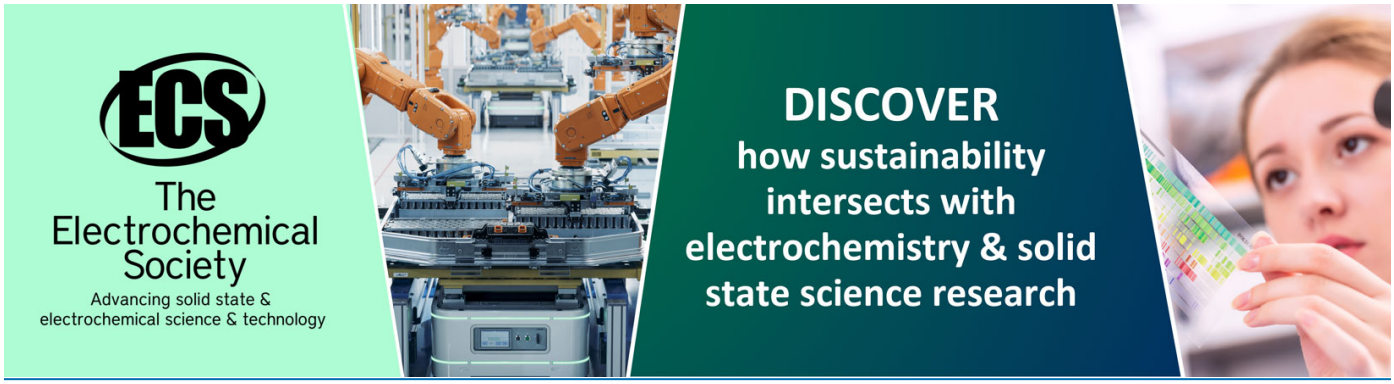
Maxillary and mandibular lengths in 10 to 16-year-old children (lateral cephalometry study)



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Maxillary and mandibular lengths in 10 to 16-year-old children (lateral cephalometry study)

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Abstract. The malocclusion prevalence rate is a large problem in Indonesia, and malocclusion should be treated at the appropriate age. During puberty, the growth rate increases, which can be used to correct malocclusion. Knowledge of the growth of the skull and jaw, especially that of the maxilla and mandible, becomes very important to design a proper treatment plan. The aim of this study was to determine the average lengths of the maxilla and mandible in 10–16-year-old boys and girls. This study used a descriptive cross-sectional design. The subjects were 211 cephalometric radiograms of 10–16-year-old children. The highest growth rate of the maxilla occurred at the age of 14–15 years in boys. The highest growth rates of the maxilla and mandible in girls and the highest growth rate of the mandible in boys occurred at the age of 13–14 years. The differences in the average lengths of the maxilla and mandible were not significant in boys and girls 10–13 years old but were significant in those >13–16 years old. There were significant differences in the maxillary and mandibular lengths between boys and girls 10–13 years old and those >13–16 years old.

1. Introduction

Dentofacial disharmony is a major dental health problem in Indonesia and ranks third after caries and periodontal disease [1]. Research on malocclusions in adolescents aged 12–14 years old in Jakarta has shown that 83.3% of respondents have experienced malocclusion [2]. Malocclusion should be treated early before reaching maturity to achieve maximum results because of significant bone growth in the craniofacial section. This bone growth will provide spaces for the malocclusion treatment process [3,4]. The growth of facial bones in infants progresses at a fairly high rate but gradually slows down during childhood and reaches a minimum speed in the prepubertal period. The growth rate then increases again during puberty and slows during maturity [5]. Knowledge of cranial and jaw growth, especially that of the maxilla and mandible, is essential in determining the right treatment plan. Establishment of standard average maxillary and mandibular lengths will enable dentists to determine

whether an abnormality that requires a more intensive treatment immediately is present in a child by considering his or her maxillary or mandibular length growth rate [6].

