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Palatal expansions in mixed dentition versus early permanent dentition

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Abstract:

There is a general agreement among orthodontists that posterior crossbites should be treated early. The question stills remains; is early treatment more effective? Thirty-four patients were examined in this retrospective study. The participants were split into two groups based on age of the patients. Seventeen patients under the age of ten were placed in one group (G1), while the other 15 patients over the age of twelve were placed in another group (G2). The pre-treatment and post-treatment study models were analyzed in both groups. Comparisons were made between the pre and post-treatment cast based on inter-canine distance, inter-molar distance, and arch length and arch perimeter for both the maxillary and mandibular casts. T-test and one-way analysis was then done on the data collected to determine if more expansion was achieved in the younger patient with a single-phase treatment compared to an older group who had expansion with comprehensive orthodontic treatment. The data showed no statistical difference between the two groups.

INTRODUCTION

For over a century, the procedure of palatal expansion has been advocated in the dental profession; however, it was not until the 1960s that Haas established the mechanism of action. Still today, palatal expansion is the non-surgical treatment modality of choice for the correction of a posterior crossbite. Some disagreements remain among experts in field as to when the treatment should be initiated.There is evidence-supporting expansion at a very early age as well as later in adolescents.

Filho et al[1] reported successful expansion could be done as early as 5 years of age, other studies have reported expansion in patients as old as 44[2]. Theoretically, palatal expansion is easier at a younger age because it is easier to open the mid-palatal suture before it fuses. It has been noticed that if expansion is carried out too young, it is not uncommon for relapse to occur necessitating retreatment later in the permanent dentition stage[3]. Profitt[4] stated that potential facial distortion may occur with early treatment. However, other researchers have shown the harmful side effects of waiting too long for palatal expansion. Capelozza et al[2] found that pain, edema, and palatal lesions occurred with palatal expansion of adults. Structures are less adaptable in adult patients, and thus they present a greater chance of relapse[5]. Early treatment is beneficial to prevent the permanent dentition from establishing a crossbite relationship in its occlusal scheme. Filho et al demonstrated that 80% of expansion in primary dentition was orthopedic and 20% was orthodontic and that there was no harmful or iatrogenic effect.

This study set out to investigate whether expansion at a younger age was more effective compared to expansion of an older group who received palatal expansion and then fixed appliances consecutively.

METHOD AND MATERIALS

Patients treated with palatal expansion were selected from two clinics, the Graduate Orthodontic Clinic and the Undergraduate SPEC Clinic both located at the University of Western Ontario.
The selected patients were divided into two groups. The first group (G1) consisted of those who received palatal expansion at early age (mean age of 8.47 years) in mixed dentition. The second group (G2) consisted of those (average age of 14.73 years) in the late mixed and permanent dentition who received palatal expansion and full fixed appliances successively. Only patients with pre-treatment and post-treatment study models were selected. There were 17 patients in G1. One patient did not have the post-treatment mandibular model. Seventeen patients were selected for G2 but two were eliminated because they had premolar extractions after the expansion. Post treatment models were taken after the orthodontic phase. One patient from this group did not have the pre-treatment and post-treatment mandibular models.

Four measurements were conducted on each cast; the intercanine distance, intermolar distance, arch depth and arch perimeter. On each cast, the cusp tip of the canines and mesiobuccal cusp of the first molars were the points of measurement. The distance between the cuspal tip on one side to the cuspal tip on the other side was measured (Figure 1). If the canines were missing, a best-fit line was used to estimate the location of the appropriate position. When the cusp tips of the canines had been worn down, we chose a position that is as close as possible to the position of the cusp tip and marked with a pencil. The Boley gauge was used to measure the two points.

