COMPARISON OF BONE-BORNE AND TOOTH TISSUE-BORNE ANCHORAGE DURING THE MAXILLARY CANINE RETRACTION IN GROWING PATIENTS: A RANDOMISED CLINICAL TRIAL

Gabriella Borsos¹, Rodica Jianu², Andras Vegh¹

INTRODUCTION

The use of the titanium implants inserted in the midpalatal area to increase anchorage is more than a decade old technique.¹ ² But, somehow during this period, it was scientifically not proven that it provides better anchorage or it reduces the orthodontic treatment time, even if this was shown by several case reports.³ ⁵

It was proven that the mid-sagittal area of the palate lends sufficient bony support for implantation...
of short implants.\textsuperscript{57} However, the use of a surgically template was suggested in order to aid in the optimal placement of the implant.\textsuperscript{6,9}

The purpose of this ongoing randomized clinical trial (RCT) was to compare the palatal implant supported bone-borne anchorage (BBA) with a conventional intra-oral tooth-borne anchorage (TBA) in adolescent patients in extraction cases requiring maximum distal anchorage. Generally, the undesirable side effects observed in canine retraction involve the risk of anchorage loss. In this paper, the authors compare these two anchorage methods during the upper canine retraction, first of all with respect to the treatment time and the anchorage loss.

**SUBJECTS AND METHODS**

This RCT was approved by the Regional Ethical Research Committee of the Semmelweis University, Budapest (Approval No: 236/2000) and an informed consent was obtained from the parents or guardians of all patients, after they have been informed about the experimental protocols.

Eighteen patients (ten males and eight females, mean age 14 years; range 12 years 6 months to 17 years 5 months) in the Orthodontic Department of the Heim Pal Children's Hospital of Budapest were selected. The exclusion criteria were: two upper first premolar extraction therapy of the dentoalveolar malocclusion, maximum posterior anchorage requirement in the maxillary arch, post pubertal growth spurt and sufficient palatal bone morphology because of the planned implantation. The allocation was carried out by using randomised blocks of size six, so that equal sample sizes could be achieved.

**BBA group**

The bone-borne anchorage (BBA) group consisted of nine patients; three males, mean age 13.3 years (12.5 to 14.0 years) and six females mean age 14.8 (12.92 to 17.42 years). Also in this group the standard Alexander bracket-system was used. For maximal anchorage, the accepted conventional intraoral desmodontal anchorage was provided by a 0.017 x 0.025 inch heat-treated stainless steel ‘utility’ arch combined with a Goshgarian type of TPA. (Fig. 2)

For the canine retraction, the same mechanism was used here as described for BBA group. In one patient there was no need of orthodontic canine retraction on one side, so seventeen canines were included into the measurements.

**TBA group**

The tooth tissue-borne anchorage (TBA) group consisted of nine patients; three males, mean age 13.9 years (12.75 to 15.08 years) and two females mean age 13.25 (12.58 to 13.92 years). In all these patients, osseointegrated midpalatal implants (Orthosystem®, Straumann AG, Waldenburg, Switzerland) were used, following the surgical protocol of the Institute Straumann. After the suggested three months healing period, impressions were taken using a conventional intraoral desmodontal anchorage was provided by a 0.017 x 0.025 inch heat-treated stainless steel ‘utility’ arch combined with a Goshgarian type of TPA. (Fig. 2)

For the canine retraction, the same mechanism was used here as described for BBA group. In one patient there was no need of orthodontic canine retraction on one side, so seventeen canines were included into the measurements.

**Assessed measurements**

The mesiodistal widths of the extracted first premolars were registered on the dental casts, using a digital gauge.

The duration of the canine retraction in both groups was determined, the start being defined as (T1), and the finish as (T2). The orthodontic check-up intervals were 3-4 weeks, so the measurements were rounded off a half month.

At (T1) and (T2) the upper 6-PTV distances were noted on the lateral cephalograms, to measure the mesial movement of the upper first molars during this period. We used a computerized cephalometric Ricketts analysis by FR-WIN® (Computer Konkret AG, Falkenstein, Germany).

A cephalometric analysis of the maxillary and the mandibular dimensions related to the cranial base were carried out. We used the points of the Condylus, Nasion, A-point and the Pogonion. Since the Nasion grows forward at the same rate as A point on the maxilla, the ratio Cond-A / Cond–N does not change appreciably with normal growth.
STATISTICAL ANALYSIS

In order to minimise methodological errors, the cephalometric measurements were repeated twice for each lateral cephalogram and the mean of the two measurements used. For metrical data, descriptive statistics show the arithmetic mean and, as a measure of variability, the standard deviation. A t-test for unrelated samples with a significance level of 0.05 (95%) was used for an exploratory comparison of the results between the two study groups.