Since there are few studies on the maxillary and mandibular lengths of Indonesian children. The aim of this study was to determine the mean lengths of the maxilla and mandible in boys and girls aged 10–16 years old, and to determine if there are differences in these lengths between boys aged 10–13 and >13–16 years old, between girls aged 10–13 and >13–16 years old, between boys and girls aged 10–13 years old, and between boys and girls aged >13–16 years old.

2. Methods

This was a descriptive analytical study using a cross-sectional method. The study sample was 211 lateral cephalograms obtained from 65 male patients and 146 female patients subjects aged 10–16 years old from one of the health clinics in Jakarta. Various points on cephalograms were identified by using Adobe Photoshop CS4 (Adobe Systems Inc., San Jose, CA). Image calibration was performed by using Image Tool version 3.0. Then, ANS-PNS and Go-Me distance measurements were made on each cephalogram by using Image Tool version 3.0. The calculated data were analyzed by using unpaired t-tests. The significance level was taken to be $p < 0.05$ for differences in variables between two groups.

3. Results

Of the 227 subjects, 211 subjects met the inclusion criteria (65 males, 146 females).

Table 1. Distribution of the children aged 10–16 years old according to sex

	Male		Female		Total	
Age (years)	n	%	n	%	n	%
10	4	40	10	60	14	6.7
11	11	35.4	20	64.6	31	14.7
12	12	28.6	29	69.0	41	19.6
13	10	29.2	23	70.8	33	15.7
14	7	22.5	24	77.5	31	14.7
15	14	45.1	17	54.9	31	14.7
16	7	23.3	23	76.7	30	13.9
Total	65	30.8	146	69.2	211	100

Table 1 shows that there were more female subjects (69.2%) than male subjects (30.8%). The 12-year-old group had the most subjects (n = 41) and the 10-year-old group had the fewest subjects (n = 14).

After the maxillary and mandibular length measurements were made by using digital radiograph cephalometry in all subjects, the average and standard deviation results were obtained and are presented in Table 2 below.

Table 2. Mean maxillary and mandibular lengths in children aged 10–16 years old

	Mean Lengths (mm)							
Age (years)	Maxilla male	± SD	Maxilla female	± SD	Mandibular male	± SD	Mandibular female	± SD
10	43.69	3.25	40.94	3.05	56.17	1.17	57.21	2.48
11	43.85	4.18	42.56	3.34	57.75	4.13	58.54	4.08
12	44.20	2.70	43.05	2.68	59.57	3.75	58.56	4.43

Table 2. *Continue*

13	45.13	3.41	43.25	5.98	60.70	2.73	59.42	4.27
14	45.71	1.62	45.25	2.61	64.81	2.94	62.69	3.86
15	48.52	2.63	45.97	2.78	65.58	2.88	62.95	5.84
16	50.25	5.63	46.71	2.24	69.48	5.12	64.29	5.02

Table 2 shows the mean maxillary and mandibular lengths in boys and girls aged 10–16 years old. The maxillary and mandibular lengths were greater in boys than in girls. The mean maxillary and mandibular lengths for each age increased from age 10 to 16 years. The smallest and largest mean maxillary and mandibular lengths were found in the 10- and 16-year-old subjects, respectively, in boys and girls.

Table 3. Mean differences in maxillary and mandibular lengths between boys and girls according to the age group (*t*-test).

	Difference in lengths between boys and girls (P-values)	
Age Group (Year)	Maxilla	Mandible
10–13 years old	0.23	0.861
>13–16 years old	0.01*	0.03*

*p<0.05

In each age group, an unpaired *t*-test was performed to determine whether there were significant differences ($p < 0.05$) in the maxillary and mandibular mean lengths between boys and girls aged 10–13 and >13–16 years. Table 3 shows that there were no significant differences in the maxillary and mandibular mean lengths between boys and girls aged 10–13 years old, but the differences were significant between boys and girls aged >13–16 years old.

