Case Report

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Surgically Assisted Eruption of Palatally Impacted Canine by Tunnel Traction: Case Report

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ABSTRACT

Background: Surgically assisted eruption is the preferred treatment for impacted canines. Exposing all canines by simple excision of the overlying tissue often makes the periodontium vulnerable to destruction. There are four techniques for exposing an impacted canine. They are (1) window exposure, (2) apically repositioned flap, (3) flap closed eruption technique and (4) tunnel traction. The choice of the technique depends primarily on the position of the impacted tooth. A case of palatally impacted canine successfully treated by surgically assisted eruption using tunnel traction technique is presented here. The teeth that required orthodontic de-rotation also had transection of the supraalveolar fibers to prevent rotational relapse. Tunnel traction is a unique technique that simulates physiologic eruption. The esthetic and periodontal outcomes are therefore better. A biomechanical explanation for the superior results achieved with tunnel traction technique is presented.

Keywords: Impacted maxillary canine, surgical exposure, surgically assisted eruption, tunnel traction, fibrotomy.

INTRODUCTION

The maxillary canine is the second most commonly impacted tooth in the human permanent dentition.[1, 2] The incidence of maxillary canine impaction in the general population has been reported to be 1- 3% [1-6], 1.7% [7] and less than 2%.[8]The ratio of maxillary to mandibular canine impaction reported in the literature is 10: 1.[9, 10, 11] In the maxilla, palatal canine impactions are more common than labial impactions. The ratios of palatal to labial canine impactions reported are 2:1[12], 3:1 [13],12:1[14] and 6.6:1.[15]Of all the patients with maxillary impacted canines, it is estimated that 8% have bilateral impactions. The incidence of mandibular canine impaction is 0.35%.[1]

Treatment modalities for management of impacted canines include (a) surgically assisted eruption (b) autogenous transplantation and (c) surgical removal followed by either orthodontic space closure or prosthodontic replacement. Considering the importance of maxillary canines for an attractive smile and function, any treatment plan that involves their removal must be considered only as a last option when other treatment modalities are of no avail**.** Surgical exposure/uncovering of the crown of the impacted canine and its orthodontic guidance to its normal position are the two steps in surgically assisted eruption. Use of the correct surgical technique for uncovering the tooth and appropriate biomechanics is the key to success.

In this case report, we present a case of a palatally impacted canine in a fifteen year old female patient successfully treated by surgically assisted eruption using tunnel traction technique.

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CASE REPORT

A fifteen year old female patient came with her parents with the chief complaint of severely rotated upper front teeth. Diagnostic methods included history, clinical examination (inspection and palpation), study casts and radiographic examination. General examination and clinical evaluation of her facial esthetics were within normal limits except for the crowded maxillary anterior teeth. Intraoral examination showed severely crowded and rotated teeth '11' and '12'. Tooth '53' was retained (Figs1A&B). The lower arch showed reasonably good alignment. The inter arch relationship was Angle's Class II with increased overjet. On palpation, a bulge was identified on the palate towards the midline. Model analysis revealed a 'tooth size arch length discrepancy' only in the upper arch.

Radiographic examination revealed an impacted '13' (Fig 1C)and tube shift technique confirmed its palatal location. Apart from identifying the presence of impaction, diagnosis must also include three-dimensional localization of the tooth and identification of any associated changes like periodontal damage, root resorption or pathologies like cyst formation. Routine radiographs like periapicals, occlusal and panoramic radiographs provide good two - dimensional representation of the tooth; but they are of limited value for three-dimensional localization and identification of areas of root resorption on adjacent teeth.[16,17]CT and CBCT are helpful in three -dimensional localization. They can also identify areas of possible root resorption on the adjacent teeth. But they were not used in this case due to non- availability in our institution.

