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ORIGINAL ARTICLE

COMPARISON OF INTERMOLAR ARCH WIDTH BEFORE AND AFTER ALIGNMENT PHASE OF ORTHODONTIC TREATMENT IN CLASS II DIV 1 PATIENTS

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ABSTRACT

Arch width changes introduced from fixed appliance treatment are significant to the orthodontist. An understanding of these changes is of utmost vitality to the clinician in terms of treatment planning. The purpose of this study was to determine and compare the inter-molar arch width in classII div 1 cases before and four months into fixed orthodontic treatment It was a cross sectional interventive study carried out in orthodontic department of Armed Forces Institute of Dentistry AFID, Rawalpindi. 208 patients of class II div 1 malocclusion were selected by non probability purposive sampling. The age range of sample was 15-25 years. Upper arch impressions were taken and maxillary intermolar width was measured on the study casts before and six months into orthodontic treatment. Standard arch wires were used starting from .012 Nitinol upto .019x.028 Nitinol. Intermolar arch width was taken as the transverse distance from the central fossa of first molar on one side to the central fossa of first molar on the other side of the same arch. The pretreatment mean values of intermolar arch width in females and males were found to be 45.01 ± 2.4mm and 46.6 ± 2.6mm respectively. However, the posttreatment T2 mean intermolar arch width was found to be 46.7 ± 2.4mm in females and 48.4 ± 2.7mm in males.

There was a mean increase of 1.7mm in pre and post treatment intermolar arch width so an orthodontist should be cautious in arch expansion mechanics specially when the treatment plan is non extraction.

Key Words: *Intermolar Arch width, Arch form, Class II div 1 malocclusion.*

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INTRODUCTION

Investigators have historically described the dental arches in simple geometric term such as ellipse, parabola, and segments of circles joined to straight line or modified spheres. The proposed ideal arrangement of the teeth was described geometrically by Angle as the line of occlusion.[1-3] Dental arch dimensions are of special interest for dentists and orthodontists in particular. In determining the normal dental arch width of a population, inter molar width (IMW) is a key measurement which assists in diagnosis and treatment planning of orthodontic patients, especially in patients requiring expansion as an alternate to premolar extractions in a patient having narrow dental arches.[4] Changes in the arch width, length, and height can result from orthodontic treatment; hence, an understanding of the dental arch dimensions is crucial.[5] Dental arches have been investigated using different measurements and reference points, including but not limited to, inter canine, inter premolar, and inter molar widths, either between cusps or fossae. The most popularly used method to measure intermolar width is Ponts index.[6] Mushtaq and Tajik estimated the mean maxillary intermolar widths of 34.6mm ,34.5mm,30.9mm,34.7 mm and 34.18mm and mean maxillary intercanine widths were found to be 24.16mm, 24.5mm, 24.6mm, 23.9mm and 23.05mm for Class I, Class II division 1,Class II division 2,Class III and Class II subdivision groups respectively.[7]

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Both the proportions and shape of dental arches have considerable impact in orthodontic diagnosis and treatment planning, affecting the space available, dental esthetics, and stability of the dentition.[8]Alteration in arch width dimension comprises the development of the alveolar process almost entirely and slight increase in skeletal width chiefly in the mandibular arch. Precisely, maxillary alveolar processes diverge as the teeth erupt; whereas the advance of the mandibular alveolar process is more parallel. Usually the maxillary width growths are much larger and can be more easily reformed with treatment.[9]

Awareness of arch dimensions is valuable resulting in a smooth occurrence of temporary malocclusion, in predicting forthcoming orthodontic problems, normal occlusal variations in mixed dentition, and appropriate successive exchange of permanent teeth.[10]

Arch width changes resulting from fixed appliance treatment are important to the orthodontist. An understanding of these changes is of utmost importance to the clinician in terms of treatment planning. The purpose of this study was to evaluate the inter molar width changes in the maxilla before and four months after the orthodontic treatment with fixed mechanotherapy.

