Original Article

Dental Arch Dimension of Mixed Dentition of Kurdish Orthodontic Patients with Class I and Class II Division 1 Malocclusion (In-Vitro Comparative Study)

Rebin A. Mohammed Amin[*1], *Mahmoud K. Mohsin*[1], *Bayan A. Hassan*[1]

Abstract

Objective: To assess dental arch dimensions (width, depth) in mixed dentition in a sample of Kurdish orthodontic patients.

Methods: A sample of 58 dental casts (28 class I, 30 class II division 1 malocclusions) from 8 years and two months to 10 years and nine months were collected. Measurement of arch dimensions was taken, including width and depth. Differences between males and females and between class I and class II division 2 malocclusion were tested using independent t-test.

Results: With gender pooled, class I group has larger UC, UE, U6, LE, L6 width than class II group, whereas class II group has larger LC width than class I group with no significant difference. The class II group has larger arch depth for maxillary measurements than the class I group, with no significant difference. While the class I group has larger arch depth for mandibular measurements than the class II group, with no significant difference except for LC. In gender dimorphism, class I group, all arch width measurements, females have a larger width than males except L6; all differences were no significant. While in all arch depth measurements, males have larger depth than females. In the class II group, all measurements of width and depth were larger in males than females, the difference in UE and U6 were significant.

Conclusions: Class I malocclusion has larger width and depth than class II division 1 malocclusion, except in the maxillary depth of class II division 1 malocclusion. Males had larger arch dimensions than females.

Keywords: *Arch dimension, Orthodontic, Kurdish, Mixed dentition.*

Submitted: November 24, 2019, Accepted: January 19, 2020, Published: June 1, 2020.

Cite this article as: Mohammed Amin RA, Mohsin MK, Hassan BA. Dental Arch Dimension of Mixed Dentition of Kurdish Orthodontic Patients with Class I and Class II Division 1 Malocclusion (In-Vitro Comparative Study). Sulaimani Dent J. 2020;7(1):42-48.

DOI: https://doi.org/10.17656/sdj.10105

1. *Department of Pedodontic, Orthodontic and Preventive Dentistry, College of Dentistry, Hawler Medical University, Erbil, Iraq.*

** Corresponding author: mahmoudkanan1987@yahoo.com*

Introduction

The form and size of the dental arch have long been an essential data source not only for dentistry but also for other fields such as biology, anthropometry, painting, and sculpture[1-3]. The dental arch is a curve that is usually described and classified by quantitative mathematical equations or qualitative geometric forms. Its shape and size come from the natural balance of the jaw bone, the alveolar bone, and the muscles around them, and may also be affected by factors such as heredity, growth of the bones, eruption, rotation, and inclination of the teeth, and environment[4-9].

A well-aligned set of teeth ascertain esthetics and stability. Furthermore, a perfect tooth position provides ideal conditions for good health and optimal care of teeth. However, the dental arch continuity and integrity are a result of harmony between tooth and arch dimensions. Any disproportion between these elements predisposes to dental crowding and spacing[10], which are considered detrimental to dental health and function. Apart from various functional incapacities, these malocclusions may be a source of compromised smile esthetics and low self-esteem[11].

The width, length, and depth of dental arches have significant effects in orthodontic diagnosis and treatment planning in modern dentistry established on prevention and early diagnosis of oral disease[12].

During the mixed dentition, the changes that occur in the dental arches are consequences of tooth movement and growth of supporting bone, besides modest genetic component[13]. These naturally occurring changes, which happen in untreated individuals, have been used many times, as comparative “gold standards,” which have been employed to assist the diagnosis and orthodontic planning[12].

Many researches have been carried out to assess dental arch dimensions in several populations[14-18], but no researches were performed in the Kurdistan Region of Iraq for mixed dentition. Therefore, this study aimed to determine the dental arch dimensions in a sample of patients seeking orthodontic treatment and to compare the effect of gender on the arch dimension in this sample.

