Periodontal health of palatally displaced canines treated with open or closed surgical technique: A multicenter, randomized controlled trial

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Introduction: The aim of this study was to investigate differences in the periodontal outcomes of palatally displaced canines (PDC) exposed with either an open or a closed surgical technique. Methods: A multicenter, randomized controlled trial was undertaken in 3 hospitals in the United Kingdom, involving 2 parallel groups. Patients with unilateral PDC were randomly allocated to receive either an open or a closed surgical exposure. Periodontal health was assessed 3 months after removal of fixed appliances. Parameters measured included clinical attachment levels, recession, alveolar bone levels, and clinical crown height. Results: Data from 62 participants (closed, 29; open, 33) were analyzed. There was no difference between PDC exposed with an open vs a closed surgical technique (mean difference, 0.1 mm; 95% confidence interval [CI], –0.2–0.5). There was, however, a statistical difference in mean attachment loss between the operated and unoperated (contralateral) canines (mean difference, 0.5 mm; 96% CI, 0.4–0.7; \( P < 0.001 \)). Twenty of the 62 subjects had some recession on the palatal aspect of the operated canine, whereas only 4 subjects had some visible root surface on the palatal aspect on the unoperated side (\( P = 0.001 \)). Conclusions: There is a periodontal impact when a unilateral PDC is exposed and aligned. This impact is small and unlikely to have clinical relevance in the short term; however, the long-term significance is unknown. When the open and closed techniques were compared, no difference in periodontal health was found. (Am J Orthod Dentofacial Orthop 2013;144:176-84)
The literature contains less criticism of the closed technique in terms of periodontal impact, although some authors have still reported periodontal concerns when canines aligned with a closed technique are compared with unoperated canines. A recent Cochrane systematic review found no robust evidence to support one surgical technique over the other.

The principal purpose of this trial was to explore any differences in periodontal health between canines exposed with an open vs a closed surgical technique. Differences in periodontal health between canines that had an operation (those that were palatally displaced and had been surgically exposed) vs the contralateral canines that did not have an operation (acting as controls) were also examined.

Two null hypotheses were tested: (1) there is no difference in periodontal health of PDC treated with either an open or a closed surgical exposure, and (2) there is no difference in the periodontal health between operated and unoperated canines.

MATERIAL AND METHODS

This was a multicenter, randomized controlled clinical trial involving 2 parallel groups of patients with unilateral PDC, randomized to 1 of 2 surgical exposure techniques and treated in a hospital setting. Ethical approval was obtained from the South Sheffield Ethics Committee (SS02/072) and the North and South Derbyshire local ethics committees (NDLREC ref: 857) in the United Kingdom. Details of our methodology, including the inclusion and exclusion criteria, have been described elsewhere.

Once informed consent was obtained from the participants, they were randomly allocated to 1 of 2 interventions. The randomization was undertaken using computer-generated random numbers to ensure that equal numbers were allocated to each intervention; allocation concealment was done with consecutively numbered, sealed, opaque envelopes as outlined previously.

The 2 surgical techniques are summarized briefly below.

For the open surgical exposure, after exposure of the PDC and excision of the palatal mucosa, a surgical pack was sutured in place. After 10 days, the patient was reviewed and the pack removed.

For the closed surgical exposure, after uncovering of the PDC, an eyelet attachment with a gold chain was bonded to the palatal or buccal surface of the ectopic canine (whichever was the most accessible).

Only patients with unilaterally displaced canines were included, so that the contralateral canine could be used as the control.

A fixed appliance was placed in the maxillary arch either before or shortly after surgery. For both groups, orthodontic traction was applied using a twin-wire technique or an elastic chain after an 0.018-in stainless steel archwire was in place and there was sufficient space to align the canine. The fundamental difference in orthodontic management was that the canine exposed with the open technique was moved into alignment above the mucosa (Fig 1), and the canine exposed with the closed procedure was moved beneath the mucosa (Fig 2).

Periodontal measurements were recorded at baseline to eliminate the possibility of previous pathology and at 3 months after removal of the fixed appliances. The periodontal outcomes were as follows.

The primary outcome of the trial was the difference in the clinical periodontal attachment level between the PDC treated with the open surgical technique and the PDC treated with the closed technique at 3 months after removal of the orthodontic appliance.

The clinical periodontal attachment level was determined from the 6-point probing depths on the mesial, midline, and distal aspects of the buccal and palatal tooth surfaces, and gingival recession was measured clinically from the visible cementoenamel junction to the gingival margin. The clinical attachment level was calculated as follows: clinical attachment level = periodontal probing depth + gingival recession.