Arch length discrepancy and the unique developmental position of the maxillary canine tooth germ have been cited as major causes for the high incidence of maxillary canine impaction.[15, 16, 18-23]The maxillary canine tooth germ develops high in the anterior wall of the maxillary antrum below the floor of the orbit and has a long and tortuous path of eruption. Therefore in cases of arch length deficiency, the canine being 'a late comer' to the dental arch often gets diverted labially or palatally.[21] Jacoby[15] was among the first to point out that labial and palatal canine impactions do not share a common etiology.According to him, excess space in the arch is a more plausible cause for palatal canine impactions.

TREATMENT OBJECTIVES

Treatment objectives included (a) extraction of the retained deciduous canine ('53') and positioning of the impacted canine ('13') in its normal position in the arch, (b) orthodontic derotation and alignment of teeth '11' & '12', (c) extraction of two maxillary first premolars and retraction of the maxillary anterior teeth to reduce the overjet and (d) transection of supracrestal fibers of the orthodontically derotated teeth to minimize relapse. No treatment was planned in the lower arch and the molars were to continue in Angle's Class II relationship.

TREATMENT ALTERNATIVES

Treatment modalities for management of impacted canines include (a) surgically assisted eruption (b) autogenous transplantation and (c) surgical removal followed by either orthodontic space closure or prosthodontic replacement. The presence of maxillary canines is very important for aesthetics and function. Therefore, all possible efforts must be made to avoid their removal in any treatment planning. Autogenous transplantation of ectopically placed canine is an option to be considered but is often associated with high prevalence of external root resorption.[24.]

Surgically assisted eruption is therefore the preferred treatment in most cases and in the case presented here also this was the treatment of choice. Surgically assisted eruption involves surgical uncovering of the crown of the impacted canine followed by its orthodontic traction. There are four techniques for uncovering an impacted canine. They are **(**a) *Window exposure (WE)*, (b) *Apically repositioned flap (ARF*), (c) *Flap closed eruption technique (FCET)* and (d) *Tunnel traction (TT)*. Of these, WE and ARF are open eruption techniques where the uncovered portion of the crown of impacted canine remains exposed permanently following the surgical procedure. FCET and TT are closed eruption techniques where the exposed canine gets covered when the flap is repositioned and sutured. Each technique has its own indications, advantages and disadvantages.

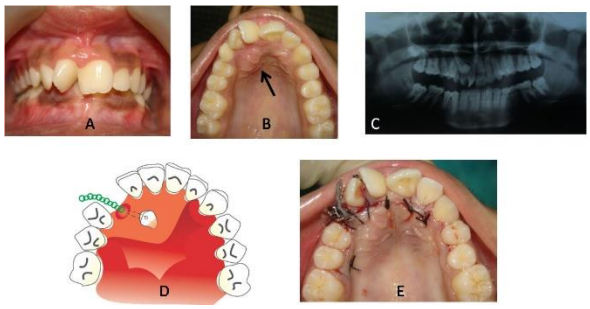

Fig 1: A&B, Pretreatment intraoral photographs showing the over retained '53' and the rotated anterior teeth. B - the bulge on the palate produced by the impacted canine can be seen. C -Pretreatment OPG showing the impacted 'I3'. D - Diagram showing the technique of tunnel traction when an impacted canine is located palatally. E- Photograph taken after closure of flap. An elastic chain and a ligature wire were ligated to the cuspid's tip.

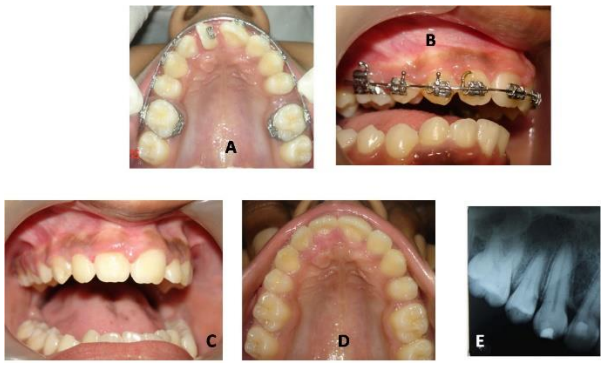

Fig 2: A Photograph taken during treatment. The impacted '13' has been aligned and '12' derotated. B- Photograph taken after aligning all teeth. Fibrotomy of '11' & '12' was done at this stage. C & D - Post treatment photographs taken two years after removal of fixed orthodontic appliance. E- Post treatment periapical X-ray taken two years after appliance removal.