Patients and methods

Maxillary and mandibular dental models of 58 untreated patients (8-11 years old) were collected from patient records at the Orthodontic Clinic at the College of Dentistry, Hawler Medical University. Patients were selected based on the following inclusion criteria:

1. No history of previous orthodontic treatment.

2. Presence of all maxillary and mandibular (permanent central incisors, primary canines, primary second molars, permanent first molars).

3. No syndrome or developmental disorder.

Each of 58 casts was divided into two groups. The inclusion criteria for each group were:

Group 1 Class I malocclusion (28 subjects: 13 males and 15 females) Class I molar relationship on both sides

Group 2 Class II division 1 (30 subjects: 14 males and 16 females)

1. End-to-end to distal-step terminal plane relationships of distal surfaces of upper and lower second primary molars on both sides.

2. Proclination of maxillary incisors.

3. Overjet ≥ 5 mm.

Measurements

The following points were used for measurements[19]:

1. Distal Midpoint (DM): the point on the distal side of the tooth, midway between the buccal and lingual surfaces.

2. Most Buccal Point (BP): the point at buccal fissure location for the permanent molars and second primary molars. For the canines, the point was the most buccal point on the buccal surface.

3. Most Lingual Point (LP): the point at lingual fissure location for the permanent molars and second deciduous molars. For the canines, the point was the most lingual point on the lingual surface.

4. Mesial Midpoint (MM): the point on the mesial side of the tooth, midway between the buccal and lingual surfaces.

5. The midpoint between the approximal midpoints (A): halfway between DM and MM.

6. The midpoint between buccal and lingual points (B).

7. Centroid (C): halfway between point A and point B.

8. Most Labial point (La): the midpoint of the most labial points of the central incisors.

Dental arch dimensions of width and depth were taken by one examiner using the digital vernier scale.

The following measurements were then taken (Figure 1 and 2):

1. Maxillary primary canines width (UC width): The distance between the centroids of primary maxillary canines (Figure 1 A).

2. Mandibular primary canines width (LC width): The distance between the centroids of mandibular primary canines (Figure 1 D).

3. Maxillary primary second molars width (UE width): The distance between the centroids of maxillary primary second molars (Figure 1 B).

4. Mandibular primary second molars width (LE width): The distance between the centroids of mandibular primary second molars (Figure 1 E).

5. Maxillary permanent first molars width (U6 width): The distance between the centroids of maxillary permanent first molars (Figure 1 C).

6. Mandibular permanent first molars width (L6 width): The distance between the centroids of mandibular permanent first molars (Figure 1 F).

7. Maxillary primary canines arch depth (UC depth): The depth from the midpoint of the most labial points of the maxillary central incisors (La) to the maxillary canines at the distal midpoint (DM) (Figure 2 G).

8. Mandibular primary canines arch depth (LC depth): The depth from the midpoint of the most labial points of the mandibular central incisors (La) to the mandibular canines at the distal midpoint (DM) (Figure 2 J).

9. Maxillary primary second molar arch depth (UE depth): The depth from the midpoint of the most labial points of the maxillary central incisors (La) to the maxillary primary second molars at the distal midpoint (DM) (Figure 2 H).

10. Mandibular primary second molar arch depth (LE depth): The depth from the midpoint of the most labial points of the mandibular central incisors (La) to the mandibular primary second molars at the distal midpoint (DM) (Figure 2 K).

11. Maxillary permanent first molar arch depth (U6 depth): The depth from the midpoint of the most labial points of the maxillary central incisors (La) to the maxillary permanent first molars at the distal midpoint (DM) (Figure 2 I).

12. Mandibular permanent first molar arch depth (L6 depth): The depth from the midpoint of the most labial points of the mandibular central incisors (La) to the mandibular permanent first molars at the distal midpoint (DM) (Figure 2 L).

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences program (SPSS), Version 21.0 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics, including the means and standard deviations, were calculated for each group. Male and female data differences between groups 1 and 2 and between males and females in each group were analyzed using an independent t-test. For all analyses, P values less than 0.05 were considered statistically significant.

