

The effect of maxillary palatal expansion on the primary dental arch circumference

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Abstract

Rapid palatal expansion was used to correct constricted maxillas on 29 subjects, 10 of whom had cleft palates. Arch width, measured transversely at the primary canine and at the primary second molar, increased in all cases with a mean value of 4.0 mm. Arch perimeter (arch length) also increased approximately 4.0 mm. Correlations between change in transverse palatal dimension versus change in arch circumference were variable. Besides the known benefits of correcting posterior crossbite through rapid palatal expansion, the probable increase of arch perimeter due to rapid palatal expansion should be recognized.

Introduction

Approximately 8% of normal children exhibit maxillary arch constriction which may be expressed dentally as either a unilateral or bilateral posterior crossbite.¹ The etiology of this malocclusion is believed to be the result of either congenital deficiencies² or acquired habits.^{3,4,5} Furthermore, the child with a cleft palate often has a constricted maxilla with associated posterior crossbite.⁶ Early correction of posterior crossbite is considered necessary for children with or without cleft palate to relocate the permanent tooth follicles in a more favorable position, and improve the potential for normal development of occlusion.^{7,8,9}

Theoretically, the maxillary constriction associated with posterior crossbite would seem to decrease available space for the succedaneous teeth; and expansion of the narrowed arch might increase arch circumference, thereby reducing the discrepancy between tooth

size and arch length. The purpose of this study was to determine if after treatment an increase in arch perimeter occurs which expands the maxilla to correct posterior crossbite.

Materials and Methods

The study consisted of 29 subjects, ranging in age from three to seven years, all of whom possessed maxillary arch constriction as demonstrated by posterior crossbite. Ten of these subjects exhibited a cleft palate while the other 19 had an absence of this birth defect.

Palatal expansion was performed with a fixed, rapid palatal expander¹⁰ which was activated 0.5 mm per day (Figure 1). The time necessary to correct and slightly overexpand the posterior segments ranged from seven to 20 days. After expansion, a fixed transpalatal wire with bilateral anterior wire extensions was used as a retainer for a minimum of 60 days.

Prior to active therapy, and following the retention period, diagnostic casts of the teeth were obtained. From these models pre- and post-expansion arch perimeters and pre- and post-expansion arch widths were obtained. Arch perimeter was defined as the length of a flexible wire needed to form a curve from the distal surface of the primary second molars while bisecting contact points of the primary first molars and canines, and smoothly fitting on the incisal edges of the anterior teeth (Figure 2). Arch width was defined as the transverse diameter of the palate measured between the most lingual points on the free gingival margin of the right and left primary canines (intercanine width), and as the most lingual points on the gingival margin of the right and left primary second molars (intermolar width). The free gingival margin was

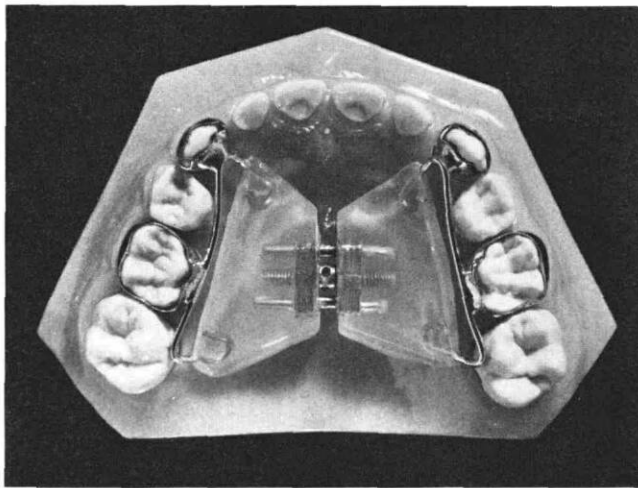


Figure 1. Fixed palatal appliance used for correction of posterior crossbite in the sample group.

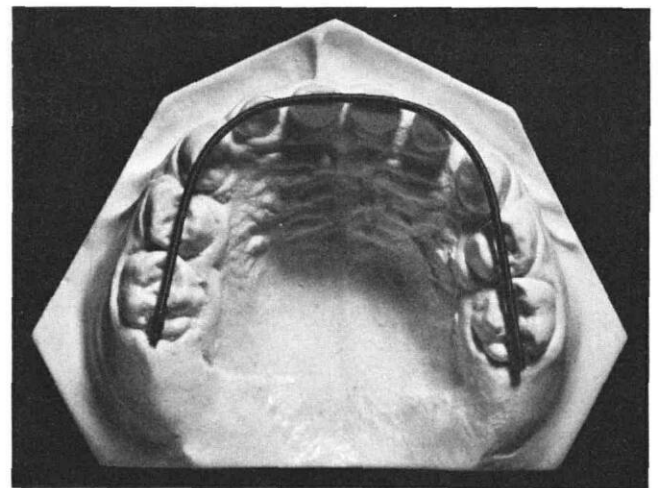


Figure 2. Diagnostic cast and flexible wire used to measure arch perimeter.

chosen as a landmark rather than the cusp tip, in order to reduce the effect on width measurements due to tooth tipping.

All measurements were made with a sliding vernier caliper with sharpened points. Two sample T-tests were used to determine significance of the treatment effect. Linear correlations with scatter diagrams were used to analyze intraindividual increase in arch width versus change in arch circumference.

