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RESEARCH ARTICLE

Differences in maturity pattern between mandibular posterior teeth and sagittal skeletal malocclusion

Shinta Amini Prativi*✉, Ria Noor Firman, Belly Sam**, Avi Laviana*****

*Department of Oral Radiology, Faculty of Dentistry, Sriwijaya University, Palembang, Indonesia
**Department of Oral Radiology, Faculty of Dentistry, Universitas Padjadjaran, Bandung, Indonesia
***Department of Orthodontics, Faculty of Dentistry, Universitas Padjadjaran, Bandung, Indonesia
*Jl Palembang-Prabumulih, KM 32 Inderalaya 30662, Indonesia. ✉ correpondence: shintaaminiprativi@fk.unsri.ac.id

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ABSTRACT

The availability of X-rays in dentistry may help visualize the stage of development of dental maturity. The high prevalence of malocclusion in a population and contradictory research results on dental maturation in each skeletal malocclusion encourage the authors to know the maturity pattern of the posterior mandibular teeth in each skeletal relation and the difference in women and men. A cross-sectional study was conducted with a sample size of 214 panoramic and cephalometric radiographs from skeletal malocclusion patients based on ANB angle (class I: 73, class II: 75, class III: 56) with an age ranging from 8 to16 years old. Maturation of the second premolar and second molar was assessed using Demirjian method. Statistical analysis used the non-parametric Kruskal Wallis test to show the difference in maturity patterns in each class of skeletal relations and Mann Whitney test to show the difference in females' and males' maturity patterns. There were significant differences in females and males dental maturity patterns in which female dental maturation was advanced than male. Differences in each skeletal relation are not significant.

Keywords: dental maturation; malocclusion; panoramic radiograph; skeletal

INTRODUCTION

Dental age estimation data is needed to establish diagnosis and treatment plans in dentistry, such as orthodontics and pedodontics. Other dentistry fields, such as forensic odontology, use dental age estimates to identify the victim's age and confirm a person's age for legal purposes.[1-6]

The availability of X-rays in the field of dentistry can help visualize the developmental stages of dental maturity.[7-10] One method, Demirjian, has high accuracy and precision in the younger age group compared to old age.[1] The Demirjian method uses left mandibular teeth (first incisors to the second molar) assessed using a panoramic radiograph.[2,4,8,11,12] However, the use of panoramic radiographs on the Demirjian method has some shortcomings. The picture of the anatomical structure in the anterior region of the child is not clear.[13-15] Second premolar and second molar teeth have a relationship with skeletal maturity, and mandibular second molar teeth are predictors of maturation stages.[5,16-18] On this basis, this research did not use anterior teeth (first incisors, second incisors, and canines), but instead it used posterior mandibular teeth of the second premolar and molar.

Various research reports using the age estimation method have been widely published, including those using the Demirjian method. Most of these studies were carried out in the general population without considering skeletal malocclusion, although malocclusion cases have a high prevalence in a population.[1,5,19, 20-24] The high prevalence of malocclusion in a population and the contradictory results of differences in dental maturation in each class of malocclusion led the authors to examine the maturation pattern of the left mandibular posterior teeth in each skeletal relation of class I, class II, and class III. However, this research has never been done in

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Table 1. Distribution Sample

	Gender		Age							
	Male	Female	8	9	10	11	12	13	14	15
Class I	25 (34%)	48 (66%)	8	5	9	9	9	9	12	12
Class II	39 (46%)	46 (54%)	12	10	17	11	8	9	7	11
Class III	26 (46%)	30 (54%)	5	4	8	7	8	10	7	7
	90 (42%)	124 (58%)	25	19	34	27	25	28	26	30
Total	214 (100%)		214							

the Indonesian population. Knowing the pattern of tooth maturation in each of the different skeletal relations in a particular population can help dentists, especially orthodontics, pedodontics, and identification of age in proper and accurate diagnosis and treatment planning. This study aims to find out patterns and differences of posterior mandibular tooth maturity in skeletal relation of class I, class II, and class III between men and women aged 8-16 years old.