MATERIALS AND METHODS

It was a cross sectional study that was conducted department of orthodontics & Dentofacial orthopedics of Armed Forces Institute of Dentistry AFID, Rawalpindi. from period of Octobor 2009 to December 2010. In this study, 208 patients of class II DIV 1 malocclusion were selected with the age range of 15-25 years from the outdoor patients of Orthodontic Department of AFID The inclusion criteria was Class II div I cases with mild to moderate crowding. No anterior and posterior open bite was present in selected cases and there was no history of previous orthodontic treatment. No extraction was done before starting the orthodontic treatment. Upper arch impressions were taken and maxillary inter molar width was calculated on the study casts before the start of treatment with the help of digital Vernier caliper to the nearest 0.01mm. The procedure was repeated after six months of orthodontic treatment. Standard arch wires were used starting from .012 Nitinol up to .019x.028 Nitinol. All measurements of the study subjects were carried out again four weeks later by same operator to evaluate measurements error. Inter molar arch width was taken as the transverse distance from the central fossa of first molar on one side to the central fossa of first molar on the other side of the same arch. The obtained data was checked, verified & edited. The data was analyzed using the SPSS (statistical package for social science) software version 16.

METHOD ERROR

For the purpose of calibration, the two examiners took all the measurements on 20 dental models and then their measurements were compared.

RESULTS

The total sample size comprised of 208 individuals of class II div 1 patients. The age range of the patients was between 15 years to 25 years. The mean age of the sample was 17.6 years ±2.7. Table 1. The most frequent age group was 15 years (22.6%). Gender distribution (Figure 1) comprised of 131 females(63%) and 77 males (37%). The most frequent age in females was 14 years and in males it was 18 years.

The mean values of intermolar arch width in the overall sample were found to be 45.6mm ± 2.62mm at T1 and 47.3mm ± 2.69 at T2 (Table 2) The pretreatment mean values of intermolar arch width in females and males were found to be 45.01 ± 2.4mm and 46.6 ± 2.6mm (figure 2) respectively. However the posttreatment T2 mean inter molar arch width was found to be 46.7 ± 2.4mm in females and 48.4 ± 2.7mm in males (FIGURE 3) .

Most frequent values in the overall sample for intermolar arch width were found to be 45mm at T1 and 47mm at T2 (Figure4). Most frequent value for pretreatment intermolar arch width was found to be 45mm in females and 46mm in males however most frequent post treatment values for intermolar arch width were found to be 47 mm in both males and females (Figure 5).

The pre and post treatment intermolar arch widths were analysed by paired sample t Test to assess the significance of difference. Results showed that there was a significant increase in arch width four months after appliance placement p value 0.00 which is highly significant (Table 3).

DISCUSSION

In our study the mean age of the sample was calculated to be 17.6±2.7 years. Gender distribution consisted of 131 females (63%) and 77 males (37%). The most recurrent age in females was 14 years and in the males it was 18 years. The inter-molar arch width is typically established till this age. All the patients were in the permanent dentition stage but still margin of residual growth was present in most of the patients so we cannot absolutely compare the inter molar width of our study with other studies.

TABLE 1: MEAN AGE OF THE SAMPLE

	N	Minimum	Maximum	Mean	Std. Deviation
Age	208	15.0	25.0	17.649	2.7092
Valid N (listwise)	208				

TABLE 2: MEAN ARCH WIDTHS AT T1 AND T2

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Arch Width T1	208	39.00	54.00	45.6154	2.62212
Arch Width T2	208	41.00	56.50	47.3317	2.69739
Valid N (Listwise)	208				

