Orthodontic and Periodontal Outcomes of Treated Impacted Maxillary Canines
An Appraisal of Prognostic Factors

Aldo Crescini; Michele Neri; Jacopo Buti; Tiziano Baccetti; Giovan Paolo Pini Prato

ABSTRACT
Objective: To evaluate the influence of pretreatment radiographic features (α-angle, d-distance, and s-sector) on (1) the duration of active orthodontic traction and (2) the posttreatment periodontal status (pocket depth [PD] and keratinized tissue width [KT]) of impacted maxillary canines treated by a combined surgical (flap approach) and orthodontic (direct traction to the center of the ridge) treatment.

Material and Methods: A study population of 168 patients (168 canines) was evaluated. Multiple regression analysis was used.

Results: Pretreatment radiographic variables were associated significantly with the duration of orthodontic traction. Age, sex, and site of impaction did not significantly affect the duration of traction. No significant differences in PD and KT were present at the end of surgical-orthodontic treatment with respect to any of the variables considered. The analysis of PD and KT variables after orthodontic treatment revealed a healthy periodontium.

Conclusions: α-angle, d-distance, and s-sector are valid indicators for the duration of orthodontic traction. They are not prognostic indicators of final periodontal status of orthodontically-repositioned canines.

KEY WORDS: Impacted canine; Panoramic radiographs; Prognosis; Surgical-orthodontic approach; Periodontal evaluation

INTRODUCTION
The prevalence of impaction of maxillary canines in Western populations ranges from 1% to 3.1 An impaction is diagnosed when the tooth is in an infraosseous position after the expected time of eruption, whereas tooth displacement is identified as an anomalous infraosseous position of the canine before the expected time of eruption. Interceptive treatment strategies have been proposed for the displaced canine, whereas a surgical-orthodontic approach is needed in case of impaction.

The treatment of an impacted maxillary canine is not completed merely with its orthodontic alignment. Final periodontal health is a fundamental key to evaluate the success of therapy for impacted maxillary canines. In previous publications, a combined surgical (flap) and orthodontic (direct traction towards the center of the ridge) approach has been proposed with the aim of simulating the physiological eruption pattern of the canine.

From the point of view of prognostic evaluation of canines with an anomalous infraosseous position, radiographic variables visible on panoramic radiographs have been used: the angulation and the position of the tooth, the distance from the occlusal plane, and the possible superimposition on the roots of the adjacent teeth. The radiographic signs have been correlated to the probability of spontaneous eruption of displaced canines. More recently, the same indicators have been studied as pretreatment predictors for the outcomes of interceptive therapy of palatally displaced canines.
canines by means of the extraction of the correspond-
ing deciduous canine and space maintenance at the
maxillary dental arch,³ and as predictors of overall du-
ration of orthodontic treatment to reposition the im-
 pacted canine.⁷,⁸
The purpose of the present study was to evaluate
the influence of pretreatment variables (with special
regard to the initial radiographic features) on (1) the
duration of active orthodontic traction and (2) the post-
treatment periodontal status (pocket depth [PD] and
keratinized tissue width [KTI]) of impacted maxillary ca-
nines treated by a combined surgical (flap approach)
and orthodontic (direct traction towards the center of
the alveolar ridge) technique.

MATERIALS AND METHODS

Study Population
An initial sample of 208 patients with unilateral or
bilateral impacted maxillary canines was consecutively
treated in a private practice by a single operator over a
period of 17 years. Because of the purpose of this
study, 40 patients were not considered for the analy-
sis: 24 patients with canine impactions that did not al-
low for direct traction to the center of the alveolar
ridge,⁶ and 16 patients with submucosal buccal im-
 paction.
A total of 168 patients with unilateral or bilateral infraosseous impacted maxillary canines were included
in this study and evaluated at the end of both active
orthodontic traction and overall orthodontic treatment:
One hundred twenty-five patients presented with uni-
lateral impaction of the maxillary canine and 43 pre-
sented with bilateral impaction. A random selection
was made on the 86 bilateral impacted canines in or-
der to evaluate only one canine per patient. The final
study population consisted of 168 patients (168 im-
pacted canines), 40 males and 128 females, ranging
in age from 12.8 to 52.0 years (mean age 17.2 ± 6.0
years).