Table 4. Differences in mean maxillary and mandibular lengths between 10–13-year-old males and >13–16-year-old females.

Comparison of 10–13-year-old and >13–16-year-old males	P-value*	Comparison of 10–13-year-old and >13–16-year-old females	P-value*
Maxilla	0.001	Maxilla	0.001
Mandible	0.001	Mandible	0.001

**t*-test; p<0.05

Table 4 shows that there were significant differences in the maxillary and mandibular mean lengths between 10–13-year-old and >13–16-year-old males and females.

4. Discussion

In this study, the subjects were 10–16 years old because this is the period when children experience a growth spurt, which accelerates the growth rates in both boys and girls. The growth spurt starts at age 10 in girls, which is 2 years earlier than in boys. At age 16, the growth spurt has completed in boys and girls. Mid- and late-puberty are interesting ages to study because the increase in sex hormones triggers rapid bone growth.

In addition, *t*-tests was used to assess differences in the maxillary and mandibular mean lengths in boys and girls between a 10–13-year-old age group and a >13–16-year-old age group. These age groups were chosen because of the difference in the starting times of the growth spurts in boys and girls. In the first age group, girls have experienced a growth spurt indicating accelerated growth, but boys have not experienced accelerated growth. In the second age group, boys have experience a growth spurt, but girls have passed their growth spurt stage [5,7].

Researchers use digital radiographs rather than radiographic film because of their advantages, such as lower cost, increased practicality, faster data processing, and easier field measurement [8–10]. In this study, we avoided primary data retrieval to avoid the effect of X-ray radiation on the subjects, which can have effects at the cellular and organ levels [11]. Table 2 shows that the maxillary and mandibular mean lengths were greater in boys than in girls. This finding was consistent with many existing theories stating that bone lengths are greater in males than in females [12,13]. Many studies using cephalometric analysis, including those by Krismiana (2001), Yi Ping Liu (2008), Al-Barakati, Wu (2007), and Shung (2010) [14–18], also found that the maxillary and mandibular mean lengths were greater in boys than in girls.

Table 3 shows the differences in the maxillary and mandibular mean lengths between boys and girls. In the 10–13-year-old age group, the differences between the maxillary ($p = 0.23$) and mandibular ($p = 0.861$) mean lengths between boys and girls were not significant. This finding may be because boys' bones are longer than girls' bones. However, at this age, girls experience a growth spurt, so the maxillary and mandibular bone lengths increased rapidly, which means that the differences between boys and girls were meaningless in this age group. In the >13–16-year-old age group, there was a significant difference between the maxillary ($p = 0.01$) and mandibular ($p = 0.03$) mean lengths in both boys and girls. This might have occurred because at this age, boys experience a period of growth acceleration until it stabilizes later, which results in an increase in the maxillary and mandibular lengths, whereas girls' accelerated growth has stopped at this age [5,12,13]. This finding was consistent with Adams' (1982), Olga's (2007), and Rusjanti's (2010), that found no significant differences in boys and girls growth acceleration aged 15–16 years old [19,20].

Table 4 shows that there were significant differences in the maxillary and mandibular mean lengths ($p = 0.001$) between boys and girls aged 10–13 years old and boys and girls aged >13–16 years old ($p = 0.001$, each). This finding might be because in the first age group, boys have not undergone growth acceleration (growth spurt), whereas in the second age group, boys have completed their growth spurt. Bone grows faster during the growth spurt, which led to significant differences in maxillary and mandibular mean lengths between the two age groups. Girls in the first age group had undergone accelerated growth, but in the second age group, growth acceleration had completed. This finding was also in accordance with Rusjanti's (2010) research that found a very significant difference in the mean lengths between age groups [5,12,19,21].

5. Conclusion

The differences in the average lengths of the maxilla and mandible were not significant in boys and girls 10–13 years old but were significant in those >13–16 years old. There were significant differences in the maxillary and mandibular lengths between boys and girls 10–13 years old and those >13–16 years old.

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