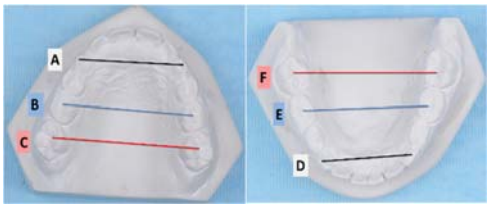

Figure 1: Measurements of arch width: Maxillary primary canines (A), Maxillary primary second molars (B) Maxillary permanent first molar (C), Mandibular primary canines (D), Mandibular primary second molars (E), Mandibular permanent first molars (F).

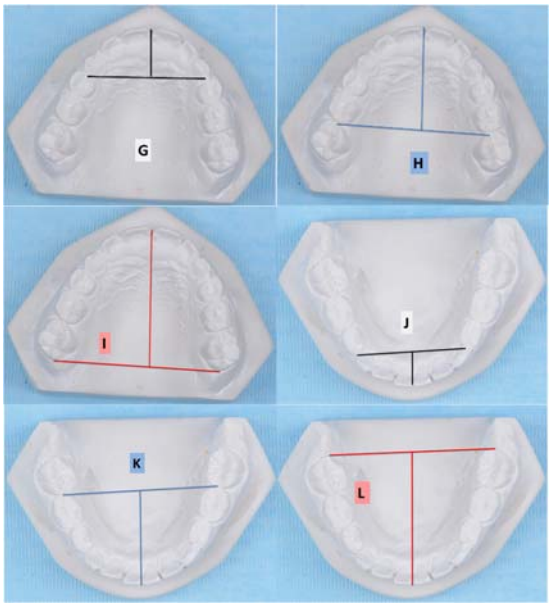

Figure 2: Measurements of arch depth: Maxillary primary canines (G) Maxillary primary second molars (H) Maxillary permanent first molars (I), Mandibular primary canines (J), Mandibular primary second molars (K), Mandibular permanent first molars (L).

Results

The sample consisted of 58 individuals (28 class I malocclusion, 30 class II division 1 malocclusion). Comparison between the different malocclusion groups arch widths

- With genders pooled, no significant differences were observed between the malocclusion groups (Table 1). The class I group had the larger UC, UE, and U6, LE, L6 width, whereas the class II division 1 group has the largest LC width with no significant difference.

Comparison between the different malocclusion groups arch depth

- Arch depths with gender pooled, No significant differences were observed between the malocclusion groups except for LC. (Table 1). The class II group had larger arch depth for maxillary measurements. On the other hand, the class I group has a larger LC, LE, and L6, with no significant difference except for LC.

Table 1: Comparison of arch dimensions in Class I, Class II (gender pooled).

Arch dimension	Variable	Group	Mean	SD	p value
Maxillary widths	C-Width	I	31.37	2.58	0.44
		II	30.85	2.68	
	E-Width	I	39.51	2.11	0.09
		II	38.42	2.82	
	6-Width	I	44.79	2.26	0.3
		II	44.22	2.08	
Mandibular width	C-Width	I	24.27	5.54	0.59
		II	24.97	4.45	
	E-Width	I	34.27	4.8	0.97
		II	34.24	3.69	
	6-Width	I	40.72	3.5	0.3
		II	39.74	3.76	
Maxillary depth	C- Depth	I	13.9	6.14	0.9
		II	14.05	5.03	
	E-Depth	I	27.22	4.67	0.23
		II	28.61	4.28	
	6-Depth	I	36.34	4.3	0.13
		II	37.96	3.87	
Mandibular depth	C- Depth	I	8.19	2.23	0.008
		II	6.83	1.54	
	E-Depth	I	22.39	3.13	0.39
		II	21.77	2.5	
	6-Depth	I	32.46	3.61	0.25
		II	31.51	2.76	

Table 2: Comparison of arch dimensions in Class I and Class II, gender dimorphism.