Pretreatment Radiographic Variables
The position of the impacted canine was evaluated
on the panoramic radiograph by using a modified ver-
sion of the criteria proposed by Ericson and Kurol²
(Figure 1):
• α-angle: Angle measured between the long axis of
  the impacted canine and the midline.
• d-distance: Distance between the canine cusp tip
  and the occlusal plane (from the first molar to the
  incisal edge of the central incisor).
• s-sector: Sector where the cusp of the impacted ca-
nine is located: sector 1, between the midline and
  the axis of the central incisor; sector 2, between the

Figure 1. Panoramic radiographic features showing displacement of
the upper left canine: α-angle, d-distance, and s-sector.
axis of the central incisor and the axis of the lateral
incisor; or sector 3, between the axis of the lateral
incisor and the axis of the first premolar.

Surgical-Orthodontic Treatment
All of the patients underwent consecutively the
same standardized surgical-orthodontic approach.⁵,⁶
The teeth were exposed by means of a repositioned
flap. Orthodontic traction was applied to guide the im-
pacted canine directly towards the center of the alve-
olar ridge. The combined technique was performed by
the same operator (Dr Crescini) on all the patients.
The overall combined treatment was divided into
three phases.
• Phase 1: Initial orthodontic treatment aimed at cre-
ating space on the maxillary arch by means of fixed
appliance therapy.
• Phase 2: Surgical exposure and orthodontic traction
of the impacted tooth towards the center of the al-
veolar ridge.⁶ A handmade chain was connected to
the attaching device on the impacted tooth and to
the elastic for the orthodontic traction. A rectangular
stabilization arch was used to obtain adequate an-
chorage and maintain sufficient space in the dental
arch, and a round arch was used as an attachment
for the elastic traction in order to guide the impacted
canine towards the center of the alveolar ridge. The
duration of this phase (duration of traction) was cal-
culated as the time elapsed between the application
of the traction device and the emergence of the cusp
of the impacted canine.
• Phase 3: Final orthodontic treatment to align the ca-
nine in the maxillary arch.
Periodontal Evaluation

The treated teeth were evaluated periodontally at the completion of the overall orthodontic treatment (Phases 1, 2, and 3).

The following periodontal variables were considered for the treated canines:

- Probing PD. The measurements were made by means of a Williams offset periodontal probe on six sites—mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual—on each of the treated teeth.
- KT, from the gingival margin to the mucogingival junction, measured on the medial position of the buccal aspect of the crown. The keratinized tissue and the alveolar mucosa were identified using Lugol’s liquid stain.

Statistical Analysis

Descriptive statistics were calculated as mean ± SD for metric variables and as frequency and percentage for nominal variables.

The inferential analysis aimed at evaluating the role of pretreatment factors on the duration of orthodontic traction (end of Phase 2), and on PD and KT variables at the end of orthodontic treatment (Phases 1, 2, 3). A multiple regression analysis was created. The duration of orthodontic traction was used as a dependent variable, and the following variables were considered independent: sex, age, impaction (unilateral or bilateral impaction), side (right or left position), location (palatal or buccal impaction of the canine), \( \alpha \)-angle, \( d \)-distance, and \( s \)-sector.

Regression analysis also tested the prognostic value of pretreatment radiographic variables on posttreatment periodontal variables PD and KT. The posttreatment PD analysis included only the deepest pocket measurement (PD\(_{\text{max}}\)) of the six probing sites of the treated teeth. Post hoc comparison for \( s \)-sector was made by a Tukey honestly significant difference test.

RESULTS

The clinical characteristics of the 168 patients/canines are reported in Table 1. In particular, the mean age of the patients was 17.2 ± 6.0 (range 12.8–52.0). The orthodontic treatment lasted overall 22.0 ± 4.8 months (range 13–34) and the active traction (phase 2) lasted 8.0 ± 2.3 months (range 4–13).

None of the patients complained of significant discomfort. All of the 168 impacted canines were successfully moved and aligned into the dental arch. None of the patients lost the attaching device. In two cases the orthodontic traction was interrupted because of breakage of the wire chain. In these patients, a flap was raised, a new wire chain was put into place, and traction was resumed. None of the patients required selective grinding of the occlusion.