TABLE 3: PAIRED SAMPLE T TEST

		N	Correlation	Sig.
Pair 1	Arch Width T1 & Arch Width T2	208	.967	.000

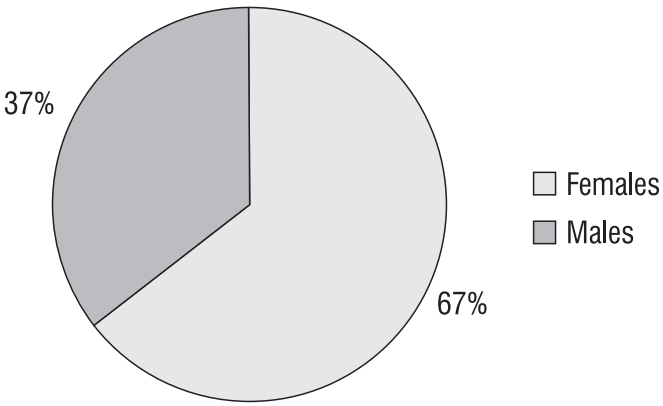

Fig 1: Distribution of males and females

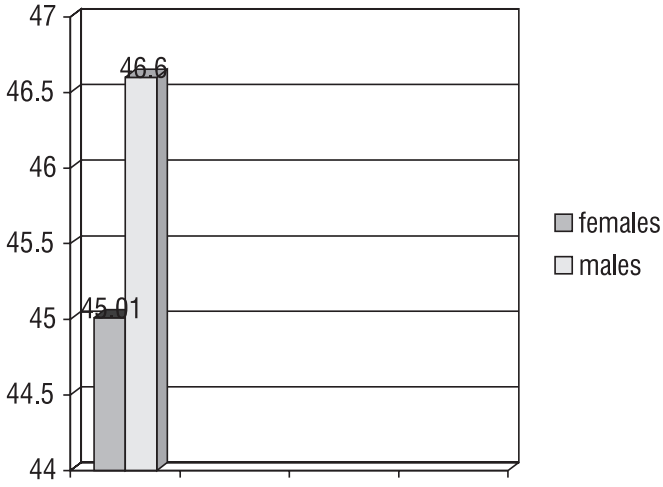

Fig 2: Mean intermolar arch width at T1 in males and females

The mean value of inter molar arch width in the overall sample were found to be 45.6mm ± 2.62mm at T1 and 47.3mm ± 2.69 at T2. The pretreatment mean values of inter molar arch width in females and males were found to be 45.01 ± 2.4mm and 46.6 ± 2.6mm (figure 2) respectively. However, the posttreatment T2 mean inter molar arch width was found to be 46.7

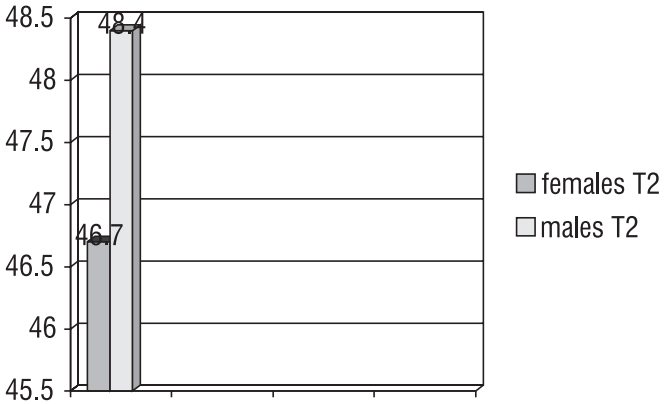

Fig 3: Post treatment mean arch width in males and females at T2

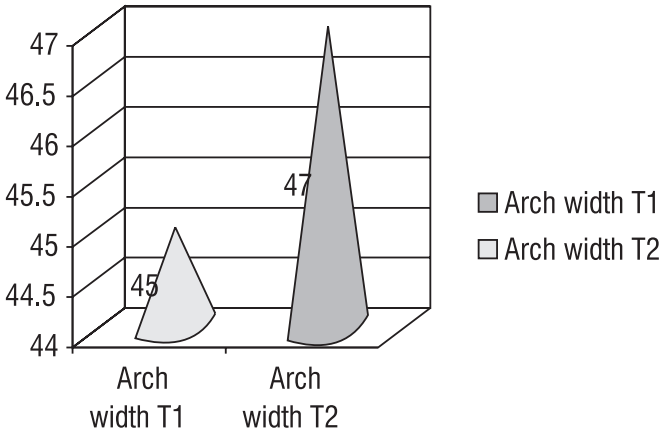

Fig 4: Most frequent arch width at T1 and T2.

