Maxillary arch dimensional changes of Class II division 1 malocclusion during orthodontic treatment

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Abstract

Orthodontist predicted the effect of orthodontic treatment on occlusion by obtaining information about dimensional changes of the dental arches .The present study is designed to investigate the maxillary dental arch dimensional changes as a result of orthodontic treatment of class II division one malocclusion and to compare between the two types of orthodontic appliances used in the treatment removable and fixed type. The present retrospective study was performed using measurement on dental cast of 15 subjects having class II division one malocclusion treated by fixed appliances (group I) and 10 subjects were treated by removable appliances. The results showed significant reduction in the means of maxillary arch dimensions during treatment and slight expansion in inter-canine width in both groups.

Introduction

Investigators have recommended strongly the early detection of all types of malocclusion , class II malocclusion is reported as the most common skeletal disharmony in orthodontic population. 1. The size and shape of the arches have considerable implications in orthodontic diagnosis and treatment planning, affecting the dental esthetics, space available, and stability of the dentition 2.Orthodontic depend on treatment mechanics and growth to correct malocclusion, the dental arch dimensions systemically change during the period of treatment . 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 3-10.

Staley et al 3 reported that patients with Class II, division 1 malocclusion had narrower maxillary, intermolar, intercanine and alveolar widths Sayin and Turkkahraman 4 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.

Buschang et al 6 had evaluated the differences in dental arch dimensions with Class I, Class II, division 2, and Class II, division 1 malocclusions and stated that Class II, division1 females had the longest and narrowest arches. Several longitudinal studies have been reported dealing with dimensional changes during and following orthodontic treatment and few studies dealt with specific malocclusion with different technique of treatment. However

,information concerning maxillary arch dimensional changes in orthodontically treated patient with class II division 1 malocclusion are important to orthodontists , since large number of patient seeking for orthodontic treatment are within this class of malocclusion. The aim of the present study is to assess the maxillary arch dimensional changes during orthodontic treatment of class II division 1 malocclusion and to compare between the two different types of orthodontic appliances used in the treatment.

Materials and Methods

This study was performed on dental casts of 25 having Class II division 1 malocclusion subjects aged 14-22 years ,who were attending Tikrit University, College of Dentistry , Department of Orthodontics and different healthy centers in Saladin city. Fifteen case have been treated by fixed orthodontic technique (group I) and ten case treated by removable appliance (group II).

Sample specification

Dental casts were taken met the following criteria: 3 (1) Class II division 1 malocclusion (mesio-buccal cusp of maxillary first molar anteriorly positioned by a half a cusp or more to the buccal groove of mandibular first molar); (2) normal growth and development, well-aligned upper dental arches with mild spacing or crowding; (3)no facial asymmetry determined clinically; (4) all teeth present except third molars; (5) good medical history; (6) no history of trauma;(7)fully erupted permanent incisors, canines, premolars and first molars ;(8) no supernumerary teeth ,no congenital missing or extracted teeth other than first premolar and (9) no intentional maxillary expansion had been undertaken during treatment .

Distances measured

Four measurements were made on maxillary casts of each patient in both groups (group I and group II): (1) intercanine distance (IC);(2) interpremolar distance (IP); (3) intermolar distance (IM) and(4) anterior arch height (AAH)8.

IC was determined as the distance between the cusp tips of the right and left canines. IP the distance between the cusp tips of the right and left second premolars. IM the distance between the mesiobuccal cusp tips of the right and left first molars. AAH was determined by the distance between the middle point of a line drawn between the fossae of second premolars, and the incisal border of the central incisors at the midline.

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. Three weeks after the first measurements, ten dental casts were selected randomly and re measured . A paired samples t-test was applied to the measurements. The difference between the two 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 .

Results

Descriptive statistics and statistical comparisons of dental

casts (mean, standard deviation, minimum and maximum) of maxillary arch dimension in group I are shown in Table 1, the results showed significant differences in maxillary interpremolar width, maxillary intermolar width and maxillary anterior arch height and non-significant differences in maxillary intercanine width.

Descriptive statistics & statistical comparison of maxillary arch dimension in group II as shown in Table 2 revealed significant differences in maxillary intercanine width ,maxillary interpremolar width, maxillary intermolar width and maxillary interarch height.

According to independent samples t-test, statistically significant differences were found in maxillary dental arch dimensions between group I and group II as demonstrated in Table 3 .Statistical comparisons of the two groups showed significant differences in maxillary intercanine , maxillary interpremolar width, maxillary intermolar width and maxillary anterior arch height.