MATERIALS AND METHODS

This research used analytic-comparative with cross-sectional research design.[25] The study was conducted at the Dental Radiology Installation of the Dental and Oral Hospital of Padjadjaran University, Bandung, and was conducted from May to August 2017. It used the panoramic radiograph; lateral cephalometric radiograph; panoramic and cephalometric machines Picasso Trio 3 in 1 digital X-ray system, Vatech Global; laptop (MacBook Pro, intel core i5, 8GB RAM, OS X Yosemite); and ImageJ software as the research tools.

The study population was taken from the data of panoramic radiographs and lateral cephalometry of the last 5 years (2012-2017) with a purposive sampling technique. The study began with the measurement of SNA, SNB, and ANB values for the determination of the class of skeletal relations group into class I (ANB 0-4°), Class II (ANB> 4°), and class III (ANB <0°), continued with the assessment of the maturation of the second premolar and second molar on a panoramic radiograph. The results will be described in tables and graphs of each variable and then performed statistical tests. The data were tested with non-parametric statistical tests using different Kruskal Wallis tests to see each skeletal relation and Mann Whitney difference test to see differences in male and female teeth maturation patterns.[25-28] The protocol of this study has received an ethical clearance from the Medical Ethics Committee of Universitas Padjadjaran No 804/UN6.C.10/PN/017.

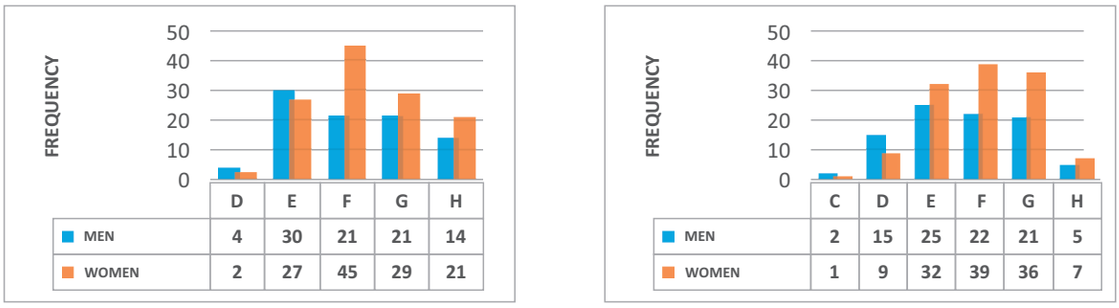
RESULTS

The study of differences in mandibular posterior teeth maturity patterns in patients with skeletal relations class I, II, and III in terms of panoramic radiographs in male and female patients aged 8-16 years using panoramic radiographs and cephalometry was 214 panoramic radiographs and 214 cephalometric radiographs. The distribution of male samples amounted to 90 people and 124 women (Table 1).

Table 2. Cohen's Kappa Score (κ)

Assesment	κ
	Intra observer
SNA	0.616
SNB	0.605
ANB	0.736
Maturation P2	1.000
Maturation M2	0.933

The level of confidence in the measurement of SNA, SNB, and ANB values on cephalometric radiographs and assessment of Demirjian based maturation stages on teeth second and first molars both intra-observer panoramic radiographs was



(A) (B)

Figure 1. Maturation stage of the second premolar (A) and Maturation stage of the second molar (B)

Table 3. Maturation of the second molars and second premolars in each skeletal relation and differences in men and women

Gender	Tooth	Mean Sceletal relation			X^2 Kruskal Wallis	p-value	Mean	Mann Whitney	p-value
		I	II	III					
Male	P2	3.080	3.154	3.115	0.055	0.973	3.122	-1.875	0.061
	M2	3.800	3.941	3.577	0.337	0.845	3.667		
Female	P2	3.417	3.196	3.367	1.868	0.393	3.323	-1.346	0.078
	M2	4.021	3.935	3.967	0.567	0.753	3.976		

measured using the Cohen's Kappa (κ) index. The results of the Cohen's Kappa score can be categorized as follows: low (κ <0.20); fair (κ = 0.21-0.40); adequate (κ = 0.41-0.60); strong (κ = 0.61-0.80) and very strong (κ = 0.81-1.00).[6]

Based on Table 2, the results of the Cohen's Kappa score on the measurement of SNA, SNB, and ANB values and the assessment of the maturation stage in the teeth the second premolar and second molar shows a value of κ above 0.60, which indicates strong accuracy in the aspect of intra-observer assessment.