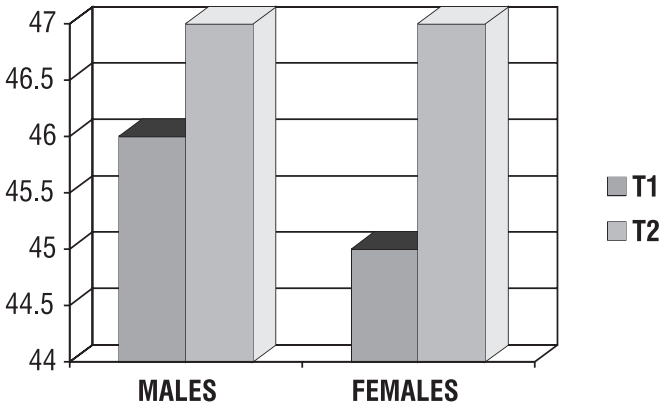

Fig 5: Most frequent intermolar arch width in males and females at T1 and T2.

± 2.4mm in females and 48.4 ± 2.7mm in male.It is a known fact that palatal width increases from primary to permanent dentition stage.[12] During the transitional dentition, increases in arch width occurs at a greater degree in maxilla than in the mandible. Followed through adolescence into adulthood, inter molar width changes vary depending on the longitudinal sample, with some investigators reporting increases, and others finding no significant changes for males and females and few showing decreases for females.[13,17] Omar and Alhajrasi found that males generally have larger dental arch measurements than females.[15] In our study, greater inter molar arch width in patients with class II div 1 malocclusion could be attributed to the racial differences, however differences in the method of measurement can also contribute to arch width differences.

Crown width and height has no significant relation to various arch length, arch perimeter, and arch width groups of maxilla and mandible.[14] Tsujino K, Machida studied the longitudinal changes in arch width from childhood to adolescence. The width between the maxillary first molars gradually increased until 15 years of age; there was no clear change thereafter. The width between the mandibular first molars was nearly stable throughout the observation period.[16] In previous studies Class II division 2 dental casts had maxillary and mandibular inter canine distances greater than average and normally distributed inter molar distances. Most of these studies presented a limited sample size resulting in questionable validity. No difference in the mean maxillary and mandibular dental arch and alveolar width dimensions among Class II division 1, Class II division 2, and a normal occlusion sample was found.[18,19]

Because orthodontists must often modify arch widths, there is a rich history of attempts to individualize predictions. Some of the authors evaluating transverse dimensions had reported that maxillary arch was narrower in patients with Class II, division 1 malocclusion, and an expansion was needed during or before treatment. A local study by Bhutta and Israr concluded that no dental and alveolar differences exist between the two malocclusion samples i.e. Class II div 1 and Class II div 2 except that the mandibular inter canine and inter premolar alveolar widths are significantly narrower in class II div 1 samples.[20] Santana found that palatal inclination of the maxillary permanent first molars occurs continuously between ages 9 and 14 years, with Class II subjects showing greater changes.[11] Uysal and Memmili concluded that that mandibular intercanine and interpremolar widths were narrower in class II div I individuals.[18] Most recently Yang and Chung compared the bucco lingual inclination of the molars of untreated adults and children. The conclusion drawn was that the maxillary first molars exhibited buccal inclination, and the inclination in adults is more palatal than that in children.[10] Our sample comprised of class II div 1 malocclusion in which mean pretreatment arch width was 45.6mm± 2.6mm which is higher than normal**.** In another study, Mc Namara found that a net gain of six mm was achieved in the maxillary arch perimeter, whereas a net gain of 4.5 mm was found for the mandibular arch perimeter of treated subjects in the long term. The amount of correction in both maxillary and mandibular inter molar widths equaled two-thirds of the initial discrepancy.[21] According to a local study Azeem and Haq found that children with Class II malocclusion have narrower maxillary arches than those with normal occlusion. The mean age of the subjects in this study was 18.23±3.75 years. The mean value of inter molar (IMW) in selected subjects was 45.33±3.42 mm. Study results concluded that in Pakistanis, ideally aligned maxillary arch and occlusion can be achieved with upper inter molar distances of 45.33±3.42 mm. Certain racial differences exists in terms of norms of mean IMW width. IMW in Kuwait residents was 51.32 mm ± 2.61 in Colombian subjects mean IMW was found to be 45.9±3.9, in Karachi population it was 45.6 mm±2.3, and in Nepalese it was 47.94±3.34. In general, IMW dimension remains very stable with some degrees of sexual dimorphism present.[4] The findings of Patel and Mehta indicated that maxillary dental arch width measurements were significantly narrower in the Class III group as compared to normal occlusion group ($P < .001$).[22] Motamedi etal found that inter molar width in the extraction group decreased significantly during treatment. In contrast to the extraction group, the control and non-extraction groups both demonstrated an increase in mean inter molar width which was 0.66 mm and 0.91 mm respectively.[23]