All measurements were made using a Williams Sensor periodontal probe (Hu-Friedy, Chicago, Ill) to the nearest millimeter. This probe is pressure sensitive, and the force is limited to 20 g. The examining clinician was instructed to insert the probe parallel to the long axis of the canine and gently “walk” it around each surface of the tooth.

The secondary outcomes were palatal gingival recession, crown height, and radiographic alveolar bone levels.

Palatal gingival recession was recorded with the following index: (1) cementoenamel junction not visible; (2) cementoenamel junction and less than 2 mm of root surface visible; and (3) cementoenamel junction and 2 mm or more of root surface visible.

The reason for this categorization was the difficulty of clinically measuring recession on the midpalatal aspect of the canine with precision.

Crown height measurements were recorded with calipers to the nearest 0.5 mm from the 3-month postde-bond study models.

Alveolar bone levels were measured from periapical radiographs taken between 3 and 12 months posttreatment using computerized image analysis (Fig 3). Although there was some variation as to exactly when the radiographs were taken, the images of the operated and the unoperated sides were obtained at the same time and compared. Film holders (Rinn XCP; Dentsply, Surrey, United Kingdom) and the long-cone technique were used for standardization.
The radiographs were analyzed by quantifying the bone level at the interproximal area between the canine and lateral incisor. This area was chosen because it was the clearest and most consistently imaged site. If not already in digital format, the images were captured with a digital camera (DCS 760; Eastman Kodak, Rochester, NY) suspended above a light box at a standardized distance with standardized shutter speed and aperture settings. Once in digital format, the images were analyzed with computer software (version 7.0, Image-Pro Plus; Media Cybernetics, Rockville, Md) using a technique described previously.14

One operator (S.J.B.) made all the measurements on the masked images and repeated them 2 weeks later. The repeatability of the methods was assessed using a paired t test to detect systematic errors and an intra-class correlation coefficient (ICC) to determine random errors. Random errors were low (ICC, 0.896). A potential systematic difference between the first and second readings was detected ($P = 0.034$); however, the mean difference between the readings was small (0.09 mm) and considered not clinically significant.

Three clinicians (N.A.P., D.T., A.-M.S.) undertook the direct clinical measurements for the trial. Before their recruitment, training and calibration was undertaken with a specialist restorative dentist (R.S.M.). Percentage agreements ranged from 81% to 88%, with kappa scores of 0.66 to 0.83; these were considered acceptable.

The examiners were masked as to the patient’s group allocation for the clinical examinations. The patient details were removed from all study models and radiographs, which were labeled with only the participant’s randomization number.

An a priori sample size calculation with data from a previous study suggested that for the primary outcome measure of clinical attachment level, a sample size of 60 was required to detect a significant difference between the open and closed exposure groups of 0.5 mm (SD, 0.61 mm; 90% power; 5% significance level; 2-tailed).10 The sample size was increased to 80 (40 open, 40 closed) to allow for a 25% drop-out rate.

**Statistical analysis**

Data analysis was divided into 2 sections. The first section compared the 2 surgical techniques; the second section investigated the impact of exposing and aligning a PDC (comparing operated with unoperated canines).

Comparing open versus closed surgical exposure. The difference between the clinical periodontal attachment levels of the operated and unoperated canines in each participant was calculated. Since there was little evidence of any serious deviation from the assumption of normality, independent t tests were used to compare the within-subject mean 6-point clinical periodontal attachment level differences (operated clinical periodontal

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**Fig 1.** Example of a participant who received an open surgical exposure where the canine was brought into alignment above the mucosa.

**Fig 2.** Example of a participant who received a closed surgical exposure where the canine was brought into alignment beneath the mucosa.

**Fig 3.** Intraoral periapical radiographs taken of both the operated and contralateral unoperated sides in a participant at 3 months after removal of the fixed appliance (randomization number 4).
attachment level minus unoperated clinical periodontal attachment level) between the open and closed groups. To prevent the dilution effect of taking the mean of 6 recordings and also to investigate which areas were most severely affected, the clinical periodontal attachment level at each site was also recorded. The independent samples $t$ test was also used to analyze the data for each site.

For midpalatal and midbuccal recession, the chi-square test for trend was used.

