

## Long-term results of Orthodontic and Periodontal treatment of Impacted Maxillary Canine

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### Abstract

**Aims:** A common procedure for the palatally impacted canines specially the deeply impacted ones, is surgical exposure followed by orthodontic treatment. Due to this we intended to evaluate the long-term treatment effect of deeply impacted maxillary canine.

**Methods:** Sixty patients were treated from 1994 to 1999 with deeply impacted maxillary canine. The canine was exposed by closed surgical exposure, the palatal mucoperiosteal flap was reflected, and bone was removed and the flap is repositioned. A hole was made through the crowns and a 0.6mm soft stainless steel was passed through the hole and a loop was made. To apply force to align the tooth in the dental arch, fixed appliances were used with a transpalatal bar and/or headgear to control vertical anchorage. The patients were followed up for three years.

**Results:** For 12 canines, a definite outcome was recorded which was predominantly successful. From the remaining canines, two were extracted due to ankylosis and two had ultimately an unfavorable alignment in the dental arch.

**Conclusion:** Closed surgical approach along with "making hole" technique is an appropriate method for the treatment of deeply impacted palatally maxillary canines (IJO 2006;1:176-83).

**Keywords:** Canine impaction, closed surgical exposure, orthodontic treatments

(Received June 2008;accepted sept.2008)

The mechanical management of certain impacted teeth can be frustrating, and in the case of improper surgical uncovering of teeth the esthetic outcome can be unpredictable. A correct uncovering technique can simplify the eruption process and give in a predictable stable and esthetic result. This is especially true for impacted maxillary canines.<sup>1</sup>

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The most common impaction encountered by orthodontists is the palatal impaction of maxillary canines. If it is not uncovered properly; palatally impacted canines could be the most difficult to handle for the orthodontists.<sup>1,5</sup>

### Surgical consideration

To align the canine within the arch can involve a range of procedures from the simple removal of any impediments to eruption (including retained deciduous canines) up to surgical reimplantations. The palatally impacted canines

usually should be uncovered by a surgeon and positioned in the dental arch by an orthodontist. The treatment alternatives include:

1. Interceptive treatment
2. surgical exposure and orthodontic alignment
3. Other options<sup>6</sup>

Considering that palatally impacted canines rarely erupt of its own record when sufficient space has been created, one of the most commonly adapted procedures is surgical exposure of the canine, followed by orthodontic alignment. Space would be created for the crown by the orthodontist (in 6-9 months) and then it would be referred to the surgeon to uncover the crown. Usually soon after the surgery, the orthodontist begins dragging the crown to the edentulous site.<sup>2, 4, 8</sup>

To uncover the crown after the preliminary orthodontic treatment, several methods of surgical exposure have been suggested. The two main surgical approaches are:

1. Replaced flap techniques, whereby the soft tissues are replaced over the exposed tooth after attaching a chain or other device with which to apply traction.
2. Excisional exposure in which mucosa overlying the crown is sacrificed and the wound pocket opens.

Even when a decision has been made to undertake excisional exposure, there are two options to be considered. The first is to permit natural eruption of the canine and the second is to place an attachment on the tooth at or very soon after surgery to facilitate orthodontically induced eruption.<sup>1, 8</sup>

Different methods are used for exposure and alignment of the canine:

- 1-Open surgical exposure and spontaneous eruption.
- 2-Open surgical exposure and packing with subsequent bonding an auxiliary.
- 3-Closed surgical exposure and bonding of attachment intra-operatively.

The first method is used when the canine has the correct inclination to erupt spontaneously and the second option is the exposure of the crown of the canine with packing. The third option involves the reflection of a palatal mucoperiosteal flap, an attachment is bonded to the crown of the tooth and an eyelet wire or gold

chain exists through the flap to gain attachment to the fixed appliance for immediate traction. The risk of attachment loss is said to be reduced if a flap is raised and then replaced over the exposed teeth like the latter technique mentioned.<sup>6, 9</sup>

One of the problems that may happen in these cases is insufficient bone removal over the crown of the impacted canine, so that the teeth can not absorb the bone over the crown efficiently. In order to present a way to solve this problem, Kokich recommended an alternative technique with earlier timing for uncovering palatally impacted canines. They time the uncovering of palatal canines before starting of the orthodontic treatment and sometimes this would be during the late mixed dentition. In these situations, a full thickness mucoperiosteal flap is elevated in the area of the impacted canine, and then all bone over the crown is removed down to the cemento-enamel junction, the flap is repositioned, and a hole is made through the gingival flap. Occasionally, if the tooth is positioned high in the palate, a dressing would be placed over the exposed area in the flap.