Role of Pretreatment Variables in the Duration of Orthodontic Traction

Regression analysis (Table 2) revealed that the three pretreatment radiographic variables (\( \alpha \)-angle, \( d \)-distance, and \( s \)-sector) significantly influenced (\( P < .01 \)) the duration of orthodontic traction (end of Phase 2). The Tukey honestly significant difference test showed that \( s \)-sector 1 was statistically significantly different from \( s \)-sector 3, but not from \( s \)-sector 2. The statistical analysis of the relationship between the duration of traction and the values of the pretreatment radiographic variables leads to the following outcomes:

- \( \alpha \)-angle: Every 5° of opening of the angle required approximately 1 more week of active orthodontic traction.
- \( d \)-distance: Every 1 mm of distance of the cusp of the impacted canine from the occlusal plane required approximately 1 more week of active orthodontic traction.
- \( s \)-sector: Impaction in sector 1 required approximately 6 more weeks of active orthodontic traction when compared to impaction in sector 3.

The other pretreatment variables (sex, age, impaction, side, and location) were not associated significantly with the duration of active orthodontic traction.

Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>17.2</td>
<td>6.0</td>
<td>12.8–52.0</td>
</tr>
<tr>
<td>Overall treatment (Phases 1, 2, and 3), mo</td>
<td>22.0</td>
<td>4.8</td>
<td>13–34</td>
</tr>
<tr>
<td>Orthodontic traction (Phase 2), mo</td>
<td>8.0</td>
<td>2.3</td>
<td>4–13</td>
</tr>
<tr>
<td>( \alpha )-angle, °</td>
<td>35.0</td>
<td>13.0</td>
<td>5–71</td>
</tr>
<tr>
<td>( d )-distance, mm</td>
<td>15.3</td>
<td>3.8</td>
<td>6–24</td>
</tr>
</tbody>
</table>

\* Age is recorded at the beginning of the traction of the impacted tooth; overall treatment refers to the duration of overall orthodontic treatment (Phases 1, 2, and 3); orthodontic traction refers to the duration of Phase 2 of the treatment; \( \alpha \)-angle is the angle measured between impacted canine long axis and the midline; \( d \)-distance is the distance between canine cusp tip and the occlusal plane; and \( s \)-sector refers to the site where the cusp of the impacted canine is located.

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Table 2. Multiple Regression Analysis for Duration of Traction (End of Phase 2) for the 168 Treated Patients/Canines

<table>
<thead>
<tr>
<th>Term</th>
<th>Estimate</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.44</td>
<td>0.76</td>
<td>.0603</td>
</tr>
<tr>
<td>Age</td>
<td>0.03</td>
<td>0.02</td>
<td>.1446</td>
</tr>
<tr>
<td>Sex</td>
<td>0.21</td>
<td>0.15</td>
<td>.1566</td>
</tr>
<tr>
<td>Impaction (unilateral or bilateral)</td>
<td>0.01</td>
<td>0.15</td>
<td>.9678</td>
</tr>
<tr>
<td>Side (right or left)</td>
<td>0.05</td>
<td>0.13</td>
<td>.6693</td>
</tr>
<tr>
<td>Location (palatal or buccal)</td>
<td>-0.11</td>
<td>0.16</td>
<td>.4654</td>
</tr>
<tr>
<td>(\alpha)-angle, (x)</td>
<td>0.05</td>
<td>0.01</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>(d)-distance, mm</td>
<td>0.27</td>
<td>0.04</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>(s)-sector 1</td>
<td>0.71</td>
<td>0.26</td>
<td>.0072</td>
</tr>
<tr>
<td>(s)-sector 2</td>
<td>-0.01</td>
<td>0.18</td>
<td>.9765</td>
</tr>
<tr>
<td>(s)-sector 3</td>
<td>-0.71</td>
<td>0.22</td>
<td>.0016</td>
</tr>
</tbody>
</table>

