

Original Article

Stability of changes in mandibular intermolar and intercuspid distances following orthodontic treatment

Alimohammad K. Motamedi, Sepideh Dadgar, Fatemeh Teimouri, Farzin Aslani

Department of Orthodontics, School of Dentistry, Khorasgan Branch, Islamic Azad University, Isfahan, Iran

ABSTRACT

Background: The aim of this study was to determine the pattern and amount of change exhibited in mandibular intercanine and intermolar width during treatment and assessing its stability 1-3 years post-retention.

Materials and Methods: The material consisted of 70 cases of which 20 cases were treated without extraction and 30 cases were treated with extraction, which were compared with 20 untreated cases which served as a control group. A series of three measurements were made for each case of the treated group: At the beginning of treatment, end of active treatment and 1-3 years post-retention; and for the control group: At 12, 15 and 18 years of age. The Wilcoxon signed ranks test was used to evaluate treatment changes in each group. The Kruskal-Wallis H test was used to compare the treatment changes between the 3 groups ($\alpha = 0.05$). SPSS 16 software (SPSS Inc., Chicago, IL, USA) was used to evaluate the data.

Results: Mean changes of intercanine width for three groups was -0.5 mm for control group, -0.26 mm for non-extraction group and $+0.18$ mm for extraction group. Intermolar width of 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 intermolar width which was 0.66 mm and 0.91 mm respectively.

Conclusion: It was concluded that although mean changes of intercanine and intermolar width were statistically significant but they were not perceptible clinically.

Key Words: Intercanine width, intermolar width, mandibular, orthodontic

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Address for correspondence:
Dr. Sepideh Dadgar,
Department of Orthodontics,
School of Dentistry,
Khorasgan Branch, Islamic
Azad University, Isfahan, Iran.
E-mail: dadgar_sepideh@
yahoo.com

INTRODUCTION

Successful treatment of malocclusions depends on accurate diagnosis and the formulation of a treatment plan that includes both the active and retentive phase of treatment. Maintaining teeth of the orthodontic patient in the position attained by treatment appears to be the most difficult task of the orthodontic profession. Consequently, many theories and schools of thought

have been proposed with regard to treatment goals, objectives and limitations.^[1-3]

The literature supports that changes in mandibular intercanine and intermolar width have been used as criteria to evaluate retention.^[4-9]

Strang^[7-9] stated that the intercanine width of the mandibular denture is an infallible guide to inherent muscular balance of an individual and dictates the limit of denture expansion in this area.

Furthermore controversial results exist about the effect of extracting permanent teeth in orthodontic treatment plan on intercanine and intermolar width and final stability.^[10-13]

Peak^[13] in a study of 43 cases out of retention for a period of 6 months or more showed a decrease in cuspid arch width in most of the cases. He also

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showed that decrease in intercanine width was more pronounced in non-extraction cases by comparing their arch width with the extraction group.

Riedel^[14] by a thorough review of the literature concluded that teeth do tend to move back toward their former positions; the arch form of the mandibular arch cannot be permanently altered by appliance therapy.

It is the intent of this paper

1. To determine the pattern of change exhibited by mandibular intercanine and intermolar width during treatment and at a minimum of 1 year following retention,
2. To determine the quantitative change within these patterns,
3. to determine the frequency of these patterns and
4. To compare changes that occur in these measurements as the result of extraction and non-extraction therapy.

MATERIALS AND METHODS

The material consisted of 70 cases of which 20 cases were treated without extraction and 30 cases were treated with extraction, which were compared with 20 untreated cases, which served as a control group. Information was acquired from the following sources.

Treated group

Out of 69 cases treated in the Department of Orthodontics, Temple University School of Dentistry, which had been evaluated post-retention, 50 cases fulfilled the following criteria:

1. Complete set of pre-treatment, retention and post-retention casts,
2. No congenitally missing teeth except third molars,
3. Treated with a multibanded edgewise technique (slot 18) and
4. Extraction of four first bicuspid or no permanent tooth extracted by the time of last evaluation (multiband standard edgewise appliance was used for both extraction and non-extraction group).

The casts for the treated group were made before orthodontic treatment (age range: 10-13, mean age: 12), at the completion of orthodontic treatment (age range: 13-16 mean age: 15) and 1-3 years after termination of retention (age range: 17-19 mean age: 18).

Control group

Control cases were selected from the collection of Dr. Richard H. Stucklen, Department of Anthropology,

University of Pennsylvania. The casts of this group were made annually from 6 to 18 years of age. Those selected for this study correspond to the ages of the treated group, i.e., 12, 15 and 18 years of age. Of 52 untreated cases, 20 cases fulfill the following requirements:

1. Casts at 12, 15 and 18 years of age,
2. An acceptable occlusion (defined in this study as one in which there was no severe overjet or overbite, no severe rotations and no crossbites) with class I molar relationship,
3. No congenitally missing teeth except third molars and
4. No permanent tooth extraction up to age 18.

