Dental and Alveolar Arch Widths in Normal Occlusion and Class II Division 1 Malocclusion

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Key words
Normal occlusion , malocclusion.

Abstract
This study was to evaluate and compare dental arch and alveolar widths of patients with Class II division one malocclusion with group of untreated normal occlusion subjects. This study was performed using measurement on dental casts of 30 normal occlusion and 30 Class II division 1 malocclusion of Iraqi sample aged 15-22 years. T-test was applied for comparing the groups , the finding of this study indicated that maxillary interpremolar width, maxillary canine, maxillary premolar and maxillary first molar and mandibular premolar and molar alveolar widths were found significantly narrower in the Class II division 1 group when compared with the normal occlusion sample (P<.001). The maxillary and mandibular intermolar and mandibular intercanine alveolar widths were statistically significantly larger in the Class II division 1 group (P<.01) . Maxillary molar teeth in subjects with Class II division 1 malocclusion tend to incline to the buccal to compensate the insufficient alveolar base therefore rapid maxillary expansion rather than slow maxillary expansion should be considered during treatment of Class II division 1 patients. The results of our study suggested that transverse discrepancy in Class II division one malocclusion originated from upper posterior teeth and maxillary alveolar base.

Introduction

Class II malocclusion is reported as the most frequently seen skeletal disharmony in orthodontic population. Investigators have recommended strongly the early detection of all Classes of malocclusion. Furthermore, they endorse preventive and interceptive orthodontics and dentofacial orthopedics for young patients to avoid, or at least to minimize the occurrence of malocclusion at the adult stage [1].

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The size and shape of the arches have considerable implications in orthodontic diagnosis and treatment planning, affecting the space available, dental esthetics, and stability of the dentition [2]. The growth changes of arch widths in normal occlusion subjects and a comparison of arch widths in normal occlusion and different malocclusion samples have been studied extensively [3-9]. Most of the studies in the literature compare dental arch widths of Class II patients with the normal occlusion samples. Some of them indicate that absolute arch widths of children with malocclusion did not differ appreciably from those with normal occlusion [3,4,6,8,9].

However, in other studies, statistically significant differences were determined in dental and alveolar width measurements of Class II patients [3,9]. Sayin and Turkkahraman [3] compared the arch and alveolar widths of patients with Class II division 1 malocclusion and subjects with Class I ideal occlusion in the permanent dentition. They indicated that mandibular intercanine widths were significantly larger in the Class II division 1 group, although maxillary intermolar widths were larger in the normal occlusion sample. Staley et al [4] stated that patients with Class II, division 1 malocclusion had narrower maxillary intercanine, intermolar, and alveolar widths. Buschang et al [6] had evaluated the differences in dental arch morphology among untreated adult females with Class I, Class II, division 1, and Class II, division 2 malocclusions and reported that Class II, division1 females had the longest and narrowest arches. Tollaro et al [10] found that patients with Class II malocclusions had a significantly narrower maxillary area during the mixed dentition phase. Bishara et al [11] reported that transverse discrepancy in Class II division 1 subjects did not appear to be self-corrected from the deciduous to the permanent dentitions. Similarly, Baccetti et al [12] reported that transverse interarch discrepancy was evident in the deciduous dentition and persisted into the mixed dentition. This study compares arch and alveolar widths of patients with Class II division 1 malocclusion and subjects with Class I ideal occlusion in the permanent dentition.

Materials and Method

This study was performed on dental casts of 30 normal occlusion and 30 Class II division 1 malocclusion subjects who were attending Tikrit University, College of Dentistry , Department of Orthodontics and different healthy centers in Saladin city.

Normal Occlusion Sample

Dental casts were taken from 30 adult subjects (13 male and 17 female) with normal occlusion, which met the following criteria: [3] (1) Class I canine and molar relationship with minor or no crowding, normal growth and development, well-aligned upper and lower dental arches; (2) all teeth present except third molars; (3)good facial symmetry determined clinically; (4) no significant medical history; (5) no history of trauma; and(6) no previous orthodontic or prosthodontic treatment, maxillofacial or plastic surgery.