* Theoretic model: duration of traction = \(\beta_0 + \beta_1 \text{ Age} + \beta_2 \text{ Sex} + \beta_3 \text{ Impaction} + \beta_4 \text{ Side} + \beta_5 \text{ Location} + \beta_6 \text{ \(\alpha\)-angle} + \beta_7 \text{ \(d\)-distance} + \beta_8 \text{ \(s\)-sector} \). \(R^2 = 0.58\). In the model, age is recorded at the beginning of the traction. The nominal variables have the following values: Sex is 1 if female and –1 if male. Impaction is 1 in case of unilateral impaction and –1 in case of bilateral impaction. Side is 1 if the tooth is on the left side and –1 if it was on the right. Location is 1 in case of buccal impaction and –1 in case of palatal impaction. \(\alpha\)-angle is the angle measured between the long axis of the impacted canine and the midline. \(d\)-distance is the distance between the canine cusp tip and the occlusal plane. \(s\)-sector has the value measured according to the corresponding sector (\(s\)-sector 1, \(s\)-sector 2, or \(s\)-sector 3).

Role of Pretreatment Variables in Periodontal Status at the End of Orthodontic Treatment

Pocket depth. Descriptive statistics showed that the mean PD\(_{\text{max}}\) after overall orthodontic treatment (Phases 1, 2, and 3) was 2.54 ± 0.45 mm (ranging from 1.5 to 4.5 mm). The PD\(_{\text{max}}\) of seven canines was deeper than 3 mm (in particular, three canines presented with PD\(_{\text{max}}\) = 3.5 mm, three with PD\(_{\text{max}}\) = 4.0 mm, and one with PD\(_{\text{max}}\) = 4.5 mm).

The regression analysis (Table 3) revealed no statistically significant differences for age or sex, and no differences for unilateral or bilateral impaction, for right or left position, or for \(\alpha\)-angle, \(d\)-distance, or \(s\)-sector. On the contrary, the analysis estimated that the PD\(_{\text{max}}\) of palatally impacted canines was 0.26 mm deeper than that of the buccally impacted teeth.

Keratinized tissue width. Descriptive statistics showed that the mean KT after overall orthodontic treatment (Phases 1, 2, and 3) was 4.42 ± 1.19 mm. The regression analysis (Table 4) revealed no statistically significant differences for age or sex, and no differences for unilateral or bilateral impaction, for right or left position, for palatal or buccal impaction, or for \(\alpha\)-angle, \(d\)-distance, or \(s\)-sector.

Recession (distance from the gingival margin to the cemento-enamel junction). Only one patient presented with a gingival recession of 1 mm at the final observation. One clinical case is shown in Figures 2 through 8.

Table 3. Multiple Regression Analysis for Pocket Depth (PD) at the End of Overall Orthodontic Treatment (Phases 1, 2, 3) for the 168 Treated Patients/Canines

<table>
<thead>
<tr>
<th>Term</th>
<th>Estimate</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.16</td>
<td>0.22</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Age</td>
<td>0.00</td>
<td>0.01</td>
<td>.6832</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.00</td>
<td>0.04</td>
<td>.9734</td>
</tr>
<tr>
<td>Impaction (unilateral or bilateral)</td>
<td>-0.02</td>
<td>0.04</td>
<td>.6312</td>
</tr>
<tr>
<td>Side (right or left)</td>
<td>-0.04</td>
<td>0.04</td>
<td>.3069</td>
</tr>
<tr>
<td>Location (palatal or buccal)</td>
<td>-0.13</td>
<td>0.04</td>
<td>.0049</td>
</tr>
<tr>
<td>(\alpha)-angle, (x)</td>
<td>0.00</td>
<td>0.00</td>
<td>.2426</td>
</tr>
<tr>
<td>(d)-distance, mm</td>
<td>0.01</td>
<td>0.01</td>
<td>.4221</td>
</tr>
<tr>
<td>(s)-sector 1</td>
<td>-0.08</td>
<td>0.07</td>
<td>.2802</td>
</tr>
<tr>
<td>(s)-sector 2</td>
<td>-0.01</td>
<td>0.05</td>
<td>.8360</td>
</tr>
<tr>
<td>(s)-sector 3</td>
<td>0.09</td>
<td>0.06</td>
<td>.1476</td>
</tr>
</tbody>
</table>