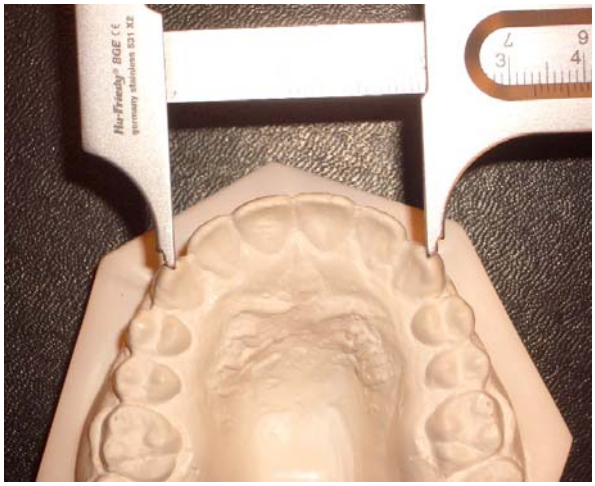

Figure 1. *Intercanine measurement between the cusp tips of the two canines.*

Similarly, the intermolar distance is measured between the two points marked on the mesiobucal cusp of the first molars with the Boley gauge (Figure 2). One of the mandibular pre-treatment casts in the older group did not show the presence of first molars and thus no measurement was recorded.

Figure 2. *Intermolar distance is measured between two mesiobuccal cusps of the first molars.*

The arch depth was measured from the contact of the two central incisors to the line connecting the two contacts of the first molars and the second pre-molar/second primary molars (Figure 3).

Figure 3. *The arch depth is measured from contact of the central incisors to the line connecting the contacts of the second premolars/second primary molars and first molars.*

Arch Perimeter was measured in four separate segments (Figure 4). The first segment was measured from the mesial contact point of one first molar to the mesial contact point of the canine. The second segment was measured from the mesial contact point of the canine to the mesial contact of the two central incisors. The third segment continued from the mesial contact of the two central incisors to the mesial contact point of the canine of the opposite quadrant. The last segment was measured from the mesial contact of the canine to the mesial contact point of first molar. A sharp Boley gauge was used.

All measurements were made with a caliper (0.1mm). To determine the error of the method, all measurements were repeated by the same investigator twice after the first time and each time was seven day apart from the previous one. The t-test revealed no statistical difference.

Figure 4**.** *The arch perimeter was measured in four separated segments*

THE RESULTS

The mean age of G1 was 8.47 as compared to the mean age of G2 of 14.73. The ratio of male to female was 47% to 53% in G1 and 40% to 60% in G2. None of these patients presented with any oral habits. The general data is presented in Table 1. There were eleven patients in G1 and 6 patients in G2 who presented with unilateral crossbites. Two patients from G1 and five patients from the G2 had bilateral crossbites. The remaining had expansion to increase arch length. An active period of expansion for G1 was 18.60 days with an average of 25.73 turns and was 23.07 days for G2 with 28.67 turns.

Canine Expansion

The results for the maxillary intercanine distance of the pre-treatment and post-treatment casts showed that similar expansion was achieved in both groups as shown in Table 1 and Figure 4A .The averaged expansion of G1 is 3.08mm compared to 2.79mm in G2. The change in mandibular intercanine distances showed a difference between G1 and G2 (Figure 4B). G2 showed an increase of transverse dimension of 1.64mm compared to 0.54mm in G1.

This difference was not statistically or clinically significant.

Table 1: Distribution of gender, age, duration of expansion and collected measurements.

	Group 1	Group 2
Male	8	6
Female	9	9
Mean age	8.47	14.73
Number of turns on average	25.73	28.67
Duration of active appliance	18.60 days	23.07 days
Mean difference in Intercanine width	Max = 3.08(±0.57) mm Mand = 0.54(±0.40) mm	Max = 2.79(±0.61) mm Mand = 1.64(±43) mm
Mean difference in Intermolar width	Max = 4.22(±0.46) mm Mand = 0.26(±0.56) mm	Max = 4.11(±0.49) mm Mand = 0.40(±0.63) mm
Mean difference in Arch Depth	Max = 0.21(±0.29) mm Mand = 0.12(±0.38) mm	Max = - 0.33(±0.31) mm Mand = 1.04(±0.41) mm
Mean difference in Arch Perimeter	Max = 2.48(±0.56) mm Mand = 0.13(±0.49) mm	Max = 3.78(±0.59) mm Mand = 1.54(±0.52) mm