Discussion

In human populations , information regarding maxillary arch dimensions is important to clinicians in orthodontics, anthropologists, oral surgery and prosthodontics. It also is of interest to other students of human oral biology [11].

This study was performed to compare the maxillary dimensional changes of Class II division1 malocclusion groups treated with fixed and removable orthodontic appliances. The present study will help clinicians diagnose and plan the treatment of patients with Class II division1 malocclusions samples.

Investigators who studied growth changes in the transverse arch width found that canine and molar arch widths did not change after age16 in male subjects and age 13 in female subjects [12-16]. On the basis of these previous studies ,the minimum ages of the subjects measured in the present study were chosen. Therefore, we assumed that the arch widths of the subjects studied were fully developed. Study models were used in many previous studies dealing with maxillary arch dimensions .It is preferred over other records ,represent the dentition accurately in three dimensions and not liable for dimensional changes or distortion ,thus it is considered as a permanent record for the patient.

The results of present study showed non-significant expansion of intercanine width ,this can be attributed to the different form of the dental arches ,while the application of a standard form of arch wires which control the final shape of the dental arch after treatment. In addition to that fixed orthodontic appliance gives the orthodontist multiple chances to manipulate the arch wire to achieve multiple tooth movement in different direction. If canines are moved distally along the dental arch would expect some expansion to be achieved ,generally speaking when canines are moved into premolar extraction spaces ,they are moving into a wider arch position, this agreed with the conclusions of Rammreez *et al* [8] and hoe and kerr[17].

Sondi[18] stated that if canine are moved into premolar extraction spaces they may be expanded buccally but collapse after

retention period . Steadman[19] noticed that inter canine width retains its original dimension after being expanded during treatment.

The results of present study in group II showed significant expansion in inter canine width during treatment with removable orthodontic appliances compared with group I , the reason for such expansion is the preference of most of the orthodontists for the use of finger spring to retract canines distally into premolar extraction spaces and as it is known ,finger spring produce tipping movement of teeth, it push the canine distally and buccally particularly if it was not positioned perfectly during fabrication of removable appliances, however the canine cusp tip would be in amore distal position that means in wider position of the dental arch. Few cases recorded decrease of inter canine width due to the use of buccal canine retractor or the modified type which can produce palatal movement of the buccally positioned canine.

The significant reduction of inter premolar and inter molar width in group I treated by fixed orthodontic appliance considered the logical consequences of forward movement of the molar into narrower part of the dental arch to close premolar extraction space, this mesial movement happened due to loss of anchorage during retraction of canines and incisors. The process of anchorage loss occurred either intentionally or as unwanted secondary movement due to un successful planning for anchorage reinforcement, the amount of reduction of inter molar width during treatment give an idea about the amount of anchorage loss . Few cases treated by fixed appliances showed mild increase of inter premolar and inter molar width as consequence extra oral traction.

The results revealed significant reduction of inter premolar and inter molar width in group II treated by removable orthodontic appliance to a less degree than that recorded in group I ,the reason for that significant difference may attributed to that the first molars in group treated by fixed orthodontic appliances are more liable to be mesially drifted and mesio-palatally rotated more than in case when it is grasped by the Adams clasp and acrylic base plate. Theoretically the molar width should be kept unchanged during treatment even in case of anchorage loss ,especially if the removable appliances was perfectly constructed and trimmed i.e. the Adams clasp and acrylic base plate grasp the first molar and do not allow for any movement except the forward movement, therefore the reason for a such reduction in inter premolar and inter molar width is due to imperfect trimming of acrylic base plate or improper Adams clasp which allow the molar to be rotated .

The decreased AAH in the present study agreed with Ho and kerr [17] who found significant reduction of vertical molar length during treatment of extraction cases of malocclusion, this because of losing of one dental unit from each side of dental arch, also changes in the labio-palatal inclination of incisors during treatment has its effect on decreasing this dimensions.