Arch Dimension		Female		Male		p value
	Variable	Mean	SD	Mean	SD	
Maxillary Width Cl I	C-Width	31.56	2.21	31.16	3.02	0.67
	E-Width	39.92	2.4	39.03	1.7	0.25
	6-Width	44.99	2.32	44.57	2.26	0.62
Mandibular Width Cl I	C-Width	24.6	5	23.89	6.27	0.73
	E-Width	34.55	4.34	33.95	5.43	0.73
	6-Width	40.51	3.4	40.97	3.72	0.72
Maxillary Depth Cl I	C- Depth	13.05	5.46	14.88	6.9	0.42
	E-Depth	26.51	4.23	28.04	5.15	0.38
	6-Depth	35.54	3.71	37.26	4.86	0.28
Mandibular Depth Cl I	C- Depth	7.58	1.7	8.9	2.61	0.1
	E-Depth	22.28	2.98	22.52	3.4	0.83
	6-Depth	32.4	3.23	32.52	4.13	0.92
Maxillary Width Cl II	C-Width	30.8	2.87	30.91	2.56	0.91
	E-Width	37.15	3.07	39.87	1.61	0.006
	6-Width	43.31	2.11	45.27	1.54	0.007
Mandibular Width Cl II	C-Width	24.31	4.34	25.73	4.61	0.39
	E-Width	33.64	3.91	34.92	3.42	0.35
	6-Width	39.14	3.31	40.43	4.23	0.35
Maxillary Depth Cl II	C- Depth	13.88	3.91	14.25	6.22	0.84
	E-Depth	28.37	3.28	28.88	5.32	0.74
	6-Depth	37.39	2.6	38.61	4.98	0.4
Mandibular Depth Cl II	C- Depth	6.41	1.58	7.31	1.4	0.11
	E-Depth	20.94	2.26	22.71	2.51	0.05
	6-Depth	30.63	2.22	32.51	3.03	0.06

Gender dimorphism for arch widths

- In the class, I group, all arch width measurements, females have larger than males except L6 (Table 2). All differences were no significant.
- While in Cl II, all measurement was larger in male, the difference in UE, U6 was significant.

Gender dimorphism for arch depth

For arch depth, all variables in class I and II, males have larger parameters.

Discussion

The present study provides information regarding arch dimensions for class I and class II division 1 malocclusion of untreated mixed dentition subjects. In the maxillary arch, class I malocclusion is wider than class II division 1 arch. In contrast, class II division 1 is larger than class I. The larger maxillary arch depths in class II division 1 group is most likely due to the proclination of upper incisors. While in the mandibular

arch, class I and class II division 2 are very near to each other in the mandibular width of intercanine, inter-deciduous second molar, and intermolar. The overall mean maxillary and mandibular arch width and depth of Class II division 1 in the present study are smaller than Caucasian American children[19]. Regarding gender dimorphism of the present study, males have a larger arch dimension than females, except in the maxillary and mandibular width of class I malocclusion, in which females have larger arch dimensions than males.

Cassidy et al., Staley, et al. and Raberin et al., studied the widths of dental arches and found that the maxillary or mandibular widths were larger in male than in female subjects[13,20,21]. Also, longitudinal studies by Bishara et al., Moorrees and Reed reported gender differences in dental arch dimensions[16,22]. Males have larger arch dimensions than females in the mixed dentition (mean age = 8 years). These findings are similar to the present study.

Moreover, Dung et al. concluded that there are no statistical differences in these dimensions between genders at age seven among Vietnamese children[23]. Ling and Wong found that the 12 years old Southern Chinese when compared with Caucasians, characterized by a wider dental arch width. All maxillary and mandibular male arch widths were significantly larger than female arch widths, except at the incisor regions[24].

Conclusions

Class, I malocclusion has a larger width and depth than class II division 1 malocclusion, except in the maxillary depth of class II division 1 malocclusion. Males have larger arch dimension, depth, and width, than females, except in maxillary width of class I malocclusion.