#### Biomechanical Consideration:

Various methods have been described for aligning the canine; Hunter used fixed appliances with a transpalatal bar and/or headgear to control vertical anchorage also described by Kochich.<sup>10</sup> McSherry discussed the use of gold chain bonded to the crown of unerupted canine to apply traction to align the tooth, and in order to achieve traction, he attached a palatal bar with soldered hook to it and introduced the use of Ballista spring (a wire loop constructed of 0.012 Inch stainless steel wire).<sup>6</sup> Roberts-Harry and Harradine described the use of a sectional approach to maxillary canines using a transpalatal arch for anchorage.<sup>11</sup> Orton and colleagues dealt with the use of a lower removable appliance with soldered hook bonded to the tooth. Some other authors advocated the application of magnetic forces to align the ectopic canine.<sup>6, 12</sup>

The aim of this study was to evaluate the long-term treatment effects of deeply palatally impacted maxillary canine, regarding esthetics



as judged by the patients and the orthodontist as well as the periodontal health, occlusal guidance, percussion, sound, and vital response. Esthetics was assessed concerning the restoration of the teeth after the treatment, and position in the dental arch. The periodontal status, caries prevalence in the surgical site where the hole was made on the teeth, the number of failures during the study, and the reasons of failure were also investigated.

## MATERIALS AND METHODS

A study was done prospectively on 16 patients (5 boys, 11 girls) who were treated in the periodontics and orthodontics department of the Dental Faculty of Tehran University of Medical Sciences between 1994 and 1999 which was approved by the ethical committee of the Dental Research Center of Tehran University of Medical Sciences. The patients were followed for 4 years.

### Sampling:

The patients were aged between 18 and 27 with an average of 22 years. The inclusion criteria of the patients were:

- Unilateral palatal impaction of the maxillary canine, which were not treatable by interceptive approaches.
- Lacking periodontal defects
- Deeply intra-osseous impacted canine
- Matured Impacted canine with a closed apex and no apical lesion
- Availability of periodontal charting records during the orthodontic treatment and appropriate plaque index.
- Good Oral hygiene
- No systemic disease

### Orthodontic Treatment:

The orthodontic treatment was composed of

#### Three phases:

Creation of space for the crown of the impacted canine

Traction application after the periodontal surgery. The period of traction is described as the time between the application of the traction device and the eruption of the cusp of the impacted canine from the dental arch.

Alignment of the canine in the dental arch and retention.

### Surgical Treatment:

The position of the canine was previously assessed by radiographs or by palpation. According to the position of the canines, the surgical method selected by the periodontist was the holing technique.

Closed surgical approach was used. The palatal mucosa was then dissected off the bone and the bony covering was removed. The cavity was enlarged, by further bone removal as required, in order to expose the entire palatal surface from cusp tip to gingulum, but leaving the cemento-enamel junction undisturbed.

The flap was repositioned, and a hole was made through the crown of the canines with a fissure bur (Fig-1). A 0.6 mm soft stainless steel wire was passed through the hole (Fig-2) and a loop was made and the flap is sutured with interrupted periosteal sutures (Fig-3). The loop should be positioned so that it would be accessible for the orthodontists to apply orthodontic traction. Two weeks after the surgery when healing of the surgical site was completed, the patients were referred to the orthodontists.

#### Post-surgical orthodontic treatment:

The orthodontic force was applied, regarding the position of the tooth in the dental arch and the space which should be gained (Fig-4). Fixed appliances were used with a transpalatal bar and/or headgear to control vertical anchorage. At first, patients were examined monthly, to check their status and re-apply orthodontic traction. When the impacted teeth were accessible for bonding after eruption, the stainless steel wire is removed and the patient is referred to a dentist for restoring the hole in the crown of the teeth. Brackets were bonded, and the force application was continued.