Exposing all impacted canines by simple excision of the overlying tissue (window exposure) is the most common cause for periodontal and esthetic complications.[30, 32]The choice of the technique is dictated primarily by the location of the impacted canine.

Choosing the correct exposure technique for the patient

Window exposure involves excision of the full thickness tissue overlying the crown of the impacted tooth. This technique is not suited for canines located deep on the palate because the circular excision of the thick palatal mucosa will leave a broad cut surface which tends to granulate and rebury the exposed tooth.[16] Placing surgical pack to prevent this usually leads to periodontal complications later. *Apically repositioned flap* technique is used only for labially impacted canines and not for palatally impacted canines. Both *Flap closed eruption technique* and *Tunnel traction technique* are closed eruption techniques and are indicated in cases where the impacted canine is

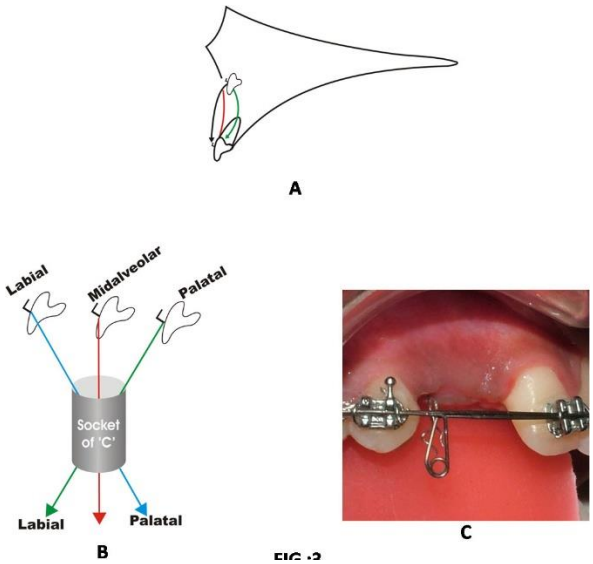

Fig 3: A-The arrows in this diagram show the different paths an impacted canine would take when it is treated by TT and FCET. In TT the canine can be encouraged to move along the line indicated by the green arrow. This would ensure low resistance movement as the canine doesn't ram into the cortical plates. In FCET, the canine gets a labially directed pull also and encounters resistance from cortical plate. Moreover it can descend only if the cortical plate shown in red color resorbs. B-Diagram shows three possible impacted canine positions. The arrows indicate the direction in which tension may be applied to the traction element, in tunnel traction, so as to encourage the tooth to move between the labial and palatal cortical plates. . For e.g. if the impacted canine is palatally placed, a labially directed pull will be helpful. This way the tooth can be made to erupt by breaking through the gingiva at the crest of the alveolar ridge. C, –An auxiliary spring ligated piggy back over a rigid archwire. In the passive state the vertical loop of the spring points inferiorly.

placed deep and high -either on the palatal side or the labial side. If the deciduous canine is retained with an unresorbed root, the tunnel traction technique becomes easier. Moreover, tunnel traction is a unique technique wherein the eruption of the impacted tooth simulates physiologic eruption and the esthetic and periodontal outcomes are the best. Considering the above factors, tunnel traction was chosen as the preferred technique for surgical uncovering of the impacted canine in this case.

Figs1D&E are diagrams that shows the technique of tunnel traction for a palatally impacted canine. The surgically exposed canine is connected by an intrabony tunnel to the socket of the deciduous canine which is extracted. One end of the traction element (elastic chain, a chain made of stainless steel wire or gold chain) is tied to the attachment fixed on the exposed canine and the other end is taken through the tunnel to emerge out through the extraction socket into the mouth.

