Jurnal Kesehatan Gigi 12 Nomor 1 (2025) 77 -82

Jurnal Kesehatan Gigi

p-ISSN: 2407-0866
e-ISSN: 2621-3664

http://ejournal.poltekkes-smg.ac.id/ojs/index.php/jkg/index

The Dental Arch Length and Width Differences Between Males and Females Ages 7-9 Years-Old Children

Atiek Driana Rahmawati[1], Ambawani Widad Surgawi[2]
[1]*Department of Pediatric Dentistry, Faculty of Dentistry, Universitas Muhammadiyah Yogyakarta, Indonesia*
[2]*School of Dentistry, Faculty of Dentistry, Universitas Muhammadiyah Yogyakarta, Indonesia*

Corresponding author: Atiek Driana Rahmawati
Email: atiek.driana@umy.ac.id

ABSTRACT

The dental arch consists of teeth that develop on the jawbone. The shape and size of the dental arch are important components in orthodontic diagnosis and treatment planning. This study is to determine if there is a relationship between gender and the length and width of the dental arch in children aged 7 to 9 years. This research is an observational study using a cross-sectional design. The sample included 72 subjects for the study, consisting of females and males ages 7, 8, and 9, who met the inclusion and exclusion criteria. The dental arch width was measured at the inter-canines and inter-molars by digital sliding calipers. Anterior and posterior size of dental arch length measured from the midpoint between the right and left permanent central incisors perpendicular to the inter-canines and inter-molars. The Independent Sample t-test results showed no significant differences in any parameters at the age of 7 years. However, at 8 years, a significant difference was observed in the intermolar of the mandible, while at 9 years, a significant difference was found in the intercanine width of the mandible between males and females. These findings indicate developmental variations in mandibular growth based on gender.
Keyword : dental arch width; dental arch length; males; females; mixed dentition

Introduction

The growth and development of the dental arch are regarded as continuing and involved biological processes[1]. These processes include three-dimensional alterations in the arch's width, length, and height. The magnitude and direction of these changes vary at each stage of dental development and are influenced by the age of the individual[2].

Several children exhibited abnormalities in tooth development, which is significant given that the dental arch undergoes continuous growth and specific morphological changes throughout the mixed dentition phase—a critical period of transition from primary to permanent teeth. [3][4]. As permanent teeth erupt, the size of the dental arch will increase[5]. This transition results in variations in the form and width of the dental arch due to the movement of teeth and the vertical growth of alveolar structures[6][7]

The development of the dental arch is influenced by a multifactorial interplay of biological and environmental determinants, including racial background, gender-related dimorphism, nutritional status, chronological age, genetic predisposition, the sequential eruption of permanent teeth, and external environmental factors[5]. Furthermore, tooth eruption is influenced by both intrinsic and extrinsic factors, such as congenital anomalies, hereditary traits, sex-related differences, systemic illnesses, and environmental conditions[8].

The timing of the pubertal growth spurt differs between males and females, with males generally experiencing this phase of accelerated development six months to two years later than females [9]. This difference in growth timing contributes to variations in dental arch development

between sexes during childhood [10]. These developmental differences highlight the importance of careful timing in orthodontic intervention, as the selection of appropriate treatment modalities is primarily guided by the developmental stage of the dentition and the degree of bone maturation in growing patients [5].

Considering its significance in orthodontic diagnosis and treatment planning, it is essential to understand the natural variations in populations without prior treatment to establish reliable baseline standards [3][11]. While earlier studies have examined changes in dental arch dimensions throughout growth, limited attention has been given to sex-based differences in arch length and width during the early mixed dentition stage. Furthermore, such data remain limited, particularly among Indonesian children.

This study aims to analyze and compare the dental arch length and width between males and females aged 7 to 9 years old, in order to identify sex-related dimensional differences that may assist in early diagnosis and orthodontic intervention strategies.

Methods

This research employed an analytical cross-sectional design. The study was conducted at Muhammadiyah Purwodiningratan Elementary School in Yogyakarta, Indonesia.

Before data collection, ethical approval was obtained from the Ethics Committee of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta (No. 220/EC-KEPK FKIK UMY/XI/2022). Informed consent forms were distributed to the parents or legal guardians of the students, and only those children whose parents provided written consent were included in the study.

The inclusion and exclusion criteria were clearly defined to ensure a homogeneous and representative sample while minimizing the risk of bias. Participants were included if they had permanent central incisors, canines, and first molars with normal occlusion, overjet, and overbite and normal tooth positioning regarding contact points and contact surfaces. Children were excluded from the study if they had malpositioned permanent incisors, canines, or molars, were undergoing or had previously undergone orthodontic treatment, or presented with caries or attrition on the canine cusps or the mesiobuccal cusps of the permanent first molars on either side. Additionally, students with a history of facial trauma accompanied by clinical symptoms were also excluded.