Shapiro measured the inter molar and inter canine width of 80 cases 10 years' post-retention and compared the results with post-treatment and end-of-treatment figures. He concluded that mandibular inter canine width has a strong tendency to return to its pretreatment dimension in all groups, i.e., extraction, non-extraction cases.[25] On the contrary, Walter, studied the plaster models of 102 North Americans, white patients between the ages of 6 and 36, 1-13 years following the removal of retaining devices, concluded that the dental arch can be permanently widened or lengthened.[24] A study by Steadman of 31 cases out of retention or more years indicated that the ultimate inter molar width of the maxillary and mandibular first molars and the ultimate inter canine width of the maxillary and mandibular canines are not determined by orthodontic treatment. He noted that premolar extraction decreased the maxillary and mandibular inter molar widths but produced no significant differences in maxillary and mandibular inter canine width. In contrast to the extraction group, the control and non-extraction groups both demonstrated an increase in mean inter molar width during the first period of observation.[26] These results are similar to our study where alignment was done for six months till .019x.028 Nitinol wire was passed. Thus in non-extraction cases of class II div I an orthodontist should expect a mean increase of 1.7mm during routine orthodontic treatment. This should be taken into consideration while planning the treatment of constricted maxillary arch. The limitation of our study

was that we did not measure the inter molar arch width at post treatment and post retention periods to assess the stability of our results. Future studies should be planned to assess these changes. Furthermore, inter molar arch width changes in extraction cases also needs further research.

CONCLUSION

In class II div I cases, inter molar width inevitably increases by 1.8 mm in initial alignment phase of fixed mechanotherapy with standard archwires.Although the increase in inter molar width was significant, still further studies are needed to assess the amount of expansion with heavy wire in extraction/non extraction cases and post treatment stability of this expansion.

REFERENCES

1 Rabbani R M G,Ali M W, Jahan E, Hasan N, Hossain M Z. A comparative Study of Arch Widths between Class I Crowded with Normal Occlusions. Update Dental College Journal. 2018 ; 8(2): 14-17

2 Al-Khateeb SN, Abu Alhaija ESJ. Tooth size discrepancies and arch parameters among different malocclusions in a Jordanian sample. Angle Orthod. 2006;76:459-65.

3 *Al-Hilal LH, Sultan K, Hajeer MY, Mahmoud G, Wanli AA. J Contemp Dent Pract. 2018; 19(4):431-37.*

4 Azeem M, Haq A, Iqbal J, Iqbal A, Hamid W. JBUMDC 2018; 8(3):139-41

5 Lione R, Buongiorno M, Franchi L, Cozza P. Evaluation of maxillary arch dimensions and palatal morphology in mouthbreathing children by using digital dental casts. International journal of pediatric otorhinolaryngology. 2014;78(1):91-95.

6 Moyers RE. Handbook of orthodontics. 4th ed. Chicago (USA): Years book publishers; 1988: 233.

7 Mushtaq N, Tajik I, Baseer S, Shakeel S. Intercanine and intermolar widths in Angle Class I, II and III malocclusions. PODJ.2014; 34(1):83-86.

8 Yang D, Liang S, Zhang K, Gao W, Bai Y. Evaluation of Growth and Development of Late Mixed Dentition Upper Dental Arch with Normal Occlusion Using 3-Dimensional Digital Models. J Health Eng. 2019;2019:4191848.