Crown lengths were analyzed by comparing the difference in height between the operated and unoperated canines in the open and closed groups. This relative value assumed that the height of the unoperated canine is the “true” measurement and relates the height of the operated canine to it; this means that variations in actual tooth size will not influence the results. The height of the operated canine was subtracted from the height of the unoperated canine for each participant. The difference was compared using independent samples $t$ tests.

Differences in alveolar bone levels were analyzed by again subtracting the unoperated values from the operated values and comparing the difference between the open and closed groups. Independent samples $t$ tests were used to compare the differences.

**Comparing operated versus unoperated canines.** Clinical attachment level has been reported as a mean of 6-point probing attachment loss. Because the data were normally distributed, paired $t$ tests were used to compare the differences between the 2 sides. Related Wilcoxon signed rank tests were used to calculate differences between the operated and unoperated canines at each site, since the data were skewed.

The data for palatal recession were categorical, and the McNemar test was used; however, for the midbuccal site, recession was measured to the nearest millimeter, although the maximum value obtained for any subject was only 2 mm. As a consequence, a related Wilcoxon signed rank test was used.

Both crown height and mesial alveolar bone levels were analyzed using a paired samples $t$ test.

**RESULTS**

Recruitment commenced at the beginning of August 2002 and finished at the end of January 2007. Figure 4 shows the flow of patients through the trial. Eighty-one participants were recruited; however, 10 were excluded from all analyses as outlined in our previous article. Nine participants were excluded from the periodontal analysis: 7 failed to attend follow-up visits (open, 2; closed, 5) and 2, both in the closed group, abandoned treatment midway through the study. Five participants received the incorrect procedure (open, 4; closed, 1); however, the intention-to-treat principle was adhered to, and they were all analyzed in their original allocated groups.

The final sample consisted of 62 participants (open, 33; closed, 29). Details of equivalence between the 2 groups are shown in Table 1.

**Comparing open versus closed surgical exposure**

The primary outcome of the trial was the mean 6-point clinical periodontal attachment level measurements. When the clinical periodontal attachment level values for the unoperated teeth were subtracted from the clinical periodontal attachment level values for the operated teeth, the mean difference between open and closed groups was just 0.1 mm (open, 0.5 mm, SD, 0.8; closed, 0.6 mm, SD, 0.6); this difference was not statistically significant (independent $t$ test, $P = 0.782$; Table II).

The mean attachment loss for 3 of 4 sites was found to be marginally greater in the closed group compared with the open group; however, the difference was not statistically significant (Table III).

In the midpalate, 8 subjects (28%) in the closed group and 12 subjects (36%) in the open group showed root visibility between 0 and 2 mm. This difference was not statistically significant (chi-square test, $P = 0.464$).

On the midbuccal aspect of the operated canine, in the closed group, 9 subjects (31%) had recession of at least 1 mm (7 subjects had recession of 1 mm, 2 had recession of 2 mm). In the open group, 8 participants (24%) showed recession of at least 1 mm (5 had 1 mm, 3 had 2 mm). No significant difference was found between the 2 groups (chi-square test, $P = 0.774$).

The available sample of 66 participants was slightly higher for the outcome measure of crown height (closed, 33; open, 33). The 4 additional patients included in this outcome did not attend their 3-month post debond recall appointment, but because their immediate debond study models were available, we decided to include them to increase the sample size. These subjects had good oral hygiene and no obvious signs of gingival inflammation or gingival hypertrophy, which, if present, could have affected crown height.

There was considerable variation in the crown lengths between participants (ranges: operated, 6-12 mm; unoperated, 7-12 mm). This necessitated the use of “difference in crown height” between the operated and unoperated canines to compare the open and closed groups (height of operated canine crown minus height of unoperated canine crown). The results are shown in Figure 5. A positive value indicates that the operated canines had slightly shorter clinical crowns than did the unoperated canines and vice versa. No statistical
significance was found between the 2 groups (mean difference, 0.2 mm; 95% CI, −0.29−0.67 mm; independent samples t test, \( P = 0.43 \)).

When the alveolar bone levels taken from the unoperated side were subtracted from the bone levels of the operated side, no significant difference was found between the open and closed groups (independent t test, \( P = 0.936 \)); however, the number of radiographs was low (\( n = 34 \): closed, 15; open, 19) because films from some participants were not available. Also, it was not always possible to see bone levels clearly for assessment.

**Comparing operated versus unoperated canines**

Differences in the mean 6-point clinical periodontal attachment levels between the operated and unoperated canines are shown in **Table II**. There was a mean of 0.5 mm more attachment loss in the operated side vs
the unoperated side; this difference was statistically significant (paired t test, \( P \leq 0.001 \)).

