong correlations in the following order: CVMS, SMI, and dental age (Table 11). Sierra[32] showed that dental maturity shows a low tendency to correlate with other developmental ages, and that there may be a difference due to the ectodermal origin of teeth and mesodermal origin of the skeleton. Thus, the correlation of the mandibular plane angle may be stronger with cervical vertebral and hand-wrist maturity than with dental maturity.

This early maturation may be considered while planning therapies that rely on the pubertal growth spurt for achieving the best treatment outcomes, such as functional and mechanical orthopedic treatment. While determining the timing of orthodontic treatment, earlier treatment initiation may be considered for patients with a predominantly vertical facial type than for those with a predominantly horizontal facial type, because the signs of pubertal growth spurt are likely to appear earlier in children with a vertical facial growth pattern, and tooth calcification and subsequent eruption may occur earlier than children with horizontal growth patterns. This also holds true for fixed appliance therapy that depends on the eruption of the second molars during the initial stages of treatment. However, the vertical facial type is an auxiliary criterion for determining the optimal time for initiating orthodontic treatment, and additional studies must be conducted to determine certain causal and clinical applications.

This study had several limitations. First, skeletal and dental growth and development of children in the developmental stage are dynamic and continuous processes; however, the present study was conducted using a cross-sectional design. Therefore, it is necessary to conduct longitudinal studies to compare the skeletal and dental maturity with increasing age. Second, this study could not identify a clear association between vertical facial types and skeletal and dental maturity. With regard to the difference in maturity according to growth patterns, previous studies have mentioned that differences in growth pattern may be related to differences in height[33]. Moreover, the intrinsic characteristics of each facial shape, in addition to genetic characteristics, were mentioned as a factor[14]. However, no study has given a clear reason. To establish a clear relationship between vertical facial types and skeletal and dental maturity, cumulative research over several years is required.

Despite these limitations, our study is important since few studies have been conducted on similar topics, especially in Korea[12], where skeletal maturity has been investigated according to vertical facial types, but only in girls and no study has been conducted on tooth maturity. Therefore, this study is meaningful because it also included boys[12] to evaluate both skeletal maturity and dental maturity according to the vertical facial types, and additionally compared sex differences. Moreover, the study is clinically meaningful because it may also provide ancillary indicators to help determine the optimal timing of orthodontic treatment initiation. Future studies using the same criteria are needed to enable accurate comparative analysis of skeletal and dental maturity according to vertical facial types.

V. Conclusion

This study was conducted to evaluate skeletal and dental maturity according to vertical facial types and the sex of Korean children in the developmental stage using lateral cephalograms, hand-wrist radiographs and panoramic radiographs. Skeletal and dental maturity was greater in the vertical growth group than in the horizontal growth group. The skeletal maturity of girls was greater than of boys, whereas dental maturity showed no significant difference between the sexes. Therefore, earlier initiation of orthodontic treatment that rely on the pubertal growth spurt, such as functional and mechanical orthopedic treatment, may be considered for patients with vertical facial growth pattern than for those with horizontal facial growth pattern.

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국문초록

성장기 아동의 수직적 안모 형태와 성별에 따른 골격적 성숙도와 치아 성숙도 평가

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이 후향적 연구의 목적은 한국 성장기 아동의 수직적인 안모 형태와 성별에 따라 골격적 성숙도와 치아의 성숙도를 평가하는 것이다.
총 184명의 8 - 14세 소아·청소년을 대상으로 진행하였다. 하악평면각을 기준으로 3개의 군으로 나누었으며 성별 간 비교를 위해 3개의 군을 각각 남아와 여아의 하위 군으로 나누었다. 골격적 성숙도와 치아 성숙도는 측모두부 방사선 사진, 수완부 방사선 사진, 파노라마 방사선 사진으로 평가하였다.
수직적 성장군은 수평적 성장군보다 경추골 및 수완부 골의 높은 성숙도를 보였다. 치아 성숙도는 수직적 성장군에서 가장 높았다. 남아보다 여아에서 골격적 성숙도가 더 높았으며 치아 성숙도는 성별 간 유의한 차이는 관찰되지 않았다.
환자의 수직적 안모 형태 분석은 교정치료 시작 시기 결정에 도움이 되는 보조지표를 제공할 수 있으며, 수직적 안모 형태를 보이는 환자의 경우 교정치료를 조기에 시작하는 것을 고려할 수 있다.