TREATMENT PROGRESS

As the canine was almost in the midline and as we were skeptical about the possible success of surgical eruption it was decided to expose the area and then determine the feasibility of surgical eruption after being able to see the canine directly. For the same reason, orthodontic appliances were not placed before surgery. The parents were advised accordingly and consent obtained.

Under local anesthesia, the palatal flap was raised and the bulge produced by the impacted canine was identified. The crown tip was exposed by removing the overlying bone with surgical bur. The location and angulation of the canine were again determined and it was decided to go ahead with surgical eruption using tunnel traction technique. A through and through bur hole was made at the tip of the crown of the cuspid and a stainless steel chain and a strip of elastic chain were tied to the cuspid tip. The retained deciduous canine was removed and a tunnel was created to connect the socket with the exposed cuspid tip. The free ends of the stainless steel chain and elastic chain were taken through the tunnel to emerge out through the extraction socket. The two first premolars were extracted to provide space to align the crowded teeth and retract the anterior teeth. Following healing, PEA (Roth, 022'') was placed in the upper arch .The impacted canine was first brought to its normal place in the dental arch (Fig 2A) and then the anterior teeth were aligned and retracted (Fig 2B). The occlusion was finished in Class II. Following orthodontic correction the teeth '11' and '12' were subjected to supracrestal fibrotomy to minimize the tendency for rotational relapse. Three weeks after fibrotomy, the appliance was removed and a removable retainer was inserted. Active treatment duration was twenty months. Oral prophylaxis was given after removal of the fixed appliance and regular home care was emphasized. The bur hole at the tip of the canine was restored with composite resin. Periodontal parameters like clinical crown height, alveolar bone level, probing pocket depth and width of attached gingiva of the surgically erupted tooth were recorded three months after appliance removal. The values were within normal limits and were comparable with those of the opposite side. The patient was instructed to wear the retainer full time for the first year followed by night time wear for an additional six months.

Follow up after two years showed stable results (Figs2 C,D& E) without any clinical or radiological evidence of adverse gingival or periodontal effects.

DISCUSSION

In the management of impacted canines, surgically assisted eruption is the preferred treatment in most cases. Most impacted canines can, in our experience, be treated by surgical eruption. Choosing the correct surgical exposure technique and using appropriate biomechanics is the key to success in surgically assisted eruption. Precise three dimensional localization of the canine is very important because successful surgical exposure technique depends on knowing the exact location of the canine. Several studies have reported that surgically assisted eruption results in varying degrees of periodontal injury and compromised dental esthetics. Reported untoward effects include failure of eruption, gingival recession, increased pocket depth, reduced alveolar bone height, root resorption, ankylosis and even loss of the tooth.[25-30]The surgical uncovering of an impacted tooth is a delicate procedure that can make the periodontium

vulnerable to destruction. Attempting to expose all impacted canines by excision of the overlying tissue is the commonest cause for periodontal complications.[16, 30, 32] The technique requires modifications depending on the exact location of the canine.

Though FCET and TT are closed eruption techniques, in our experience, TT often produces better esthetic and periodontal results. This difference in the outcome can be attributed to the manner in which the impacted tooth is guided to its normal position in the two techniques(Fig 3A). In FCET, the traction element ligated to the attachment on the surgically exposed tooth emerges out through a surgically created small window on the labial cortex (palatal cortex if the tooth is approached through the palatal side) and lies subperiosteally to emerge at the free gingival margin. When traction is applied, the impacted tooth receives a traction directed labioincisally. As the impacted tooth moves labioincisally, it meets increased resistance from the cortical bone. This prolongs the treatment duration. Moreover, the tooth can descend only if the labial cortex below the level of the impacted tooth (shown in red line in Fig 3A) resorbs. This results in considerable thinning of the investing periodontal tissues on the labial side. Clinically this manifests as increased root prominence.