* Theoretic model: PD = \(\beta_0 + \beta_1 \text{ Age} + \beta_2 \text{ Sex} + \beta_3 \text{ Impaction} + \beta_4 \text{ Side} + \beta_5 \text{ Location} + \beta_6 \text{ \(\alpha\)-angle} + \beta_7 \text{ \(d\)-distance} + \beta_8 \text{ \(s\)-sector} \). \(R^2 = 0.08\). In the model, age is recorded at the beginning of the traction. The nominal variables have the following values: Sex is 1 if female and –1 if male. Impaction is 1 in case of unilateral impaction and –1 in case of bilateral impaction. Side is 1 if the tooth is on the left side and –1 if it was on the right. Location is 1 in case of buccal impaction and –1 in case of palatal impaction. \(\alpha\)-angle is the angle measured between the long axis of the impacted canine and the midline. \(d\)-distance is the distance between the canine cusp tip and the occlusal plane. \(s\)-sector has the value measured according to the corresponding sector (\(s\)-sector 1, \(s\)-sector 2, or \(s\)-sector 3).

Table 4. Multiple Regression Analysis for Keratinized Tissue Width (KT) at the End of Overall Orthodontic Treatment (Phases 1, 2, 3) for the 168 Treated Patients/Canines

<table>
<thead>
<tr>
<th>Term</th>
<th>Estimate</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.46</td>
<td>0.58</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Age</td>
<td>-0.00</td>
<td>0.02</td>
<td>.8240</td>
</tr>
<tr>
<td>Sex</td>
<td>0.06</td>
<td>0.11</td>
<td>.5619</td>
</tr>
<tr>
<td>Impaction (unilateral or bilateral)</td>
<td>0.12</td>
<td>0.11</td>
<td>.2677</td>
</tr>
<tr>
<td>Side (right or left)</td>
<td>-0.06</td>
<td>0.10</td>
<td>.5535</td>
</tr>
<tr>
<td>Location (palatal or buccal)</td>
<td>-0.21</td>
<td>0.12</td>
<td>.0826</td>
</tr>
<tr>
<td>(\alpha)-angle, (x)</td>
<td>-0.01</td>
<td>0.01</td>
<td>.5850</td>
</tr>
<tr>
<td>(d)-distance, mm</td>
<td>-0.00</td>
<td>0.03</td>
<td>.9001</td>
</tr>
<tr>
<td>(s)-sector 1</td>
<td>-0.29</td>
<td>0.20</td>
<td>.1452</td>
</tr>
<tr>
<td>(s)-sector 2</td>
<td>0.04</td>
<td>0.13</td>
<td>.7487</td>
</tr>
<tr>
<td>(s)-sector 3</td>
<td>0.25</td>
<td>0.17</td>
<td>.1394</td>
</tr>
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</table>

* Theoretic model: KT = \(\beta_0 + \beta_1 \text{ Age} + \beta_2 \text{ Sex} + \beta_3 \text{ Impaction} + \beta_4 \text{ Side} + \beta_5 \text{ Location} + \beta_6 \text{ \(\alpha\)-angle} + \beta_7 \text{ \(d\)-distance} + \beta_8 \text{ \(s\)-sector} \). \(R^2 = 0.08\). In the model, age is recorded at the beginning of the traction. The nominal variables have the following values: Sex is 1 if female and –1 if male. Impaction is 1 in case of unilateral impaction and –1 in case of bilateral impaction. Side is 1 if the tooth is on the left side and –1 if it was on the right. Location is 1 in case of buccal impaction and –1 in case of palatal impaction. \(\alpha\)-angle is the angle measured between the long axis of the impacted canine and the midline. \(d\)-distance is the distance between the canine cusp tip and the occlusal plane. \(s\)-sector has the value measured according to the corresponding sector (\(s\)-sector 1, \(s\)-sector 2, or \(s\)-sector 3).
DISCUSSION

The purpose of the present longitudinal study was to assess the utility of pretreatment radiographic indicators of infraosseous displacement of the permanent maxillary canine with regard to (1) the duration of orthodontic traction and (2) the periodontal conditions following surgical-orthodontic therapy of the impacted tooth.