Malocclusion Sample

A sample of 30 subjects (16 male and 14 female) with Class II division 1 malocclusion were selected from patient records. The inclusion criteria used to select Class II division 1 samples were [3] (1) bilateral Class II molar relationship in centric occlusion with the distobuccal cusp tip of the maxillary first molar within one mm (anterior or posterior) from the buccal groove of the mandibular first molar and protrusive maxillary incisors; (2) all teeth present except third molars; (3) no significant medical history; and (4) no history of trauma, and no previous orthodontic, prosthodontic treatment, maxillofacial or plastic surgery. Twelve width measurements were performed on the dental casts of each subject [9]. The arch width measurements were recorded from each subject's dental casts by one examiner, using a dial caliper and recording the data to the nearest 0.1 mm. These dental and alveolar arch width measurements are shown in Table 1, and Figure 1 and 2. Four weeks after the first measurements, 20 dental casts were selected randomly and remeasured . A paired samples t-test was applied to the measurements. The difference between the first and second measurements was statistically insignificant. Independent-samples t-test was applied for comparison of the groups. All statistical analyses were performed using the Statistical Package for Social Sciences for Windows (SPSS) software package (version10.1, SPSS Inc, Chicago, Ill).

Results

Four weeks after the first measurements, 20 randomly selected dental casts were remeasured. A paired-samples t-test was

applied to the measurements. The difference between the first and second measurements of the 20 casts was statistically insignificant. The method error was calculated by using Dahlberg's formula. Values varied from 0.360 to 0.882 and were within acceptable limits (Table 2).Descriptive statistics (mean, standard deviation, and minimum and maximum) and statistical comparisons of dental and alveolar width measurements for dental casts in two groups (normal occlusion and Class II division 1 malocclusion) are shown in Table 3. According to independent samples t-test, statistically significant differences were found in maxillary and mandibular dental arch and alveolar width dimensions between Class II division 1 malocclusion and normal occlusion samples. Statistical comparisons of the two groups showed no significant differences in maxillary intercanine (UC-C), mandibular interpremolar (LP-P) and mandibular canine alveolar width (LAC-C) measurements(P> .05).Statistically significant differences were found in nine of the 12 measurements. The maxillary interpremolar width (P< .001); maxillary canine (P< .001), premolar (P < .001), and molar (P < .05) alveolar widths; and mandibular premolar (P, .001) and molar(P < .05) alveolar widths were significantly narrower in the Class II division 1 group when compared with the normal occlusion sample. The upper (P< .01) and lower (P< .01) intermolar and lower intercanine (P<.001) widths were statistically significantly larger in the Class II division 1 group (Table 3).

Discussion

Information regarding maxillary arch dimensions in human populations is important to clinicians in orthodontics, prosthodontics, and oral surgery. It also is of interest to anthropologists and other students of human oral biology [13]. A survey of arch size could help the clinician in choosing correctly shaped stock impression trays for prosthodontic treatment. In addition to the selection of stock trays, the sizes of artificial teeth and the overall form of the artificial dental

arch at the wax trial stage are amenable to modification by the dental surgeon in orthodontic treatment [14]. This study was carried out to compare the dental arch and alveolar base widths of Class II division 1 malocclusion groups with the untreated normal occlusion sample.Width measurements described in this article will help clinicians diagnose and plan the treatment of patients with Class II division 1 malocclusions samples. Investigators who studied growth changes in the transverse arch width found that molar and canine arch widths did not change after age 13 in female subjects and age 16 in male subjects [15-19]. The minimum ages of the subjects measured in this study were chosen on the basis of these previous studies. Therefore, we assumed that the arch widths of the subjects studied were fully developed.Clinicians have speculated that nasal obstruction, finger habits, tongue thrusting, low tongue position, and abnormal swallowing and sucking behaviors were reasons for narrower maxillary dental arch widths in Class II division 1 malocclusions compared with a normal occlusion sample. Staley et al [4] stated that the maxillary dental arch as a whole is narrower in adults with Class II division 1 malocclusion than it is in adults with normal occlusion. When we compare the dental and alveolar arch widths of Class II division 1 malocclusion samples with the normal occlusion samples, statistically significant lower values were found in most of the upper arch widths in Class II division 1 patients. Intercanine widths were investigated in a few of the previous studies, and conflicting results were found. These differences may be due to the age or severity of malocclusion of the subjects examined. Frö̈hlich [20] compared intercanine widths of both arches from children with Class II malocclusion with data collected by Moorrees [19] from children with normal occlusion and found that absolute arch widths of the Class II children did not differ appreciably from those of children with normal occlusion.Staley et al [4] reported that subjects with normal occlusion had larger maxillary canine widths than the malocclusion subjects, but no differences were found in mandibular