Table 1 shows a summary of the material.

The intercanine and intermolar widths were measured on the mandibular casts of 70 cases. The mandibular intercanine width was measured as the straight line distance between the heights of the incisal edge of the central lobe of each mandibular permanent canine. The mandibular intermolar width was measured as the straight line distance between the summits of the mesiobuccal cusp of each permanent first molar.

The widths were measured by means of a digital caliper. A series of three measurements were made for each case of the treated group: On casts made

1. At the beginning of treatment,
2. At the end of active treatment and
3. 1-3 years following the removal of retaining devices; for the control group: On casts made at 12, 15 and 18 years of age.

The treatment change is determined by subtracting the pretreatment dimension from the end-of-treatment dimension. The post-treatment change is determined by subtracting the end-of-treatment dimension from the post-retention dimension. The total change is the sum of these differences. If the result of subtraction is a positive (+) quantity, it indicates a gain in width. If the result of subtraction is a negative quantity (-), it indicates a decrease in width.

Table 1: Summary of materials

Group	Angle classification	No.	Sex	No.
Untreated	Class I	20	Male	7
			Female	13
Non-extraction	Class I	2	Male	8
	Class II, division 1	15	Female	12
	Class II, division 2	3		
Extraction	Class I	18	Male	8
	Class II, division 1	12	Female	22

It should be noted, however, that the usual method of retention employed in treated cases of this study was a mandibular cuspid to cuspid or bicuspid to bicuspid fixed retainer, while no retaining device was placed from molar to molar.

The Sign test was used to evaluate treatment changes in each group. The Kruskal-Wallis H test was used to compare the pre-treatment and post-treatment values and the treatment changes between the 3 groups ($\alpha = 0.05$). SPSS 16 software (SPSS Inc., Chicago, IL, USA) was used to evaluate the data.

RESULTS

The differences in mean intercanine width of the three groups were not statistically significant at (Kruskal-Wallis H test) at start of treatment or approximately age 12 ($P = 0.054$).

Differences in the mean intercanine width of the three groups at 15 years of age for the control group and end of active treatment for the treated groups were found to be statistically significant ($P < 0.001$). This indicates that while mean intercanine width for the control group decreased during this period, it increased for both treated groups.

The difference in intercanine width during this period for each group was tested by the Sign test (one-tailed at $\alpha = 0.05$) and found to be statistically significant (control ($P:0.035$), non-extraction ($P:0.004$) and extraction ($P < 0.001$)).

At post-retention or approximately age 18, both

treated and control groups showed a reduction in intercanine width.

Differences in the mean intercanine width of the three groups at the last observation were found to be statistically significant ($P:0.003$).

Table 2 shows mean intercanine distance for the three groups at three different intervals with their standard deviations and changes over the base-line measurements.

The differences in mean intermolar width of the three groups were not statistically significant (Kruskal-Wallis H test) at the start of treatment or approximately age 12 ($P:0.063$), assuring valid comparison of the groups.

The differences in mean intermolar width of the three groups at 15 years of age or end of treatment were found to be statistically significant ($P:0.002$).

This indicates that while mean intermolar width for the extraction group decreased during this period, it increased for both control and non-extraction groups.

At post-retention or approximately age 18, different patterns in intermolar width were observed in the three groups. Intermolar width either increased or remained the same in the control group, predominantly increased in the non-extraction group and decreased in the extraction group.

The fact that the mean intermolar width of the three groups at the last observation was statistically significant ($P < 0.001$) confirmed the discrepancies noted in the three groups. Table 3 shows mean intermolar distance for the three groups at three

Table 2: Mean intercanine distance for the three groups at three different intervals with their SDs and changes over the base-line measurements

Group	At age 12 or pre-treatment		At age 15 or end of treatment			At age 18 or post-retention		
	Mean (mm)	SD	Mean (mm)	SD	Change	Mean (mm)	SD	Total change
Control	25.33	1.64	25.11	1.89	-0.22	24.83	1.90	-0.5
Non-extraction	26.14	1.75	27.32	2.04	+1.18	25.88	1.78	-0.26
Extraction	26.78	2.22	28.53	1.54	+1.75	26.96	1.87	+0.18

SD: Standard deviation

Table 3: Mean intermolar distance for the three groups at three different intervals with their SDs and changes over the base-line measurements

Group	At age 12 or pre-treatment		At age 15 or end of treatment			At age 18 or post-retention		
	Mean (mm)	SD	Mean (mm)	SD	Change	Mean (mm)	SD	Total change
Control	44.12	2.94	44.60	2.88	+0.48	44.78	2.96	+0.66
Non-extraction	43.09	3.07	44.38	2.82	+1.29	44.00	2.87	+0.91
Extraction	42.18	3.33	41.52	2.52	-0.66	40.43	2.27	-1.75

SD: Standard deviation

different intervals with their standard deviations and changes over the base-line measurements.

