A modified palatal arch for treatment of unilateral functional cross-bite in the primary dentition

Lars Granath and Sven-Olof Petersson
Department of Pedodontics, Lund University, School of Dentistry, Malmö, Sweden

SUMMARY A modified palatal arch, based on the classical principle of the safety pin and aimed at bilateral expansion in cases with a unilateral functional cross-bite, is described. It is illustrated with case reports.

Introduction
Unilateral functional cross-bite in the primary dentition, involving a lateral displacement of the mandible on closing, may be treated either by grinding (occlusal adjustment), or with a removable plate, or a palatal arch, depending on whether the cross-bite is of a dentoalveolar or skeletal nature. Disregarding differential diagnosis, the success rate after grinding is low (Thilander et al., 1984). To achieve a >85 per cent success rate, Lindner (1989) found that the maxillary-mandibular arch width difference at the canines has to be at least 3.3 mm. Grinding, which in principle is indicated only in the dentoalveolar case, should be based on well-defined stomatognathic premises (Granath, 1978). The skeletal case needs active bilateral transverse expansion.

The removable plate has some advantages over the palatal arch. It exerts a direct effect on both teeth and the alveolar process during the initial phase of treatment and facilitates cleaning procedures. The disadvantages, however, preponderate. The low height of the clinical crown of primary molars makes retention difficult and effective treatment presupposes good cooperation from the patient. Furthermore, movement of teeth by means of a palatal arch seems to have a remodelling effect also on the alveolar bone, since later erupting permanent first molars in the majority of cases have a normal transverse relation, as shown in a study of preschool children with unilateral functional cross-bite (Schröder and Schröder, 1984). A slight maxillary expansion, measured as increased midpalatal suture width 12 weeks after a 4-week active treatment with a modified quadhelix appliance and a subsequent 4-week retention period, has been shown by Lindner et al. (1986) on similar material. In the mixed dentition, Hermanson et al. (1985) found the success rate with a palatal arch (quadhelix) to be about the same as with removable plates, but the mean cost was 40 per cent higher in the plate group. The palatal arch is, therefore, the treatment of choice for skeletal cross-bite, certainly also for the dentoalveolar type since grinding, although a cost-effective and rational treatment on correct indications, requires a psychologically stable patient.

Interceptive orthodontics should be co-ordinated with development of the occlusion. At the age of about 5 years, a second period of transverse growth of the jaws commences, which is related to eruption movements of the incisor germs. This can be measured as a continuously increasing distance between the primary canines until between 9 (girls, lower jaw) and 15 years (boys, upper jaw) (Moorrees, 1959). The age of 5 years is also considered to be a psychologically well balanced period in the child's growth and development (Gesell and Ilg, 1946). Finally, much will be gained if the relation between the jaws can be normalized before eruption of the 6-year molars.

Since occlusal interference between primary canines is the main reason for the occurrence of a functional cross-bite, the primary task must be to align the inclined upper canine and increase the inter-canine distance. In principle, the classical palatal arch with an anteriorly open Coffin loop facilitated the achievement of these aims, but in practice the arch was sometimes difficult to master at activation because of three-dimensional effects. The introduction of the quadhelix or the W-arch appliance, which basic-
ally works as a quadhelix without loops, over-
came the technical difficulties. The drawbacks
of these appliances are first that the force is
exerted on the canines by free ends and, sec-
ondly, that the posterior parts of the arch, in
particular the posterior loops of the quadhelix,
may make irritating impressions in the palatal
mucosa. The disadvantage of the free ends is
due to their being soldered to the molar bands
or attached by means of brackets, which means
that teeth between anchoring molars and can-
ines have to be moved in order to move the
canines, and that the appropriate force cannot
be predetermined. Sometimes, the appliance has
to be reactivated and recemented if the arch is
soldered to the bands, which extends the time
in the chair.

These circumstances prompted efforts to
modify the classical palatal arch so that the
main effect is exerted on the primary canines
and gives rise to rapid treatment with predeter-
mined forces, making reactivation unnecessary.
This paper presents the results of the first five
cases treated according to such principles.