canine widths. Bishara et al [11] studied the growth trends in maxillary and mandibular dental arch widths and lengths in persons with Class II division 1 malocclusions and normal subjects and reported no differences in maxillary and mandibular canine width measurements between the groups. In contrast with the others, Sayin and Turkkahraman [3] found that mandibular intercanine widths were significantly larger in the Class II division 1 group than in the Class I group, whereas no significant differences were found among maxillary intercanine width measurements. In accordance with Sayin and Turkkahraman [3], the results of this study showed that the maxillary intercanine width difference was similar in Class I and Class II division1 groups, and the mandibular intercanine width was significantly larger in the Class II division 1 sample.Intermolar widths were the most commonly evaluated measurement in previous studies. Fro¨hlich [20] found no difference in molar widths between normal and Class II subjects. Bishara et al [11] found no significant differences in the female comparisons of the intermolar width measurements. Staley et al [4] reported that subjects with normal occlusion had larger maxillary molar widths and intermolar width differences than subjects with malocclusion. While evaluating alveolar widths, they reported that maxillary alveolar widths and mandibular alveolar widths of the males were larger in the Class I group. Again, alveolar width differences were found to be greater in the Class I group. They suggested that palatal movement of maxillary posterior teeth in Class II patients was needed to compensate for the increased overjet and to have good posterior interdigitation.Tollaro et al [10] compared arch widths of 60 Class II, division 1 patients (26 males and 34 females) with 70 Class I subjects (25 males and 35 females) in the mixed dentition. Class II,division 1 subjects were grouped according to the presence of the posterior transverse interarch discrepancy (PTID). They reported that Class II, division 1 patients with PTID had narrower maxillary intermolar widths than Class II, division1 patients without PTID

and Class I subjects. Mandibular intermolar widths did not differ between the three groups. They also suggested that Class II patients with PTID needed a preliminary expansion of the maxillary arch.In this study, molar reference points were taken from Staley et al [4], who measured the widths between the mesiobuccal cusp tips of the maxillary first molars and the buccal grooves of the lower first molars. Because, in normal centric occlusion, the mesiobuccal cusp tips of the maxillary molars are positioned near the buccal grooves of the mandibular molars.

In this study we suggested that the narrow widths of the dental arch in Class II division 1 patients appeared to be caused by palatally tipped teeth and also by narrower bony bases of the dental arch. The results showed that transverse discrepancy in Class II division 1 patients originated from upper posterior teeth and not from the maxillary alveolar base. However, in contrast with previous studies, these findings indicated that the upper alveolar intermolar width was narrower and upper and lower intermolar widths were larger in patients with Class II division 1 malocclusion when compared with the normal occlusion sample. Therefore, we concluded that subjects with Class II division 1 malocclusions tend to have the maxillary molar teeth inclined to the buccal to compensate for the insufficient alveolar base. For that reason, rapid maxillary expansion rather than slow expansion may be considered before or during the treatment of a Class II division 1 patient ,in agreement with Staley et al [4] and Sayin and Turkkahraman [3] .