References

1. Burdi AR. Morphogenesis of mandibular dental arch shape in human embryos. J Dent Res. 1968;47(1):50-8.
2. Bishara SE, Jakobsen BP. Longitudinal comparisons of dental arch changes in normal and untreated class II, division 1 subjects and their clinical implications. Am J Orthod Dentofacial Orthop. 1996;110(5):483-9.
3. Bishara SE, Bishara SE, Staley RN. Maxillary expansion: clinical implications. Am J Orthod Dentofacial. 1987;91(1):3-14.
4. Hassanali J, Odhiambo JW. Analysis of dental casts of 6–8- and 12-year-old Kenyan children. Eur J Orthod. 2000;22(2):135-42.
5. Al-Khateeb SN, Abu Alhaija ESJ. Tooth Size Discrepancies and Arch Parameters among Different Malocclusions in a Jordanian Sample. Angle Orthod. 2006;76(3):459-65.
6. Sillman JH. Dimensional changes of the dental arches: longitudinal study from birth to 25 years. Am J Orthod. 1964;50(11):600-16.
7. Knott VB. Longitudinal study of dental arch width at four stages of dentition. Angle Orthod. 1972;42(4):387-95.
8. Moorrees CFA. The dentition of the growing child. (Cambridge, Harvard University Press, 1959).
9. Lavelle CL, Flinn RM, Foster TD, Hamilton M. An analysis into age changes of human dental arch by a multivariate technique. Am J Phys Anthropol. 1970;33(3):403-12.
10. Moorrees CFA, Reed RB. Correlation among crown diameters of human teeth. Arch Oral Biol. 1964;9(6):685-97.
11. Jung M. Evaluation of the effects of malocclusion and orthodontic treatment on self-esteem in an adolescent population. Am J Orthod Dento facial Orthop. 2010;138(2):160-6.
12. Carter GA, McNamara JA Jr. Longitudinal dental arch changes in adults. Am J Orthod Dentofacial Orthop. 1998;114(1):88-99.
13. Cassidy KM, Harris EF, Tolley EA, Keim RG. Genetic influence on dental arch form in orthodontic patients. Angle Orthod. 1998;68(5):445-54.
14. Moorrees CF, Reed RB. Changes in dental arch dimensions expressed on the basis of tooth eruption as a measure of biologic age. J Dent Res. 1965;44:129-41.
15. Knott VB. Longitudinal study of dental arch widths at four stages of dentition. Angle Orthod. 1972;42(4):387-94.
16. Bishara SE, Jakobsen JR, Treder J, Nowak A. Arch width changes from 6 weeks to 45 years of age. Am J Orthod Dentofacial Orthop. 1997;111(4):401-9.
17. Defraia E, Baroni G, Marinelli A. Dental arch dimensions in the mixed dentition: a study of Italian children born in the 1950s and the 1990s. Angle Orthod. 2006;76(3):446-51.
18. Louly F, Nouer PRA, Janson G, Pinzan A. Dental arch dimensions in the mixed dentition: a study of Brazilian children from 9 to 12 years of age. J Appl Oral Sci. 2011;19(2):169-74.

19. Vanichvatana S. Comparison of Dental arch dimension of untreated mixed dentition patients with Class II division 1, Class II division 2, and Class III malocclusion.(2015; PhD Thesis, Saint Louis University).
20. Staley RN, Stuntz WR, Peterson LC. A comparison of arch widths in adults with normal occlusion and adults with class II, Division 1 malocclusion. Am J Orthod. 1985;88(2):163-9.
21. Raberin M, Laumon B, Martin JL, Brunner F. Dimensions and form of dental arches in subjects with normal occlusions. Am J Orthod Dentofacial Orthop. 1993;104(1):67-72.
22. Moyers RE, van der Linden FPGM, Roiolo ML, McNamara JA Jr. Standards of human occlusal development, monograph no. 5, craniofacial growth series. ann arbor, michigan: center for human growth and development, University of Michigan; 1976.
23. Dung TM, Ngoc VT, Khoi TD, Chu DT, Dung DT, Khue LN et al. The dental arch dimensions in Vietnamese children at 7 years of age, and their variation by gender and ethnicity. J Oral Biol Craniofac Res. 2019;9(3):236–40.
24. Ling JY, Wong RW. Dental arch widths of Southern Chinese. Angle Orthod. 2009;79(1):54–63.