RESULTS

There was no difference in the size of the premolars measured in the two groups. In the BBA group it was 7.32 (± 0.33) mm and in the TBA group 7.23 (± 0.59) mm. Reynolds (1968) reported an average width of 7.2 mm.\(^{11}\)

As shown in the Table 1, the duration of the extraction’s gap closure by canine retraction was 5.63 + 1.45 months for the ‘BBA’ group and 4.76 + 1.78 months for the ‘TBA’ group. These values were not significantly different (\(P = 0.140\)).

A statistically non-significant difference (\(P = 0.241\)) was found in the average mesial movement of the upper first molars during the canine retraction period between the two groups. The 6-PTV distance increased in the ‘BBA’ group by 0.68 + 0.59 mm while in the ‘TBA’ group by 1.51 + 1.88 mm.

In Table 2, the maxillary and the mandibular dimensions related to the dimensions of the cranial base are summarized. The Condylus–A-point to Condylus – Nasion proportion was 0.9684 (± 0.026) at T1 and 0.9623 (± 0.030) at T2 in the BBA group and 0.9733 (± 0.025) at T1 and 0.9731 (± 0.027) at T2 in the TBA group; this ratio was used to determine the maxillary growth. The Condylus – Pogonion to Condylus – Nasion proportion was 1.2676 (± 0.074) at T1 and 1.3123 (± 0.059) at T2 in the BBA group and 1.2545 (± 0.082) at T1 and 1.2544 (± 0.094) at T2 in the TBA group. The Condylus-Pogonion to Condylus-Nasion proportion was used to determine the mandibular growth.

DISCUSSION

The purpose of this study was to compare the palatal implant supported bone-borne anchorage (BBA) with a conventional intra-oral tooth-borne anchorage (TBA) in adolescent patients during the upper canine retraction, in extraction cases requiring maximum distal anchorage. It is known that during maxillary growth the first permanent molars undergo a downward and mesial drift along the facial axis, so the 6-PTV distance increases on average 1 mm per year with the skeletofacial growth in adolescents. The measurements in the ‘BBA’ group seem to agree with this observation: an average 0.6 mm increase in the 6-PTV distance was found over the 5.6 months. Normal growth is also presumable in the ‘TBA’ group, so during the measured 4.97 months period the average increase in the 6-PTV distance should be approx. 0.5 mm. Therefore the suspicion of a 1 mm anchorage loss (1.51 mm − 0.5 mm) is to be supposed in the ‘TBA’ group. This amount of the anchorage loss could be the reason of the shorter canine retraction time in the ‘TBA’ group; the ‘reciprocal’ extraction gap closure needs less time than one from only one side.

<table>
<thead>
<tr>
<th>Maxillary canine retraction</th>
<th>BBA (n = 9)</th>
<th>TBA (n = 9)</th>
<th>Significance (Student test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>ΔT (months)</td>
<td>5.63</td>
<td>1.45</td>
<td>4.76</td>
</tr>
<tr>
<td>Δ6-PTV (mm)</td>
<td>0.68</td>
<td>0.59</td>
<td>1.51</td>
</tr>
</tbody>
</table>

| T1                          | Cond-A / Cond-N | 0.9684 | 0.026 | 0.9733 | 0.025 |
| T2                          | Cond-A / Cond-N | 0.9623 | 0.030 | 0.9731 | 0.027 |
| T1                          | Cond-Pog / Cond-N | 1.2676 | 0.074 | 1.2545 | 0.082 |
| T2                          | Cond-Pog / Cond-N | 1.3123 | 0.059 | 1.2544 | 0.094 |

Table 1. Duration of extractions gap closure (canine retractions) and the meanwhile mesialisation of the upper first molars.

Table 2. Maxillary and mandibular dimensions related to the dimensions of the cranial base.
CONCLUSION

The results proved that the maxillary growth was not influenced by using a palatal implant in growing patients, so under strict indication the palatal implant can be successfully applied also for the treatment of adolescent patients. The increase of the upper first molar-Ptv distance was more than 2 times greater in the conventional tooth tissue-borne anchorage group, than in the bone-borne anchorage group, so an anchorage loss is to be supposed during the observed canine retraction period, which was nearly the same 5 months in both groups. This implies that the reduction of the canine retraction time (by conventional mechanics) is not an advantage of using the palatal implant anchorage.

REFERENCES