The differences in the clinical attachment levels between the operated and unoperated canines for each site are shown in Table IV. Midbuccal and midpalatal sites are not shown because the probing depths at these sites were mainly scored at 0 or 1 mm. The difference was statistically significant in all 4 sites. The greatest mean differences were found at the mesiobuccal and distobuccal sites of the operated canines (0.55 and 0.50 mm, respectively).

Generally, the scores for recession were low. Only the scores at the midbuccal and midpalatal aspects have been described in detail.

At the midpalatal aspect (Table V), no subject scored higher than 1, meaning that the amount of recession was less than 2 mm. On the operated side, 20 of 62 subjects showed some recession. On the unoperated side, only 4 of 62 subjects had some visible root surface on the palatal aspect. This difference in prevalence of recession between the operated and unoperated canines was statistically significant (McNemar test, \( P = 0.001 \)).

Midbuccal recession was evident in the operated canines, but the figures were again low; the highest recorded measurement was 2 mm. Mean recession values were 0.4 mm (SD, 0.6) for the operated canines and 0.2 mm (SD, 0.5) for the unoperated canines. This difference was statistically significant (related Wilcoxon signed rank test, \( P = 0.031 \)); however, the difference is unlikely to be clinically relevant.

The differences in canine crown height between the operated and unoperated sides are shown in Figure 6. Although there was no significant difference in crown height between the operated and unoperated canines (paired t test, \( P = 0.10 \)), the variation was much greater on the operated side. There were 28 patients in whom the crown height of the unoperated canine was greater than the crown height of the operated canine. Only 18 patients had a crown height of the operated canine greater than that of the unoperated canine. This suggests that the clinical crowns of operated canines are slightly shorter than those of unoperated canines. Figure 6 supports this suggestion, in that 50% of the values in the operated sample lie between 8 and 10 mm, whereas 50% of the values in the unoperated sample lie between 9 and 10 mm.

Table III. Descriptive data for the differences in clinical periodontal attachment level (mm) between the operated and contralateral unoperated canine teeth at each site for the open and closed groups

<table>
<thead>
<tr>
<th>Site</th>
<th>Operated (n = 33)</th>
<th>Unoperated (n = 29)</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
</tr>
<tr>
<td>Mesiobuccal</td>
<td>0.3 (-0.1-0.8)</td>
<td>0.8 (0.3-1.3)</td>
<td>0.5 (-0.2-1.1)</td>
</tr>
<tr>
<td>Mesiopalatal</td>
<td>0.4 (0.0-0.7)</td>
<td>0.5 (0.1-0.9)</td>
<td>0.1 (-0.4-0.6)</td>
</tr>
<tr>
<td>Distobuccal</td>
<td>0.6 (0.2-1.0)</td>
<td>0.4 (0.0-0.8)</td>
<td>-0.2 (-0.8-0.3)</td>
</tr>
<tr>
<td>Distopalatal</td>
<td>0.2 (-0.2-0.6)</td>
<td>0.6 (0.2-1.0)</td>
<td>0.4 (-0.1-0.9)</td>
</tr>
</tbody>
</table>

Differences were examined with an independent t test.

Table IV. Descriptive data for the clinical periodontal attachment level (mm) between the operated and unoperated canines at individual sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Operated canine (n = 62)</th>
<th>Unoperated canine (n = 62)</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
</tr>
<tr>
<td>Mesiobuccal</td>
<td>2.0 (1.7-2.3)</td>
<td>1.5 (1.2-1.7)</td>
<td>0.5 (0.2-0.8)</td>
</tr>
<tr>
<td>Mesiopalatal</td>
<td>1.8 (1.6-2.0)</td>
<td>1.4 (1.2-1.6)</td>
<td>0.4 (0.2-0.7)</td>
</tr>
<tr>
<td>Distobuccal</td>
<td>1.9 (1.6-2.1)</td>
<td>1.4 (1.2-1.6)</td>
<td>0.5 (0.2-0.8)</td>
</tr>
<tr>
<td>Distopalatal</td>
<td>1.6 (1.3-1.9)</td>
<td>1.2 (1.0-1.4)</td>
<td>0.4 (0.1-0.6)</td>
</tr>
</tbody>
</table>

Differences were examined with Wilcoxon signed rank tests.