### Follow up:

In the first year, follow up of the patients were monthly, to adjust, reinforce the appliance and check the oral hygiene measures. During the rest 3 year follow-up, the recalls were 6 months.

Evaluation criteria:



The position of the teeth in alveolar bone, its depth in the bone (mm), and its angulations (Horizontal, Oblique ( $<45^\circ$  from the vertical axis), almost horizontal ( $>45^\circ$  from the vertical axis)).

#### Exposure amount during the surgery:

The breakdown of the wire during the orthodontic treatment

Injuries and allergic reaction to the stainless steel wire

Duration of orthodontic forces applied

Amount of pain during the application of orthodontic forces

Existing caries, especially around the hole at the incisal crest

Plaque index (PI), bleeding index (BI), periodontal pocket depth (PPD)

Width of attached gingiva (mm)

Number of failures, extracted teeth and their causes, i.e. ankylosis

Vitality test

Comparison of the predicted and final position of the canine after treatment

Patient's satisfaction of the result of the treatment

Orthodontist's satisfaction of the results of the treatment.

#### Success Rate:

The success rate was calculated as the percentage of successfully aligned canines relative to the total number of canines treated.



Fig 1: Making a hole in the impacted tooth



Fig 2: Placing an stainless steel wire in the hole



Fig 3: End of surgery



Fig 4: End stages of canine movement

## RESULTS

### Radiographic position:

The position of the impacted maxillary canine was as follow in the alveolar bone:

Oblique: 68.7 %

Almost Horizontal: 18.7%

Horizontal: 12.5%

The average depth of impacted maxillary canine from the crestal alveolar bone is  $13.62 \pm 1.77$  mm.

### Outcomes:

A definite outcome was recorded for 12 teeth. From the four remaining teeth, two were extracted due to ankylosis after the force application and two had unfavorable alignment in the dental arch after the primary orthodontic treatment. 66.7% of the 12 teeth were successful (S), and 33.3% were partially successful (P), judged by the orthodontists.

The status during the treatment:

12.5% of the teeth got pulp exposed during the preparation of the hole.

None of the wires used as a loop were broken during the treatment.

No injury or allergic reaction to the wire was observed.

During the treatment, 93.7% of the teeth had no lesions under the wire

Duration of force application was in 18% more than one year and in 82% less than one year.

Two teeth were extracted due to Ankylosis

The post-treatment status of the teeth (Table-1, Box-1): The PPD measurement of the teeth after the treatment was as follow: 58% had 1-2mm PPD, and 42% had 2-3% PPD in the lingual.

The GI index was zero for all of the cases during post-treatment examinations 25% of the cases had the number one score and in 75% had zero

The width of the attached gingival (AG) was as seen in Table.1

In 37% of the teeth, the vitality test was positive, when the teeth reached the intended position

12.5% of the teeth had caries around the area of wire application. All the teeth undergone a restorative treatment post-operative. 56.2% of the teeth needed RCT after being aligned in the dental arch and in 18% of the teeth signs of root resorption were seen.

Statistics	Mean	Standard Deviation	Range
Variable			
Buccal PPD (After treatment)	2.25	0.80	3.0
Lingual PPD (After treatment)	2.0	0.634	1.06
Width of Keratinized Gingiva (After treatment)	4.58	1.52	4.0
Depth of Impaction (Before Treatment)	13.625	3.13	11.0

**Table 1-** The mean and Standard Deviation and range of measurements of the Buccal PPD, Lingual PPD, Width of Keratinized Gingiva, Depth of Impaction

Numbers of failures were four in 16 cases, two were due to ankylosis, and two were due to improper alignment.

### Satisfactions:

Considering the 12 cases which lacked complications, the orthodontists ranked the result of the treatment as 66.7% successful, 33.3% partially successful, and all the patients found the results successful (100%). During the force eruption, 33.3% of the patients had no pain, 66.7% had occasionally pain, but none considered it as too painful.