Of the four main categories in Angle's classifications of malocclusions, the Class II division 2 type of discrepancy occurs the least often. Obtaining data on Class II division 2 patients has always been challenging because of the low prevalence rates. For that reason, little data was found in the literature related to the alveolar widths of this malocclusion. In one of them, Walkow and Peck [21] indicated that mandibular canine width was significantly less in Class II division 2 deepbite patients and suggested that the extreme deep bite may inhibit anterior development of the

mandibular dentoalveolar segment.In a cross-sectional study, Buschang et al [6] found that Class II division 2 patients showed smaller mandibular intercanine and intermolar widths than the Class I and II division 1 patients.Buschang et al [6] reported that in an adult female sample, the maxillary intermolar width of Class II cases as smaller than in the Class I subjects. Within the class II malocclusion group, the maxillary width was smaller in the Class II division 1 group than in the Class II division 2 subjects. Lux et al [22] found dental arch widths of Class II division 2 cases took a position between the Class II division 1 cases and the Class I control groups. Moorrees et al [19] used serial dental casts of untreated Class II malocclusions to compare arch dimensions of Class II division 1 and Class II division 2 subgroups. Compared with dental cast measurements from a control reference population, the Class II division 2 dental casts had greater than average maxillary and mandibular intercanine distances with the intermolar distances normally distributed.The findings of this study indicated that almost all the upper dental and alveolar width measurements were narrower in patients with Class II division 1 malocclusion when compared with the normal occlusion sample. In addition, the mandibular dental width measurements were larger in the Class II division 1 group. Subjects with Class II division 1 malocclusion tend to have the maxillary teeth inclined to the lingual and mandibular teeth inclined to the buccal direction because of the restriction of maxillary growth and development. Therefore, rapid maxillary expansion may be considered before or during the treatment of a Class II division 1 patient. 2. Based on previous studies on relapse, it is generally agreed that post orthodontic occlusal stability is enhanced through maintenance of the original inter-canine width. Again no significant differences found comparing upper and lower intermolar widths (M-M) in all groups , this come in accordance with Frhlich [31] , Nojima etal [32] , Kook [33] and Susan and Elham [11]. while disagree with other studies [34,35] in which the M-M width is class II division 1 is significantly smaller

than class II division 2 and class I normal occlusion. Lastly comparing arch length (I-CC ,I-MM) of all groups there were no significant differences except that of upper and lower arch length in class II division 1 is significantly larger than that of class II division 2 and normal occlusion this is in accordance to the finding of Susan and Elham in Jordan population [11] , this may be attributed to proclination of anterior teeth . Whereas, comparing with class 1 only upper anterior arch length of class I normal occlusion is significantly smaller than class II division 1 as well as the lower I-MM .As a suggestion to further studies, it is of interest to relate dental arch width to the prevalence of respiratory disease. Epidemiologic surveys have shown that the prevalence of asthma in Iraq is relatively higher than in other nearby countries like Turkey, Lebanon, Jordan. Moreover, and was much higher than France, Italy, Sweden and Spain [36]. Accordingly, further study is needed to investigate the association between the prevalence of respiratory disease and arch widths in our population.

Conclusions

-Maxillary interpremolar width, all maxillary alveolar widths, and mandibular premolar and molar alveolar widths were significantly narrower in the Class II division 1 group when compared with the normal occlusion sample.

-Upper alveolar intermolar width was narrower, and upper and lower intermolar width was greater in patients with Class II division 1 malocclusion when compared with the normal occlusion sample.

-Maxillary molar teeth in subjects with Class II division 1 malocclusions tend to incline buccally to compensate for the insufficient alveolar base.For that reason, rapid maxillary expansion rather than slow expansion may be considered before or during the treatment of a Class II division 1 patient.

Table(1):- Maxillary and mandibular dental and alveolar width measurements used in the study

1. Maxillary intercanine width (UC-C): the distance between the cusp tips of the right and left canines or the center of the   wear facets in cases of attrition.

2. Maxillary interpremolar width (UP-P): the distance between the cusp tips of the right and left first premolars.

3. Maxillary intermolar width (UM-M): the distance between the mesiobuccal cusp tips of the right and left first molars.

4. Mandibular intercanine width (LC-C): the distance between the cusp tips of the right and left mandibular canines.

5. Mandibular interpremolar width (LP-P): the distance between the cusp tips of the right and left mandibular first   premolars.

6. Mandibular intermolar width (LM-M): between the most gingival extensions of the buccal grooves on the first molars   or, when the grooves had no distinct terminus on the buccal surface, between points on the grooves located at the   middle of the buccal surfaces.

7. Maxillary canine alveolar width (UAC-C): the distance between two points at the mucogingival junctions above the   cusp tips of the maxillary right and left canines.