Difference is the change between pre-treatment and the post-treatment

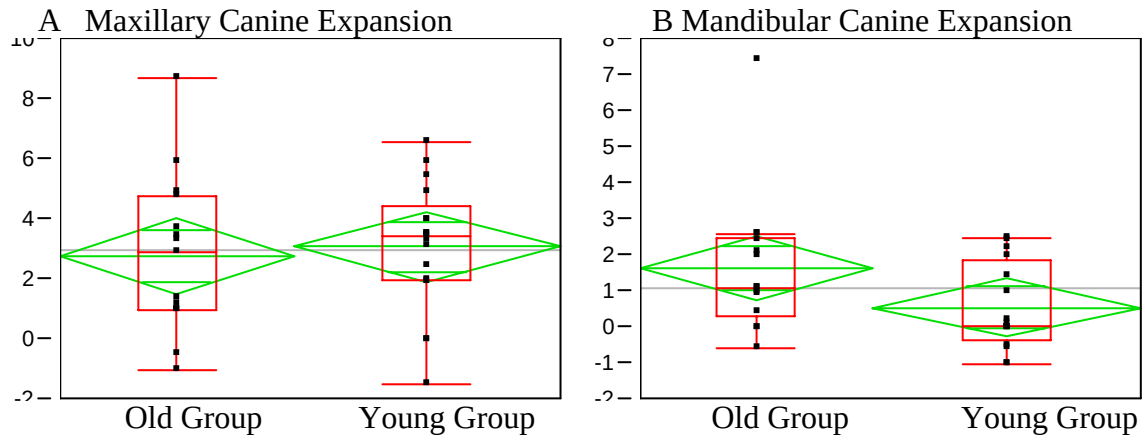

Figure 4: *Maxillary intercanine comparison in A. Mandibular intercanine comparison in B*

Molar expansion

The maxillary molar expansion of G1 was 4.22mm while G2 was slightly less at 4.11mm (Figure 5A). The mandibular molar expansion in both groups was similar and minimal (Figure 5B). G1 showed an increase of .26mm compared to 0.40mm in G2. The differences in molar expansion between the two groups in both arches were neither statistically nor clinically significant.

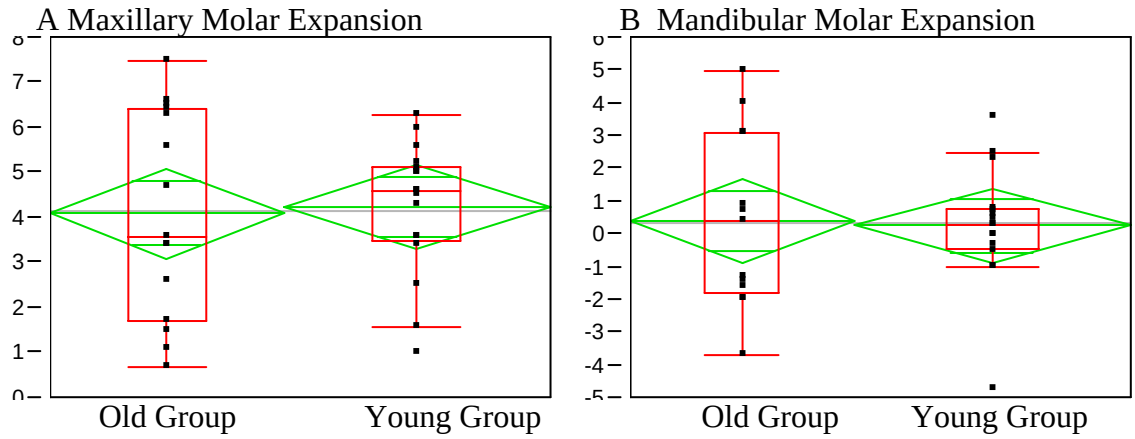

Figure 5: *Maxillary molar comparison in A. Mandibular molar comparison in B*

Arch Depth

Arch depths showed very minimal changes in both upper and lower arches after the treatment. G1 showed an averaged increase of 0.21mm and G2 showed a decrease of 0.33mm of maxillary arch depth (Figure 6A). The mandibular arch depths of both groups showed an increases (Figure 6B). G2 had an increase in arch depth of 1.04 mm compared to 0.12mm in G1. The changes in both arches were not clinically significant or statistically.