Table V. Prevalence of recession on the midpalatal aspects of the operated and unoperated canines

<table>
<thead>
<tr>
<th>Site</th>
<th>Operated (n = 62)</th>
<th>Unoperated (n = 62)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No recession</td>
<td>Recession</td>
<td></td>
</tr>
<tr>
<td>Unoperated</td>
<td>38</td>
<td>20</td>
<td>58</td>
</tr>
<tr>
<td>Recession</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>20</td>
<td>62</td>
</tr>
</tbody>
</table>
For the alveolar bone levels, the mean difference between the operated and unoperated canines was 0.4 mm (operated, 0.6 mm [SD, 0.57]; unoperated, 0.2 mm [SD, 0.19]); this was statistically significant (related Wilcoxon signed rank test, \( P < 0.001 \)). Figure 7 shows that the variations in bone levels in the operated canines were far greater than those in the unoperated canines.

**DISCUSSION**

Our findings in this clinical trial indicate that there is a small periodontal cost to a maxillary PDC when it is surgical exposed and aligned; however, the periodontal health scores were similar at 3 months after removal of the fixed orthodontic appliances, whether an open or a closed surgical technique was used.

The main question we attempted to address was “does moving the canine above or below the mucosa influence clinical attachment levels?” The findings suggest that with regard to this outcome, it makes no difference which technique is used. No evidence of a difference is an interesting finding because previous authors have tended to imply that the closed technique is superior in terms of clinical attachment levels. Schmidt and Kokich thought that allowing the exposed canine to erupt autonomously before placement of an orthodontic attachment could cause less overall trauma to the periodontium and improve “cleansibility.” In our study, normal eruption of the PDC was allowed to some extent in the open group, since an orthodontic bracket was not bonded until adequate enamel was available; however, there was no significant improvement in periodontal health after autonomous eruption compared with immediate traction after closed exposure.

The only published study that directly compares the periodontal health of open vs closed surgical exposure is by Wisth et al. They found that the periodontal impact of aligning canines after open exposure was more detrimental in terms of probing depths (open mean, 2.46 mm; closed mean, 2.06 mm; \( P < 0.05 \)). However, in regard to the clinical periodontal attachment level, this only reached significance on the palatal surface (open mean, 1.85 mm [SD, 1.58]; closed mean, 1.09 mm [SD, 0.87]). Unfortunately, this study, which has been quoted on numerous occasion, has many shortcomings. It was retrospective and therefore has high risks of selection, allocation, and treatment biases. In addition, it is not clear when the periodontal assessments were undertaken or by whom, and whether they were suitably masked; this causes a high risk of assessment bias.

There is more evidence in the literature in regard to the impact on the periodontal health of surgical exposure and alignment. Becker et al assessed the periodontal health of 23 young people who had had surgical exposure of a unilateral maxillary canine and orthodontic alignment, at an average of 2.3 years after treatment. They found that the mean 6-point pocket depths were significantly greater for the operated canines (2.5 mm; SD, 0.7) compared with the unoperated canines (2.2 mm; SD, 0.5). The surgical technique, as described, appears to be more radical than those used in this study, although their findings were similar. Becker et al did not assess the clinical periodontal attachment level; therefore, it is more difficult to compare results. However, the authors of another retrospective cohort study with
children who had 1 or 2 maxillary ectopic canines at an average of 3.5 years after treatment also found significant differences in the pocket depths between the operated and unoperated sides, but again the differences were about 0.5 mm, which is similar to our results. In a systematic review, Bollen et al found that orthodontic treatment had a minimal impact on periodontal health, with 0.23 mm of increased pocket depth (95% CI, 0.15–0.30 mm), but the evidence was weak. Some of our subjects had more extensive attachment losses after treatment (maximum amounts of 3.2 mm for the operated canines and 2.3 mm for the unoperated canines), but the long-term implications for the health of these teeth are unknown.

Some studies have found that the periodontal effects of aligning an ectopic tooth are more pronounced in certain sites around the tooth. Woloshyn et al, using a closed exposure, and Hansson and Rindler, using mainly an open exposure, found deeper probing depths on the mesial aspects of the teeth. We found that the greatest mean difference in clinical periodontal attachment level was 0.5 mm on both the mesiobuccal and distobuccal aspects of the operated canine.