Subjects and methods

Subjects

The subjects comprised three girls and two boys
aged 5.3–7.3 years at the start of the treatment.
All of them presented a unilateral functional
cross-bite. One girl had 6-year molars erupted.
Measurements of changes in transverse width
were taken on casts by means of a calliper
(INOX, Seitz & Haag Zürcher Modell,
Maillefer, Ballaigues, Switzerland) in the canine
region on the top of the alveolar crest distally
to the teeth and in the molar region in central
central occlusal fissures, which were all sound.

The appliance

The construction is based on the classical prin-
ciple of the safety pin. An appliance is repro-
duced in Fig. 1 in the passive and activated
states. The distance between the vertical
branches at the opening corresponds to the
required increase in the distance between the
upper primary canines. This increase is esti-
mated by subtracting the transverse distance
between the distal prominences of the lower
primary canines from that of the upper canines.
According to Sillman (1964), under normal
conditions this difference amounts to about

6 mm. The estimated need is then 6 mm minus
the measured difference. It is advisable to add
1 mm in order to compensate for measuring
errors and a slight unintentional opening
between the branches after cementation.

The diameter of the loop is about 3 mm. The
length of the branches determines the force
exerted on the primary canines. If the diameter
of the stainless steel elastic wire is 0.7 mm, a
ratio of about 0.3 between the opening and the
length of the branches is well tolerated by the
patients, e.g. opening 3 mm/length 11 mm or
opening 4 mm/length 13 mm. The wire is bent
90° off the passive branches, which are adapted
to the vault of the palate. Thereafter, the
branches are fixed tightly together by means of
a soft 0.2 mm stainless steel ligature; the wire is
contoured to contact the lingual prominences
of the primary canines and first molars, and
soldered to orthodontic bands on the second
molars. Finally, the bends close to the canines
are opened so that the distal ends of the passive
palatal arch expand over half of the buccolingual width of the second molars.

The appliance is positioned in the mouth and the soft ligature removed, whereupon the appliance acts on both canines and molars. The upper parts of the branches should be as close together as possible (Fig. 2a). Sometimes there happens to be a small opening initially, as in Fig. 3a, which is why it is important to add an extra millimetre to the estimated need of transverse expansion so the appliance does not have to be reactivated and recemented. It is advisable to ligate the branches again before cementation as this makes it easier to position the palatal arch correctly.

If the 6-year molars have erupted, as in Fig. 4a, the appliance is modified so that the wire extends to embrace the palatal surface and the distopalatal corner of the permanent molars, the reason being that their clinical crowns are usually too short to carry bands without injuring the periodontal tissues.

Course of treatment and follow-up

The patient should be seen after about 2 weeks in order to check the position of the appliance and the condition of the soft tissues. Correction of the lateral shift is likely to have occurred, with a normalized occlusion. However, it seems that about a month is needed for the full effect of the activation. A further 2 months of retention is advocated, but in the event of an early correction and stable occlusion, the appliance might be removed after a retention period of 1 month.

Results

The results are presented in Table 1 and Figs 2–5. Treatment was successful in four of the five cases. The remaining case (Fig. 5) responded as expected initially, but showed a relapse some time after the appliance had been removed. Later, it was discovered that the appliance had been constructed for an expansion of about 3 mm instead of 5 mm. All cross-bites were corrected within 15 days and stable occlusion was obtained after 26–62 days in the four successfully treated cases.

Table 2 shows the increase in transverse width in different regions from the start of the treatment until the end of the follow-up period. The distance between the primary second molars increased by 1.9 to 3.8 mm and between the canines by 1.9 to 3.3 mm. In four cases the achieved increase was from 0.1 to 2.7 mm less

![Figure 2](https://academic.oup.com/ejo/article-abstract/16/1/35/559691/06-March-2019)

Figure 2  Case no. 5. Modified palatal arch immediately (a) after cementation, with optimal position of the vertical branches and (b) after completed expansion. (c–e) Models before treatment and (f–h) at the end of the follow-up period.
than the estimated need. In one case the achieved increase exceeded the need by 0.8 mm.