Results

Palatal expansion produced measurable increases in both arch widths and arch perimeter for all the study subjects. The greatest increase in arch width was recorded in one patient with a cleft palate who had a 9 mm change in the intermolar area. The smallest change in arch width was noted on two patients with cleft palates in which only 1 mm change was measured in the canine region. The mean change in arch width noted in the patients without cleft palate was 3.8 mm ($p < .01$) as measured in the canine region, and 4.2 mm ($p < .01$) in the molar region (Table 1). For the children with cleft palate, the mean increase was similar with 3.9 mm intercanine width increase ($p < .05$) and 4.8 mm ($p < .05$) intermolar width increase (Table 2). A higher standard deviation of change of width dimension in the patients with cleft palates, however, was suggestive of more treatment variability among this group.

Arch perimeter increases were of the same magnitude as those increases noted for change of arch width. Yet, intraindividual correlations (r) between change in transverse palatal dimension versus change in arch circumference were more variable. The highest correlations ($r = .53$; $p < .01$) between change in

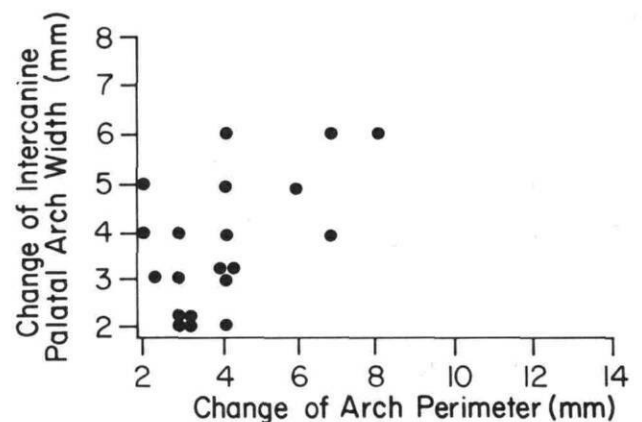


Figure 3. Scatter diagram correlating change of palatal arch width versus change of arch perimeter. Nineteen children without cleft palates, ages 3-7, underwent rapid palatal expansion to correct posterior crossbites.

arch width and arch perimeter was noted when comparing intercanine width to arch circumference for the patients without cleft palate (Figure 3). However, correlation of intermolar widths to arch perimeter was a low $r = .25$ (N.S.). In the subjects with cleft palate, both the change in intercanine width versus the change in arch perimeter, and the change in intermolar width versus the change in arch perimeter had statistically nonsignificant correlations of $r = .35$ and $r = .46$, respectively.

Table 1. Change of intercanine and intermolar transverse palatal diameter and arch perimeter on 19 children without cleft palate, age range 3-7, who underwent rapid palatal expansion.

	<i>Mean Intercanine Arch Width (mm ± S.D.)</i>	<i>Mean Intermolar Arch Width (mm ± S.D.)</i>	<i>Mean Arch Perimeter (mm ± S.D.)</i>
Before Treatment (Tx)	26.3 ± 3.0	33.1 ± 2.8	73.5 ± 3.3
After Tx	30.1 ± 3.3	37.3 ± 3.2	77.5 ± 3.2
Difference due to Tx	3.8 ± 1.4	4.2 ± 1.5	4.1 ± 1.7
p*	< .01	< .01	< .01

* T-test for statistical significance

Table 2. Changes of intercanine and intermolar transverse palatal diameter and arch perimeter on 10 children with cleft palate, age range 4-5, who underwent rapid palatal expansion.

	<i>Mean Intercanine Arch Width (mm ± S.D.)</i>	<i>Mean Intermolar Arch Width (mm ± S.D.)</i>	<i>Mean Arch Perimeter (mm ± S.D.)</i>
Before Treatment (Tx)	24.4 ± 3.7	34.5 ± 1.1	74.6 ± 3.7
After Tx	28.3 ± 2.9	39.3 ± 2.9	78.6 ± 4.8
Difference due to Tx	3.9 ± 2.3	4.8 ± 2.1	4.0 ± 1.9
p*	< .05	< .05	< .05

* T-test for statistical significance

Discussion

During rapid expansion of the midpalatal suture, the maxillary halves arc laterally with the fulcrum located close to the maxillofrontal suture. When viewed from a frontal plane, there is a pyramidal opening of the maxilla, the base located in the midpalatal area, and the apex extending in a superior direction.¹¹ With these changes an increase in arch perimeter should occur.

The subjects of this study, patients with constricted maxilla, were successfully treated with a rapid palatal expansion device for correction of posterior crossbite. All the subjects demonstrated an increase in arch perimeter. This increase in arch perimeter might be as important for proper tooth alignment in these patients as the primary goal of the treatment, crossbite correction. The magnitude of arch perimeter change found in this study, a mean of 4 mm, could improve the potential for the normal eruption of permanent teeth in these patients with constricted maxilla.

Using mean values, the ratio of change of arch width at the canine region and at the molar region is nearly equal to the change in arch perimeter. Yet, on an individual basis, there was a variable arch perime-

ter response to expansion, and only the change in intercanine width in the patients without cleft palate correlated to the change in arch perimeter. Several factors may account for the variable arch perimeter response. Possibly, differences in bony morphology could vary the space gain due to expansion. Differences in perioral musculature might also alter the arch perimeter after expansion. Hence, palatal expansion will improve a predicted arch length to tooth size discrepancy; yet, the magnitude of the increase in arch perimeter on an individual basis may not be accurately predicted before treatment.

This variability of change of arch perimeter due to rapid expansion was more evident in the patients with cleft palate. Tightness of oral muscular and soft tissues subsequent to surgical repair in these patients may have a greater impact on the position of teeth and subsequent arch perimeter.

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