9 Park S J, Leesungbok R, Song J W , Chang S H , Lee1 S W , Ahn S J. Analysis of dimensions and shapes of maxillary and mandibular dental arch in Korean young adults. J Adv Prosthodont 2017;9:321-27.

10 Yang B ,Chung C H, Buccolingual inclination of molars in untreated children and adults. a cone beam computed tomography study. *Angle Orthod* (2019) 89 (1): 87–92.

11 Santana L, Motro M, Bamashmous MS, Kantarci A, Will LA. Buccolingual angulation and intermolar width changes in the maxillary first molars of untreated growing children. Am J Orthod Dentofacial Orthop. 2017 May;151(5):921-28.

12 Eslami Amirabadi G, Golshah A, Derakhshan S, Khandan S, Saeidipour M, Nikkerdar N. Palatal dimensions at different stages of dentition in 5 to 18-year-old Iranian children and adolescent with normal occlusion. BMC Oral Health. 2018 May 15;18(1):87-92.

13 Oliva, B., Sferra, S., Greco, A.L. et al. Three-dimensional analysis of dental arch forms in Italian population. Prog Orthod. 2018;19 (1):34-41.

14 Shahid F, Alam MK, Khamis MF. Maxillary and mandibular anterior crown width/height ratio and its relation to various arch perimeters, arch length, and arch width groups. Eur J Dent. 2015 Oct-Dec;9(4):490-99.

15 Omar H, Alhajrasi M, Felemban N, Hassan A. Dental arch dimensions, form and tooth size ratio among a Saudi sample. Saudi Med J. 2018;39:86–91.

16 Tsujino K, Machida Y. A longitudinal study of the growth and development of the dental arch width from childhood to adolescence in Japanese. Bull Tokyo Dent Coll. 1998;39(2):75-89.

17 Ribeiro, Jucienne Salgado, Ambrosio, Aldrieli Regina, Santos-Pinto, Ary dos, Shimizu, Isabella Almeida, & Shimizu, Roberto Hideo. (2012). Evaluation of transverse changes in the dental arches according to growth pattern: a longitudinal study. Dental Press Journal of Orthodontics, 17(1), 66-73.

18 Uysal T, Memili B, Usumez S, Sari Z. Dental and alveolar arch widths in normal occlusion, class II division 1 and class II division 2. Angle Orthod. 2005 ;75(6):941-7.

19 Bishara SE, Bayati P, Jakobsen JR. 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: 483-89.

20 Bhutta N, Israr J, Ijaz A. Comparison of dental and alveolar arch widths in class i and class ii division 1 malocclusion. PODJ .2013;33(2) :289-97.

21 McNamara JA Jr, Baccetti T, Franchi L, Herberger TA. Rapid maxillary expansion followed by fixed appliances: a long-term evaluation of changes in arch dimensions. Angle Orthod. 2003; 73(4):344-53.

22 Patel D, Mehta F, Patel N, Mehta N, Trivedi I, Mehta A. Evaluation of arch width among Class I normal occlusion, Class II Division 1, Class II Division 2, and Class III malocclusion in Indian population. Contemp Clin Dent. 2015;6 (Suppl 1):S202-9.

23 Motamedi AK, Dadgar S, Teimouri F, Aslani F. Stability of changes in mandibular intermolar and intercuspid distances following orthodontic treatment. Dent Res J (Isfahan). 2015;12 (1):71-75.

24 Walter DC. Changes in the form and dimensions of dental arches resulting from orthodontic treatment. Angle Orthod.1953;23:3-18.

25 Shapiro PA. Mandibular dental arch form and dimension. Treatment and post retention changes. Am J Orthod. 1974;66:58-70.

26 Steadman SR. Changes of intermolar and intercuspid distances following orthodontic treatment. Angle Orthod.1961;31:207-15.

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3 Hameed Ullah Jan (R):	Discussion.
4 Tariq Hameed:	Results and figures.
5 Umer Hameed:	Referrences.