References

1. **Lee RT.** Arch width and form: a review. Am J Orthod Dentofacial Orthop. 2012; 127:325–333.
2. **El-Mangoury NH, Mostafa YA.** Epidemiologic panorama of dental occlusion. Angle Orthod. 1990;60:207–214.
3. **Staley RN, Peterson LC, Stuntz WR.** A comparison of arch widths in adults with normal occlusion and adults with Class II division 1 malocclusion. Am J Orthod. 1985;88:163–169.
4. **Sayin MO, Turkkahraman H.** Comparison of dental arch and alveolar widths of patients with Class II division 1 malocclusion and subjects with Class I ideal occlusion. Angle Orthod.2004;74:356–360.
5 **Enlow DH, Hans MG.** Essentials of Facial Growth. Philadelphia,Pa: WB Saunders; 1996:1–280.
6. **Buschang PH, Alexander RG, Stroud J.** Differences in dental arch morphology among adult females with untreated Class I and Class II malocclusion. Eur J Orthod. 1994;16:47–52.
7. **Moorrees CFA, Lebret LML, Yen PKJ, Gron AM, Frohlich FJ.** Growth studies of the dentition: a review. Am J Orthod.1969;55:600–616.
8. **Ramirez YJ, Sidlauskas A, Junior E, Fluter J .** Dimensional Changes in Dental Arches After Treatment with a Prefabricated Functional Appliance. J Clin Pediatr Dent 2007;31(4):279-283.
9. **Uysal T, Usumez S, Sari Z, Memili B.** Dental and alveolar arch widths in normal occlusion, Class II division 1 and Class II division 2. Angle Orthod. 2013;72(6):456–462.
10. **Tollaro I, Franchi L, Tanesescu CD, Baccetti T.** Role of posterior transverse interarch discrepancy in Class II, division 1 malocclusion during the mixed dentition phase. Am J Orthod Dentofacial Orthop. 1996;110:417–422.
11. **Younes SAES.** Maxillary arch dimensions in Saudi and Egypt population sample. Am J Orthod Dentofacial Orthop. 1984;85:83–88.
12. **Moorrees CFA.** The Dentition of the Growing Child. Cambridge, Mass: Harvard University Press; 1959:87–110.
13. **Sillman JH.** Dimensional changes of the dental arches: longitudinal study from birth to 25 years. Am J Orthod. 1964;50:824–842.
14. **Knott VB.** Longitudinal study of dental arch widths at four stages of dentition. Angle Orthod. 1972;42:387–394.
15. **Knott VB.** Size and form of the dental arches in children with good occlusion studied longitudinally from age 9 years to late adolescence. Am J Phys Anthropol. 1961;19:263–284.
16. **DeKock WH.** Dental arch depth and width studied longitudinally from 12 years of age to adulthood. Am J Orthod. 1972;62:56–66.
17.**Ho KK, Kerr WJ.** Arch dimensional changes during and following fixed theraoy.Br J Orthod. 2011;16:85-93.
18.**Sondi A**. Dimensional changes in the dental arches of orthodontically treated cases. Am J Orthod. 2008;78:155–163.
19.**Steadman SR**. Changes in inter molar and inter cuspid distance following orthodontic treatment. Angle Orthod. 1998;36:207–215.

TABLE 1. Descriptive statistics and statistical comparisons of maxillary dimensional changes of class II division 1 malocclusion samples for group I treated by fixed appliances.

	Before treatment				***After treatment***				***Significant difference***
Variable	Mean	SD	Min	Max	Mean	SD	Min	Max	
IC	32.8	0.5	29.8	34.7	33.4	1.4	30.3	35.4	NS
IP	38.5	0.7	36.4	40.2	36.3	1.6	33.2	39.3	**
IM	48.4	0.6	45.4	51.4	45.8	0.9	41.8	49.2	**
AAH	27.2	0.7	25.3	31.4	20.4	1.1	18.5	23.6	**

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

TABLE 2. Descriptive statistics and statistical comparisons of maxillary dimensional changes of class II division 1 malocclusion samples for group II treated by removable appliances.

	Before treatment				***After treatment***				***Significant difference***
Variable	Mean	SD	Min	Max	Mean	SD	Min	Max	
IC	33.7	0.9	30.1	35.2	35.5	1.2	30.3	37.8	**
IP	37.6	0.6	35.2	41.2	37.2	1. 3	33.2	39.9	**
IM	48.8	0.6	44.2	50.2	44.6	0.8	41.8	48.9	***
AAH	28.2	0.7	26.1	32.1	24.6	1.4	18.5	26.2	**

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

TABLE 3. Paired t-test of maxillary dimensional changes in group I and group II.

	Group I	***Group II***		
Variable	Mean difference	Mean difference	t-values	Significant level
IC	**2.3**	**3.2**	**0.5**	****
IP	**1.5**	**2.4**	**1.2**	****
IM	**5.6**	**3.2**	**1.8**	****
AAH	**8.3**	**4.5**	**3.6**	*****