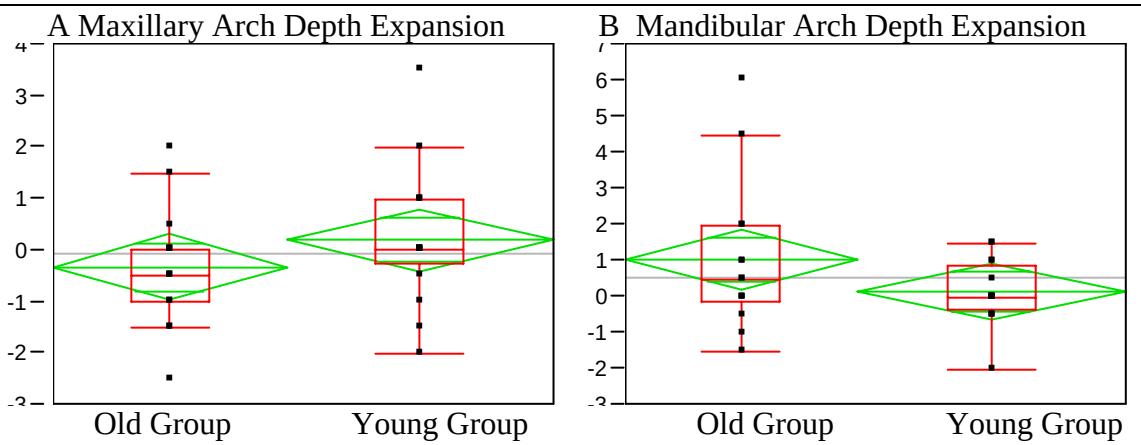

Figure 6: *Maxillary arch depth comparison in A. Mandibular arch depth comparison in B*

Arch Perimeter

Arch perimeter showed a greater increase in G2 compared to G1 in both maxillary and mandibular arches (Figure 7), however t-test did not show that there is a statistically significant difference of the arch perimeter for either maxillary or mandibular arches of the two groups. The maxillary arch perimeter showed an increase of 3.78mm in G2 compared to 2.48mm in G1 (Figure 7A). The mandibular arch perimeter also showed an increase in G2 (1.54mm) compared to G1 (0.13mm).

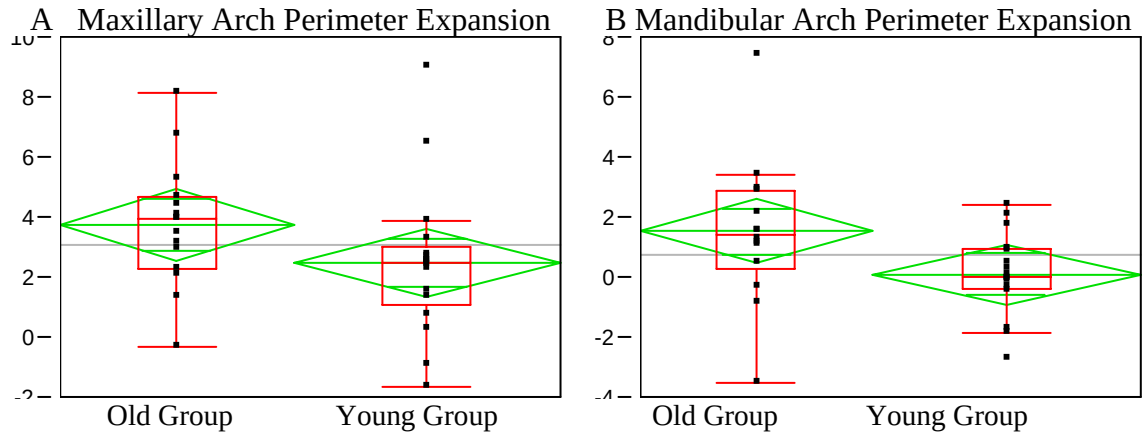

Figure 7: *Maxillary arch perimeter comparison in A. Mandibular arch perimeter comparison in B.*

DISCUSSION

This study did not show any statistically or clinically significant difference between the expansion of G1 and G2. A number of factors may have contributed to these results. The most significant problem was that the study did not have sufficient power due to the lack of suitable cases. Furthermore, retrospective studies are often flawed as the researcher is not permitted to randomly select patients and often has no control over the treatment protocol. Furthermore, due to the nature of the study, the issue of compliance was not taken into consideration. Also the amount of expansion required on a per patient basis was unknown.

Canine Expansion

Our study was consistent with other studies including Capelozza, Handelman et al[6] and McNamara et al[7] in that intercanine expansion was smaller than intermolar expansion in both groups. Often when there is a constricted maxillary arch, permanent canines erupt labial to the arch. After treatment, the canines are positioned
within the arch, which makes the changes for pre-treatment and post-treatment inter-canine distance smaller.