In the past, pretreatment variables visible on panoramic radiographs were employed to predict the success rate of both interceptive treatment and overall surgical-orthodontic therapy in patients with impacted canines.2–4,7,8 As for the interceptive treatment of displaced canines by means of enhanced space on the maxillary arch, Olive4 reported that canines displaced in more unfavorable sectors emerged after a period of time that was significantly longer than that for canines displaced in more favorable sectors.

With regard to overall orthodontic treatment of impacted canines, in a sample of 47 patients Stewart et al7 found that the younger the patient, the more severely impacted the canine, and the longer the duration of orthodontic treatment. As for the d-distance on panoramic radiographs, the authors reported an average treatment duration of 23.8 months in case of a distance from the occlusal plane of less than 14 mm, whereas treatment duration averaged 31.1 months when the distance was more than 14 mm. Recently, Zuccati et al8 reported that the amount of chairside time in patients with impacted canines was proportional to the patient’s age, the d-distance, and the s-sector, and it was inversely proportional to the α-angle of impaction.

The present study on a large sample of impacted canines (168 canines) showed lack of significant associations between age, sex, site of impaction, and duration of orthodontic treatment. It must be emphasized that the variable observed in terms of treatment duration was calculated as the actual amount of active orthodontic traction, ie, as the time elapsed between the application of the traction device and the emergence of the cusp of the impacted canine.

On the other hand, pretreatment radiographic variables on panoramic radiographs significantly influenced the duration of active orthodontic traction. In particular, the outcome of multiple regression analysis indicated that every 1 mm of d-distance of the cusp of the impacted canine from the occlusal plane requires approximately 1 more week of traction, every 5° of opening of the α-angle require approximately 1 more week of traction, and impaction in sector 1 requires approximately 6 more weeks of active orthodontic traction when compared to impaction in sector 3. To predict the duration of active orthodontic traction, the clinician can insert the variables of the given patient in the formula of the theoretical model (Table 2).

In addition, in the present study the overall duration of orthodontic treatment (Phases 1, 2, and 3) lasted on average 22.1 months, with an average pretreatment d-distance of 15.3 ± 3.80 mm. This duration of treatment was inferior to that reported by Stewart and coworkers for favorable cases (d-distance less than 14 mm).7 This outcome is probably because of the orthodontic technique employed here, which, in all the cases treated, applied a direct traction of the impacted tooth towards the center of the ridge, which probably minimized the duration of overall orthodontic treatment.
(Phases 1, 2, and 3). In fact, the cases in which direct traction was not allowed (transposition of the impacted tooth, presence of obstacles on the traction pathway) were excluded from the study.

No previous data are available in the orthodontic literature with regard to the possible significance of pretreatment radiographic measures with respect to the periodontal status of orthodontically-repositioned impacted canines. In this regard, it should be emphasized that in the present investigation, patients with impacted canines were consistently treated by the same standardized surgical-orthodontic approach aimed to guide the impacted canine towards the center of the alveolar ridge in the maxillary arch.5,6 This technique is intended to allow the repositioned canine to be surrounded by a physiological amount of gingiva at the end of orthodontic treatment.9 The amount of PD and KT at posttreatment periodontal evaluation of treated impacted canines was indicative of healthy periodontal tissues. This outcome is similar to the findings of the longitudinal investigation by Quirynen et al.10

The findings of the present longitudinal study showed that repositioned canines exhibited an average PD (evaluated by taking into consideration the PDmax of the six measurements on each of the treated teeth) of about 2.5 mm and an average KT of about 4.4 mm. These values for PD and KT are representative of an adequate periodontal status of the repositioned canines.11 Only one patient presented with a gingival recession of 1 mm at the final observation. No significant differences in PD and KT were present at the end of surgical-orthodontic treatment with respect to age, sex, site of impaction, or the pretreatment radiographic position of the impacted canine. The only statistically (P = .0049), but not clinically significant (about 0.3 mm), difference was detected for PDmax, which was deeper for the palatally impacted canines than for the buccally impacted ones.

CONCLUSIONS

- The pretreatment radiographic features assessed on the panoramic radiographs are useful indicators for the duration of orthodontic traction.
The pretreatment radiographic features assessed on the panoramic radiographs are not valid predictors of the final periodontal status of orthodontically-repositioned impacted canines.

REFERENCES