In tunnel traction, by changing the direction of pull on the traction element that emerges out of the socket, the unerupted tooth can be encouraged to move between the labial and palatal cortical plates without thinning out either of the two. Fig 3B shows the three possible directions in which orthodontic tension can be applied to the traction element so as to minimize the possibility of the impacted tooth ramming onto the cortical plates which would otherwise increase resistance to movement. Finally the tooth can be made to erupt by breaking through the gingiva at the crest of the alveolar ridge with adequate alveolar bone and attached gingiva both labially and palatally. Therefore, the eruption of the tooth in tunnel traction simulates physiologic eruption[16, 31].It is this transmedullary movement that makes this a unique technique. Therefore in our opinion, ***transmedullary guidance (TMG)*** of impacted canine seems to be a more appropriate terminology for this technique. In order to guide the erupting tooth to the center of the alveolar crest some modification of biomechanics may also be required. Jacoby's 'ballista' spring[14] or an auxiliary spring as shown in Fig 3C can be used. The auxiliary spring can be made of 0.014 inch or 0.016 inch S.S arch wire and ligated 'piggy back' on a .017 X.025 inch S.S arch wire. In the passive state, the vertical loop of the spring points inferiorly. The traction element coming out of the extraction socket is ligated to the terminal helix of the vertical loop. This will deflect the vertical loop palatally towards the alveolar crest. By varying the length of the vertical loop, the erupting tooth can be encouraged to move labially or palatally as it descends. Similarly, by altering the mesiodistal position of the vertical loop, the tooth can be encouraged to move mesially or distally.

In the case presented here, a chain made of stainless steel and a strip of elastic chain was used to give traction to the impacted tooth. A gold chain or one made of stainless steel wire is preferable to an elastic chain, as the latter tends to decay over a short period of time. Moreover, the former two are considered more biocompatible than elastic chain since in tunnel traction, it remains buried inside the tissues.

In surgical eruption, it is advisable to first insert orthodontic appliances to align other teeth and create sufficient space for the impacted canine before surgical exposure is performed. We follow this protocol in nearly all our cases. But in the case presented here, we followed a different approach as it was difficult to determine the exact position of the impacted teeth until they were exposed and could be inspected directly (we didn't have access to CBCT) . If the position is too undesirable, removal of the impacted tooth may be considered followed by orthodontic space closure.

However, if apically repositioned flap is the choice of surgical exposure technique, it is mandatory that space for the canine is created before surgically exposing the canine. This is critical because, without sufficient space for the canine in the arch, there will not be sufficient attached gingiva for the surgical repositioning. In such cases by first creating space, we gain not only adequate space for the unerupted canine but also

create an adequately wide zone of attached gingiva for apical repositioning.

The choice of piercing the tooth's tip instead of placing an attachment also needs contemplation as this, evidently, is an avoidable invasive procedure. In closed eruption techniques, our routine practice is to bond an eyelet. But an advantage of piercing the tooth worth mentioning is that it avoids the inconvenience associated with having to bond an attachment in a blood contaminated environment. Moreover the possibility of a bond failure during later stages of treatment is also avoided. It must be remembered that bond failure during the course of treatment will necessitate a repeat surgery to get access to the tooth. We had instances where such bond failures necessitated surgical re-entry. This prompted us to try piercing technique in few cases.

CONCLUSION

Management of a palatally impacted canine in a fifteen year old patient who presented with a Class II Div1 malocclusion and severely crowded and rotated maxillary anteriors is presented here. The palatally impacted canine was successfully treated by surgically assisted eruption using tunnel traction technique. An explanation based on biomechanics is suggested to elucidate the usually superior esthetic and periodontal results achieved with tunnel traction. The maxillary anterior teeth that required orthodontic derotation also had supracrestal fibrotomy performed to prevent relapse. Clinical and radiological examination of the surgically erupted tooth and its adjacent teeth three months after active orthodontic treatment showed normal gingival and periodontal parameters and the values were comparable with those for the opposite side. Post treatment evaluation two years after active phase of treatment also showed stable orthodontic result without any adverse gingival or periodontal effects.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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