DISCUSSION

Interarch measurement of specific teeth similar to the method used in this study has been employed in several investigations of similar nature.^[12,15-17]

Nevertheless, certain inadequacies of the procedure must be acknowledged. Selecting the incisal tips of canines and the buccal cusp tips of molars is a subjective decision that is influenced by tooth function, position, age in the mouth and wear accentuated by the original malocclusion. To offset these shortcomings, however, certain procedures were adapted to assure consistency of measurement. All measurements were performed only by the author with one measuring device used throughout the study. No measuring session exceeded one and 1½ h nor continued if signs of eye fatigue were expressed. Each measurement was checked twice. All computations were made on an electronic calculator and checked twice.

In contrast to both treated groups, intercanine width of the control group predominantly decreased between 12 and 15 years of age and either continued to decrease or was maintained between 15 and 18 years of age. The loss in mean intercanine width during the first phase was 0.22 mm and 0.28 mm in the second phase, whereas a mean total loss of 0.5 mm.

When comparing the control group with the treated groups, it is interesting to note that, unlike the control group, the mean intercanine width of the non-extraction group increased 1.18 mm during treatment.

However, during post-retention the mean intercanine width of the non-extraction group decreased beyond its original dimension up to 1.44 mm with a mean effective loss of 0.26 mm.

This pattern is quite similar to that of the control group during the second period studied. Contrarily, the mean intercanine width of the extraction group increased 1.75 mm during treatment. However, at post-retention the mean intercanine width decreased 1.57 mm with a mean effective gain of 0.18 mm. Although these differences are statistically significant, clinically mean changes of -0.5, -0.26 and +0.18 are not perceptible. Therefore, the patterns of change are viewed as similar for all three groups. In view of the multifactorial complex that influences final tooth alignment, it seems safe to say that intercuspid

width at post-retention is independent of the choice of treatment by extraction or non-extraction, at least at the clinically perceptible level.

Similar results were achieved by the study done by Shapiro.^[18] He measured the intermolar and intercanine width of 80 cases 10 years post-retention and compared the results with post-treatment and end-of-treatment figures. He concluded that mandibular intercanine width has a strong tendency to return to its pretreatment dimension in all groups, i.e., extraction, non-extraction, class I, class II, division 1, class II, division 2.

On the contrary, Walter,^[17] who studied the plaster models of 102 North American, white patients between the ages of 6 and 36, 1-13 years following removal of retaining devices, concluded that the dental arch can be permanently widened or lengthened.

Strang^[8] concluded that when cuspids are moved to a wider portion of the arch, some degree of permanent expansion can be expected. In this study, only 10% of the original cuspid expansion was maintained in the extraction group. In cases where maintaining the alignment of mandibular incisors is a primary objective and where this alignment can be accomplished only by an increase in intercanine width, clinical application of this study would indicate that permanent or prolonged retention should be considered.

Intermolar width of the extraction group decreased significantly during treatment as a result of mesial movement of the first molar into a narrower portion of the arch. If this explanation is valid, then it would be reasonable to expect that distal movement of the canine into a wider dimension would result in an increased intercanine width. This, in fact, was the case in this study. However, following a post-retention period, the increase in intercanine width was not maintained, whereas the decrease in intermolar width remained.

Some studies showed similar results to current study. A study by Steadman^[12] of 31 cases out of retention 1 or more years indicated that the ultimate intermolar width of the maxillary and mandibular first molars and the ultimate intercanine width of the maxillary and mandibular canines are not determined by orthodontic treatment. He noted that premolar extraction decreased the maxillary and mandibular intermolar widths but produced no discernible differences in maxillary and mandibular intercanine width.

In contrast to the extraction group, the control and non-extraction groups both demonstrated an increase in mean intermolar width during the first period of observation. Intermolar width in the control group continued to increase between age 15 and 18 with a mean effective increase of 0.66 mm. Conversely, during retention, the non-extraction group regressed to some extent, resulting in a mean effective increase of 0.91 mm. Again, the measurable differences, although statistically significant, are of such clinically minute quantities as to be of no great concern.

CONCLUSION

Based on the present study, intercanine width of the original malocclusion can serve as an excellent indication of the intercanine dimension to be expected following several years post-retention. The patterns of intercanine width change are similar for both treatment groups and control group at post-retention or age 18. Premolar extraction therapy has no clinically significant effect on the resultant intercanine width but significantly decreases intermolar width during treatment and this decrease is maintained in to post-retention. Non-extraction therapy is more likely to demonstrate an increase in intermolar width that will be maintained in to post-retention and more closely resembles the pattern of change of the control group. Patterns of change in intercanine width are independent of patterns of change in intermolar width.

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