The results showed differences in tooth maturation in men and women using the non-parametric test, namely the Mann Whitney difference test which showed a significant difference ($p<0.1$) of maturation stage of the second premolar and second molar, where women had higher maturation stage than the maturation stage of the second premolar male (Figure 1 and Table 3). The Kruskal Wallis statistical analysis results showed no significant difference ($p>0.1$) between class I, II, and III relations. Based on the average value of each relation in the male sex, skeletal relations in class II have a higher average than other classes, and women in class I have a higher average than other classes (Table 3).

DISCUSSION

The effect of skeletal patterns on tooth development is still unclear, but the research on tooth maturation and skeletal maturation shows a strong relationship between tooth maturation and skeletal maturation.[3,5,6,16-18,29] Based on the results, a graphical study of tooth maturation distribution with chronological age indicates that the maturity pattern in each relation runs linearly as age increases. This is in line with Tunc and Koyuturk's research, which states a strong linear relationship between dental maturation and chronological age in both women ($r^2 = 0.77$) and men ($r^2 = 0.78$).[6]

Statistical results show no significant difference in each skeletal relation. This finding is similar to the Nakas et al. study, which examined 231 orthodontic patients before treatment (127 males and 104 females) from ages 5.9-15.8 years. The assessment of dental maturation using

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the Demirjian method and the Willems method and the determination of skeletal relations with the measurement of ANB angles obtained no significant differences in tooth maturation in each sagittal skeletal relation ($p>0.05$).[11]

Similarly, Sukhia et al. conducted a cross-sectional study in orthodontic patients with 264 subjects (111 males and 153 females), then determined the sagittal patient group by dividing them into skeletal relations classes I and II. Determination of tooth maturation is associated with sagittal facial patterns. The results showed no significant differences between the sagittal facial pattern groups ($p = 0.975$).[2] These findings are different from Esenlik et al., Durca-Zajac et al., which showed significant differences in dental maturation in each skeletal relation. In contrast, Lauc et al. stated that significant differences were found in male groups, whereas in women, no significant differences were found between tooth age and skeletal relationships.[3,6,30] This can be caused by the discrepancy in number, age, and race of the subject, differences in climate, nutrition, and socio-economic status of each sample, which may lead to variations in each finding.[5]

The test results between male and female tooth maturation patterns in the second premolar and mandibular second molars showed significant differences in female teeth' maturation, which was faster than the maturation of male teeth. This finding is in line with Esenlik et al., Sukhia et al., Zhao et al., who stated that the women's dental maturation was significantly much faster than that of men.[2,3] Research by Waqar et al. also explained significant differences between men and women due to peak puberty. Women had faster dental maturation of 4 months earlier than men. The average female puberty was 11.7 months, and in men, the average was 13.3 months.[3,31] This was also supported by Lopes et al. who revealed that chronologically each period of growth and development of skeletal maturation occurs consistently earlier in women with a chronological age of women 1.8 years earlier than men.[5] The faster female puberty than men is also influenced by growth hormone (GH), in which insulin-like growth factor-1 (IGF-1) as a GH receptor mediator in women is higher at puberty compared to men. This leads to faster and earlier growth process and development in women than men.[31-33]

The shortcoming of this study is the fact that it uses secondary data as a primary sample. There will be better result in the use of longitudinal research for a broader population as a way to get better and more accurate research results. Body mass index, race, nutritional status, economic status, systemic conditions, and hormonal factors are confounding factors that significantly influence the research results.

This study assesses two things: the pattern of dental maturity and skeletal relations. The results show no significant differences in the pattern of dental maturity in each class of skeletal relations. Hence, it can be concluded that skeletal relations tend to have less influence on the pattern of tooth maturity. Skeletal malocclusion can be caused by familial specific genes and environmental factors, which have less influence on tooth development. Because there are not many theories that discuss the relationship between tooth maturity and skeletal relations, further research is needed on genetics and biomolecular mechanisms that show the relationship between craniofacial and dental development.

CONCLUSIONS

Maturation of posterior mandibular teeth in males with skeletal relation class II was more advanced than that of another class, and maturation of posterior mandibular teeth in females were more advanced than males. There is no difference in stage maturation among different sagittal skeletal growth patterns. In addition, stage maturation of females were more advanced than males.

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