Another consequence of surgical exposure and orthodontic alignment was mild recession on the palatal and buccal aspects of the canine. Of the few other studies that have recorded recession, little difference between the operated and unoperated canines has been reported. In a retrospective analysis consisting of 32 patients who had surgical exposure with the closed technique, Zasciurinskiene et al found that 6 (18.8%) had gingival recession, although the mean values were small, and it was not clear at which site the recession was present, nor was the range of the recession quantified. The greatest mean value was at the palatal aspect of the canine (0.16 mm; SD, 0.22); this was not significantly different from the unoperated contralateral canines. Our clinical trial is the only study to compare recession between open and closed exposures, and no significant difference was found. Esthetic analysis of exposed canines will be reported in the future.

Clinical crown height is an outcome that has not been assessed in previous studies. Clinical experience suggests that an open exposure might lead to “bunching” of the mucosa during traction and reduced crown height. In contrast, closed exposure theoretically could lead to increased clinical crown length because of difficulty in immediately placing the bracket in the correct position. If the eyelet had been placed on the palatal aspect of the canine during surgery, the canine might erupt in a rotated position. The process of derotating the canine could result in reduced attached gingivae on the buccal aspect and increased length of the crown.

The height of the clinical crown was not significantly different between canines treated with either the open or closed surgical technique, or between the operated and unoperated teeth, although there was more variation in height of the operated canines. Considering the finding that more recession was present in operated canines, the implication is that for canines whose crown height is reduced, there must have been considerable reduction to compensate for the canines with recession. This makes clinical sense because we know that PDC are often undertorqued at the end of treatment; this might be a subject for future research.

We found statistically significant lower alveolar bone levels on the mesial aspect of the operated canine compared with the unoperated canine. These findings agree with the retrospective study of canines exposed with a closed technique by Woloshyn et al. The results contrast with canines exposed with an open technique by Schmidt and Kokich, who found only a significant difference in bone levels around the lateral incisor adjacent to the operated canine, particularly the distal aspect. Again, the differences were small (mean, 0.76 mm more bone loss), and it could be questioned whether this is clinically significant in the long term. There was no difference in alveolar bone levels for open vs closed exposure; however, the difference in our study between operated and unoperated canines was so small (0.4 mm) and the variability such that it is unlikely that even a study with a much larger sample size would detect a clinically significant difference.

A potential problem with this study was that participants were lost at several points during the trial. Fifteen patients who consented did not receive their allocated surgery for various reasons explained in another article, although 5 of them were included in the analysis under the intention-to-treat guidance. In addition, 9 participants were lost to follow-up (open, 2; closed, 7). Only 1 patient had an infection requiring systemic antibiotics after surgery. The final proportions of patients included in the analysis were 83% in the open group and 71% in the closed group, and this level of dropouts was accounted for in the sample size calculation.

Another possible limitation of the study was that several operators and assessors were involved. Participants were recruited from more than 1 center to ensure that adequate numbers were achieved. The use of multiple centers also allows for more generalizability, because the results are less likely to be due to the skill and experience of 1 operator. The impact of using several assessors to measure the outcomes should be minimal. Advice was sought from an experienced periodontist, and a calibration exercise was undertaken before recruiting participants. In addition, only patients with
a unilateral displaced canine were included in the trial. Potential inconsistencies between assessors with regard to the absolute measurements were reduced by examining the differences between the operated and the contralateral, unoperated canine measured by the same assessor in the same patient. When possible, the assessor was different from the operator to reduce the possibility of assessment bias if they had knowledge of the group allocation.

This trial was undertaken with appropriate research methods to reduce the possibility of bias; however, a null finding prompts the question as to whether there were sufficient participants to find a significant difference between the 2 techniques, if it exists. We used a clinical difference (0.5 mm), which, although measurable, might be considered too harsh by some. The sample size calculation was based on weak retrospective data, but the variation in our study was of a similar magnitude; this was probably due to the ages of the participants, in whom periodontal disease is rare. We did find a statistically significant difference between the operated and unoperated sides, but no difference between the 2 surgical techniques. Close examination of the data suggests that the differences and the variability are such that even a trial with a considerably larger sample would be unlikely to find a statistically significant difference. We are therefore reasonably confident that these null findings are generalizable to patients from other centers and populations with similar inclusion and exclusion criteria; however, this will need confirmation with further clinical trials.

CONCLUSIONS

In this randomized clinical trial, we found that exposure and alignment of PDC has a small impact on periodontal health. The magnitude of this impact is not influenced by surgical technique (in terms of open vs closed exposure) and is so small that it is unlikely to influence the prognosis of a tooth in the long term in most patients.

ACKNOWLEDGMENTS

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