**Success Rate:** Considering the two extracted teeth and two malaligned ones, the success rate was about 75%.

## DISCUSSION

The impacted maxillary canines which are the second most commonly impacted permanent teeth (prevalence 0.9–2.2%), usually need to undergo surgical exposure and the use of fixed orthodontic appliances.<sup>2</sup> If the Surgical exposure is not done properly, it can be difficult to handle for the orthodontists.<sup>1,5</sup>

The most frequent causes of these kinds of impactions seem to be lack of available space at the appropriate time to ensure a normal eruption of the canine. Other factors were suggested like narrowness of the upper arch, Class II division 2 incisor relations, familiar tendency and cyst formation.<sup>6,7</sup>



In this study, all the teeth were identifiable as palatally impacted maxillary canines for the orthodontist with radiographic records and palpation, and all needed surgical and orthodontic management due to the position of their maxillary canine in the alveolar bone. After the treatment, all of the teeth were successfully aligned in the dental arch, except for four of them. Excluding these four canines and considering that most of the canines selected for this study were deeply impacted in the alveolar bone and mostly had unfavorable angulations, the overall evaluation of the results of this study can be considered satisfactory.

The overall complications in treating impacted canines include failure to erupt, ankylosis<sup>3,13</sup> bond failures,<sup>3,13,14</sup> and periodontal defects.<sup>15</sup> Since the canines in our study had undergone closed surgical exposure and forced eruption, failure to erupt is not considered as a complication in our study.

Regarding the second complication, the effect of ankylosis is to prevent tooth eruption. This may cause the anchoring teeth, on the archwire, to tip into the space created for the canine. Ankylosis has also been implicated in some cases where the canine initially moved and then suddenly ceased to erupt. Luxation of the ankylosed tooth has been a recommended treatment however, success is unpredictable.<sup>13</sup> In this study, two of the teeth were extracted due to ankylosis. It is assumed that the probability of the ankylosis can be reduced with less bone removal and using proper anchorage.

Considering the third complication, failure of bonding and fracture of the wire from the attachment can be encountered during the surgical exposure, if the patients undergo bracketing. Additionally, orthodontic bracketing is a more technique sensitive procedure, and dependent on the experiences of the operators.<sup>16</sup> This is especially true when the maxillary canine is deeply intra-osseous impacted which is the case of this study. Therefore due to the potential risk of contamination of the bonding and detachment of the bracket, the holing technique was used in this study.

In regard of the forth complication, the periodontal status around the teeth in this study was favorable in all subjects. This result was

obtained from the average probing depth which was about 2.25mm in buccal and 2mm in lingual of the canines. These results were confirmed by the gingival index, which was zero for all the canines and bleeding index, which was zero for 75% of the studied canines. Because of the 3-7mm (average: 4.58) width of the keratinized gingiva in the buccal of the surgical site after the treatment, an appropriate periodontal status will be guaranteed in future.

The other complications which occurred in this study were pulp exposure, and root resorption. The most significant complication observed was pulp exposure. Only 50% of the teeth were vital at the end of the treatment. If the canine has a more favorable position, which is not the case in this study, bracketing will be recommended. Root resorption was seen in 25% of the cases, but it was not judged as significant, since it did not influence the overall results in our study. Neither fracture of the wire nor lesion and allergic reaction besides the wire was observed in this study. The average time needed for the alignment of these canines was less than 1 year in 18% of the cases and more than 1 year in 82% of the cases.

The results of 12 from 16 of the canines were favorable judged by the patients and orthodontists. Two of the remaining teeth were extracted due to ankylosis. The two others were extracted due to the unacceptable position of the teeth at the beginning of the treatment, but the other teeth were aligned in the dental arch.

We concluded that this technique is acceptable to be used in cases which the teeth are deeply impacted and have unfavorable angulations and it would avoid unnecessary extraction of the teeth. The firm junction of the wire to the teeth, lack of bonding problems, less bone removal, less periodontal and supporting tissue destruction, and more favorable access for the later bracketing makes this technique more appropriate for similar cases.

## CONCLUSION

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