8. Maxillary premolar alveolar width (UAP-P): the distance between two points at the mucogingival junctions above the   interdental contact point of the maxillary first and second premolars.

9. Maxillary molar alveolar width (UAM-M): the distance between two points at the mucogingival junctions above the   mesiobuccal cusp tips of the maxillary first molars

10. Mandibular canine alveolar width (LAC-C): the projection of UAC-C point in the lower jaw

11. Mandibular premolar alveolar width (LAP-P): the projection of UAP-P point in the lower jaw

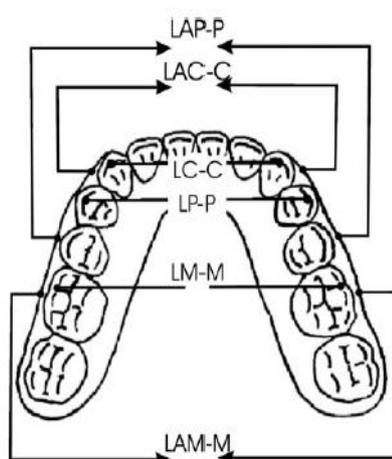**12. Mandibular molar alveolar width (LAM-M):** the projection of UAM-M point in the lower jaw

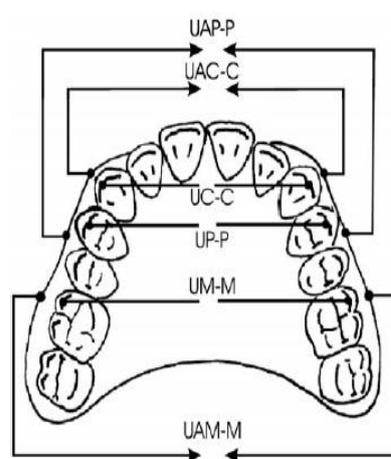Fig.(1):- Mandibular dental cast measurements modified from (Sayin and Turkkahraman).

Fig.(2) :-Maxillary dental cast measurments modified from(Sayin and Turkkahraman)

Table(2):- Error of the method

Transverse measurment	Dahlberg₋s calculation	Reliability coefficient
UC-C	0.882	0.993
UP-P	0.567	0.912
UM-M	0.786	0.983
LC-C	0.654	0.917
LP-P	0.756	0.903
LM-M	0.360	0.982
UAC-C	0.534	0.943
UAP-P	0.456	0.936
UAM-M	0.365	0.948
LAC-C	0.452	0.915
LAP-P	0.654	0.920
LAM-M	0.423	0.936

Table(3):- Descriptive statistics and statistical comparisons of dental and alveolar widths of normal occlusion and class II division 1 malocclusion samples [a]

Normal occlusion					Class II division 1 malocclusion				Normal occlusion vs class II div 1
	Mean	SD	Min	Max	Mean	SD	Min	Max	
UC-C	33.4	2.2	28.1	39.5	32.2	2.2	26.1	37.6	NS
UP-P	41.1	3.1	33.2	49.8	36.1	3.1	30.2	47.4	***
UM-M	51.3	2.6	45.0	60.1	53.3	2.6	47.0	63.3	**
LC-C	24.9	4.2	21.1	34.2	26.9	4.2	23.4	39.5	***
LP-P	33.6	1.6	28.3	40.4	34.6	1.6	29.3	41.5	NS
LM-M	46.2	1.7	40.3	52.1	48.3	1.7	41.3	54.2	**
UAC-C	38.5	3.6	32.6	45.9	35.5	3.6	30.5	42.9	***
UAP-P	48.9	4.7	40.8	58.7	44.3	4.7	37.8	55.0	***
UAM-M	59.4	2.2	55.6	65.3	56.4	2.2	53.4	62.3	*
LAC-C	33.8	3.4	30.2	41.0	32.7	3.4	29.2	40.2	NS
LAP-P	46.6	2.3	41.2	52.3	40.1	2.3	36.3	46.3	***
LAM-M	59.1	2.8	52.4	68.4	56.1	2.8	50.4	68.3	***

a SD indicates standard deviation; Min, minimum; Max, maximum; NS, not significant.
* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

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