The subjects for this study were selected using a simple random sampling technique to ensure that all students had an equal opportunity to be included. Seventy-two dental models were collected and categorized into three age groups: seven, eight, and nine years old. Each age group consisted of twelve male and twelve female participants, providing a balanced representation of both sexes.

Alginate impressions (Aroma Fine Plus Normal Set, GC Corporation, Tokyo, Japan) were taken from each participant to create negative impressions of their dental arches. These study models were then categorized according to the gender of the subject. Following this, precise measurements of the dental arches were conducted to assess various parameters associated with arch dimensions.

Results and Discussion

The study involved the analysis of 72 dental models obtained from students at Muhammadiyah Elementary School in Purwodiningratan, Yogyakarta. The selection of study models was carried out based on specific inclusion criteria to ensure the validity and reliability of the data. Each measurement was conducted twice for accuracy, and the final value was determined by averaging the results of both measurements. This approach helped minimize potential errors and ensure consistency in the data collection process. The following tables display comprehensive findings regarding the length and girth of dental arches by gender for participants aged seven, eight, and nine years.

Table 1. Data analysis of the length and width of the dental arch of 7-year-old children.

Indicator	Gender	Mean	Std. Dev.	Sig.	Remarks
Arch length Maxillary intercanine	Females	0.76	0.14	0.79	No difference
	Males	0.75	0.14		
Arch length Maxillary intermolar	Females	2.82	0.2	0.85	No difference
	Males	2.80	0.2		
Arch width Maxillary intercanine	Females	3.26	0.22	0.07	No difference
	Males	3.12	0.14		
Arch width Maxillary intermolar	Females	5.06	0.42	0.25	No difference
	Males	4.79	0.66		
Arch length Mandibulary intercanine	Females	0.43	0.13	0.87	No difference
	Males	0.44	0.12		
Arch length Mandibulary intermolar	Females	2.47	0.21	0.71	No difference
	Males	2.5	0.16		
Arch width Mandibulary intercanine	Females	2.46	0.15	0.15	No difference
	Males	2.55	0.16		
Arch width Mandibulary intermolar	Females	4.58	0.69	0.36	No difference
	Males	4.28	0.9		

Table 2. Data analysis of the length and width of the dental arch of 8-year-old children.

Indicator	Gender	Mean	Std. Dev.	Sig.	Remarks
Arch length Maxillary intercanine	Females	1.07	0.43	0,53	No difference
	Males	0.87	0.14		
Arch length Maxillary intermolar	Females	2.99	0.29	0,79	No difference
	Males	2.96	0.22		
Arch width Maxillary intercanine	Females	3.38	0.22	0,70	No difference
	Males	3.42	0.21		
Arch width Maxillary intermolar	Females	5.47	0.3	0,29	No difference
	Males	5.6	0.29		
Arch length Mandibulary intercanine	Females	0.6	0.13	0,18	No difference
	Males	0.52	0.15		
Arch length Mandibulary intermolar	Females	2.67	0.29	0,07	No difference
	Males	2.93	0.45		
Arch width Mandibulary intercanine	Females	2.75	0.19	1,00	No difference
	Males	2.79	0.32		
Arch width Mandibulary intermolar	Females	4.8	0.59	0,01	Significant difference
	Males	5.28	0.72		

The results in Table 1 demonstrate that there were not any statistically significant differences in the length and width of the dental arches—maxillary and mandibular—between males and females participants at the age of 7 years. The evidence indicates that, at this early stage of the mixed dentition phase, the development of dental arch dimensions is comparatively consistent between genders.

At age 7, most children are in the early stages of mixed dentition, with only the permanent incisors and first molars erupting. The skeletal growth during this period is generally gradual and not yet influenced by hormonal factors that distinctly affect males and females differently during puberty[9]. The absence of significant differences at age 7 years can serve as a baseline for comparative analysis and future orthodontic planning, while also highlighting the importance of monitoring dental arch development longitudinally throughout the critical growth phases.

The measurement results for 8-year-old children can be seen in Table 2.

Table 2 presents a detailed summary of the measurements of the length and width of the dental arch in eight-year-old children. A significant observation in this age group concerns the mandibular arch, particularly at the intermolar width region. The statistical study indicates a significant difference in the arch width of mandibular intermolar between males and females. This is evidenced by the p-value which is below the standard threshold for statistical significance ($p<0.05$). The findings distinctly demonstrate that gender significantly influences the variation of mandibular intermolar dimensions at this particular age. This result suggests that sexual dimorphism in dental arch development begins to emerge during this age, particularly in the posterior region of the mandible.