Molar Expansion

Expansion was achieved in both of our groups. Generally, the mid-palatal suture ossifies at age of 14 in females and 17 in males[2]. Thus as patients grow older, there will be more resistance to expansion

force. Our patients in G1 were younger than 10 years of age. G2 had two males over age 17 and five females over age of 15. As observed in this study, mean maxillary molar expansion in G1 was 4.22 ± 0.46 mm from 25.73 turns in 18.6 days. G2 gained 4.11 ± 0.49 mm in molar expansion from 28.67 turns in 23.07 days. Assuming compliance was similar for both groups our study indicated that although both G1 and G2 had similar maxillary molar expansions, G1 took five days less. This could also be explained by the presence of two males and five females in G2 who were over the age of ossifications. It should be noticed that only seven patients from the G1 required an orthodontic phase of treatment at a later age. This may indicate a slight advantage for early expansion. However, our study did not collect enough power to enforce the validity of finding.

Arch Depth

Arch depths in this study were not changed significantly. Both maxillary and mandibular arch depths in G1 were almost unchanged while maxillary arch depth in G2 showed a small decrease of 0.33mm. Adkins et al (1990) and Moussa et al[8] showed similar decrease of 0.4mm and 0.1mm respectively. Perhaps in the non-growing, maxillary arch expansions results a decrease in arch length. Mandibular arch depths of G2 were observed to be slightly increased, yet it was neither statistically nor clinically significant (Table1). This increase was possibly due to the full fixed appliances

Arch Perimeter

It has been stated that a significant increase of arch perimeter can be gained from palatal expansion. Adkins et al[9] demonstrated in their study that for every millimeter expansion with molar region, this produces about 0.7 mm increase in arch perimeter. Our study showed a different amount gained in arch perimeter for G1and G2 for every millimeter gained from the molar expansion. In G1 maxillary perimeter arch increase of 2.48mm was gained with the 4.22 mm molar expansion i.e. 0.59mm of arch perimeter gained for every millimeter molar expansion. The gain found in G2 was higher, at 0.91mm.

The greater expansion in G2 compared to G1 was probably due to the orthodontic treatment following palatal expansion. Most patients in G2 had a constricted maxilla with anterior crowding yielding a tapered arch form. The archwires placed after palatal expansion transformed the tapered arch into a U-shape arch and thus increased the arch perimeter in G2. This arch shaped change also occured in the mandibular arch. We found that G2 had a much greater increase in mandibular arch perimeter relative to G1 (1.54mm verses 0.13mm). However these findings are not clinically significant. Inherently, the archwires in the orthodontic phase of G2 were perhaps the reason for a greater mandibular intercanine expansion than in G1(1.64mm to 0.54mm) where there was no treatment in the mandibular arch.

Other studies have demonstrated greater increases in arch perimeters. McNamara et al showed an increase of 6mm of the maxillary arch and 4.5 mm of the mandibular arch. Our study showed approximately half of that increase with a maxillary perimeter increase of 2.48 mm in G1, and 3.78 mm in G2 and a mandibular perimeter increase of 0.13 mm in G1 and 1.54 mm in G2. This could be explained by the fact that the amount of expansion in our study was less. A quarter of our patients were expanded to create space for tooth alignment, not to correct crossbites. The patients with unilateral crossbites in G1 (11 of 17) had a mean expansion of 1.77mm, which was only half of what Berlocher et al[10] indicated one can expect. While unilateral crossbite patients (6 out of 15) in G2 had a mean expansion of 2.92mm.

CONCLUSION

There was no statistically or clinically significant differences in intercanine width between G1 and G2.

The intermolar width increased in both groups and showed similar results in maxillary and mandibular arches the increases found were not statistically or clinically significant.

Similarly, there was no statistically or clinically significant differences increases found in arch depths between G1 and G2 in the maxilla or mandible. All changes in arch depth were minimal.

G2 showed a greater increase in maxillary and mandibular arch perimeter than G1. However this study did not show statistically significant difference.

Overall, there were no statistically or clinically significant arch width, length or perimeter changes found between the younger group who received early expansion only and the older group who received expansion and comprehensive orthodontic treatment successively. Although we did not have

sufficient power to show it, the results of this study revealed a tendency for early expansion to be quicker. Also, it should be noted that more than a third of the younger patients in this study did not require any further treatment.

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