Discussion

In this pilot study, the proposed modified palatal arch for treatment of unilateral cross-bites in the primary dentition proved to be efficient both biomechanically and with regard to treatment time. Drawing such a conclusion from only five cases may seem venturesome, particularly since case no. 2 showed a relapse: the immediate effect was promising, but a stable occlusion could not be obtained. The reason for the failure was probably that the width in the canine region was not increased sufficiently,
Table 1 Details of the first five consecutive cases treated with a modified palatal arch for unilateral functional cross-bite in the primary dentition.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age at start of treatment (years)</th>
<th>Time before correction was observed (days)</th>
<th>Time before stable occlusion was observed (days)</th>
<th>Retention period (weeks)</th>
<th>Follow-up period (months)</th>
<th>Result, pos: + neg: —</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AG girl</td>
<td>5.2</td>
<td>12</td>
<td>26</td>
<td>8</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>2. LW boy</td>
<td>5.5</td>
<td>15</td>
<td>*</td>
<td>9</td>
<td>7.5</td>
<td>—</td>
</tr>
<tr>
<td>3. JA boy</td>
<td>7.1</td>
<td>15</td>
<td>29</td>
<td>7</td>
<td>8.5</td>
<td>+</td>
</tr>
<tr>
<td>4. LW girl</td>
<td>7.3</td>
<td>15</td>
<td>62</td>
<td>6</td>
<td>3.5</td>
<td>+</td>
</tr>
<tr>
<td>5. VD girl</td>
<td>5.3</td>
<td>14</td>
<td>29</td>
<td>4</td>
<td>5</td>
<td>+</td>
</tr>
</tbody>
</table>

*Stable occlusion not obtained.

Figure 5 Case no. 2. (a-c) Models of unsuccessful case before treatment, (d-f) after completed expansion, and (g-i) at the end of the follow-up period.

as indicated by the partially persistent midline deviation demonstrated in Fig. 5. This also limited the possibility of spontaneous correction of the post-normal occlusion. A contributory factor may have been that the inter-canine width in the lower jaw had increased by 2.7 mm at the end of the follow-up period, whereas the change in the other four cases varied between −1.0 and 1.0 mm.

Some other data require comment. In case no. 3, the achieved expansion in the canine region was 1 mm less than the estimated need. This difference is clearly explained by the fact that about 1 mm of the expansion capacity was lost after the palatal arch had been cemented. The reason for the longer period for observing stable occlusion in case no. 4 compared to cases 1, 3, and 5 was that the girl demolished the palatal arch on two occasions in connection with eating sticky sweets.

No attention was paid to differential diagnosis of the cross-bites. Subjectively, a con-
Table 2 Increased transverse width in millimetres in different upper jaw regions in five cases treated with a modified palatal arch for unilateral functional cross-bite in the primary dentition, from the start of the treatment until the end of the follow-up period, related to the estimated need in the canine region; for further information, see Table 1.

<table>
<thead>
<tr>
<th>Case</th>
<th>16–26</th>
<th>55–65</th>
<th>53–63</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Achieved increase</td>
<td>Estimated need</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3.5</td>
<td>1.9</td>
<td>2.1</td>
</tr>
<tr>
<td>2</td>
<td>3.3</td>
<td>2.1</td>
<td>4.8</td>
</tr>
<tr>
<td>3</td>
<td>1.9</td>
<td>3.1</td>
<td>4.2</td>
</tr>
<tr>
<td>4</td>
<td>3.2</td>
<td>3.8</td>
<td>2.5</td>
</tr>
<tr>
<td>5</td>
<td>1.8</td>
<td>1.9</td>
<td>2.0</td>
</tr>
</tbody>
</table>

The promising results of the present study should encourage further tests with the modified palatal arch, which has served as an efficient instrument for rapid and safe correction of unilateral functional cross-bite in the primary dentition. It should, however, be borne in mind that favourable results require cautious measurements to determine the need of expansion, as well as a high technical standard of laboratory work.

Address for correspondence
Professor Lars Granath
School of Dentistry
S-214 21 Malmö
Sweden

References