The mandibular intermolar width, which is primarily determined by the morphology of the basal bone and the mandibular growth pattern, reflects early skeletal differences likely attributable to sex-related variations in growth rate during the prepubertal phase [9]. The present study underscores the relevance of these findings by demonstrating that such differences can be identified as early as eight years of age, thereby highlighting the importance of incorporating gender-specific considerations in orthodontic diagnosis and treatment planning. This result aligns

with the findings of Islam et al[12]. Islam et al, who reviewed dental arch dimensions across various populations and reported that males generally exhibited greater arch widths than females, focused on global populations, including several ethnic groups. This study's results are consistent with previous findings, such as those by Babu and Kavyashree[13] and Shahid et al. [14], who reported early differences in dental arch dimensions between sexes. The present study expands this body of knowledge by providing normative, sex-based normative data specific to Indonesian children. This population remains underrepresented in orthodontic literature, contributing valuable insights for region-specific orthodontic assessment and treatment planning.

Table 3. Data analysis of the length and width of the dental arch of 9-year-old children.

Indicator	Gender	Mean	Std. Dev.	Sig.	Remarks
Arch length Maxillary intercanine	Females	0.72	0.43	0,53	No
	Males	0.69	0.14		difference
Arch length Maxillary intermolar	Females	2.73	0.29	0,79	No
	Males	2.78	0.22		difference
Arch width Maxillary intercanine	Females	3.38	0.22	0,70	No
	Males	3.42	0.21		difference
Arch width Maxillary intermolar	Females	5.32	0.3	0,29	No
	Males	5.46	0.29		difference
Arch length Mandibulary intercanine	Females	0.45	0.13	0,18	No
	Males	0.49	0.15		difference
Arch length Mandibulary intermolar	Females	2.47	0.29	0,07	No
	Males	2.56	0.45		difference
Arch width Mandibulary intercanine	Females	2.57	0.19	1,00	Significant
	Males	2.73	0.32		difference
Arch width Mandibulary intermolar	Females	4.76	0.59	0,01	No
	Males	4.79	0.72		difference

Table 3 shows the measurement of the dental arch length and width of 9-year-old children. That table indicates a significant difference in the arch width mandibulary intercanine between males and females at the age of 9 years.The age range of 7 to 9 years corresponds to the mixed dentition stage[14]. Between the ages of 7 and 9 years, the central incisors, lateral incisors, and first permanent molars commence eruption. Permanent canines commence eruption at the age of 9 years[15][16].

Table 3 indicates a significant difference in the intercanine width of the mandibular arch at the age of 9 years. The analyzed difference, confirmed by the significance value, indicates that the anterior portion of the lower tooth arch is similarly influenced by gender-related growth disparities as children near the final phases of mixed dentition. This phase correlates with the eruption of permanent canines, which are known to affect the width of the anterior arch. This was related to the greater mesiodistal dimension of permanent canines compared to their primary predecessors, along with the proclination of erupting permanent incisors[15].

A significant increase in the mandibular intercanine width was found at 9 years of age, correlating with the eruption period of the permanent canine teeth[17] and was significantly greater in males than in females[18][19]. The result of this study was in line with previous research by Stern, et al. which stated that the comparison of dental arch dimensions between genders revealed that males had greater values than females across all parameters; however, these differences were statistically significant only for the lower intercanine width[20]

Significant differences between males and females in this study were observed in the arch width mandibulary intermolar at 8 years of age and the arch width mandibulary intercanine at 9 years of age. The difference results from the mesiodistal measurements of male teeth being larger than those of females. Research by Irine indicates a considerable difference in the average mesiodistal dimensions of permanent incisors between genders, meaning that males have larger mesiodistal incisor teeth than females.

The jaw contains the implanted tooth buds that will subsequently emerge in the dental arch. The position of teeth in the jaw influences the dental arch[21][22]. Previous studies also indicated that males have wider dental arches than females [23][24]. The upper and lower posterior and total arch perimeters were shown to be significantly bigger in male participants until the late mixed dentition stage. Therefore, a tendency for increasing dimensions in males for those characteristics was observed. The upper and lower intercanine, interpremolars, and intermolar widths were consistently greater in males [20]

Conclusion

Research indicates that there are differences in the length and width of the dental arch between

males and females at the ages of 8 and 9 years in particular aspects, with larger sizes in males than in females

Acknowledgments

The authors like to express their sincere gratitude to Muhammadiyah Purwodiningratan Elementary School in Yogyakarta for the support and cooperation provided during this study. Gratitude is extended for permitting the research within the school environment and for facilitating the data-collecting process involving students. The school community's participation was valuable to the successful completion of this research.

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