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OPEN VERSUS CLOSED EXPOSURE OF IMPACTED MAXILLARY CANINES

ОТВОРЕНА НАСПРОТИ ЗАТВОРЕНА (ТЕХНИКА) НА ЕКСПОЗИЦИЈА НА ИМПАКТИРАНИ МАКСИЛАРНИ КАНИНИ

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Abstract

This review aims to compare the effectiveness of two different canine exposure techniques (open vs. closed) regarding periodontal outcomes, duration of surgical treatment and canine's eruption, patient perception, aesthetics, and orthodontic treatment complications. The results indicate no significant difference between the two techniques in terms of periodontal outcomes and aesthetic appearance. However, the surgical procedure is shorter in the open exposure group, and the amount of postoperative pain during the first day is similar between the open and closed surgical exposure patients. **Keywords:** impacted maxillary canines, open surgical exposure, closed surgical exposure.

Апстракт

Целта на овој преглед е да ја спореди ефикасноста на две различни техники за експонирање на канините(отворена и затворена) во однос на периодонталниот резултат, траењето на хируршкиот третман и ерупцијата на канините,перцепцијата на пациентот, естетскиот резултат и ортодонтските компликации од третманот. Резултатот е дека нема сигнификантна разлика помеѓу двете техники од аспект на пародонтолошки и естетски резултати. Меѓутоа, хируршката процедура е пократка кај отворената метода, а постоперативната болка во првиот постоперативен ден е слична помеѓу отворената и затворената метода. **Клучни зборови:** импактирани максиларни канини, отворено хируршко експонирање, затворено хируршко експонирање.

Introduction

An impacted tooth can be defined as a tooth whose eruption is considerably delayed and for which there is clinical or radiographic evidence that further eruption may not take place[1].The incidence of canine impaction is 1.7%[2]. Impacted canines are palatally positioned in 85% of the cases[3].

Surgically assisted orthodontic intervention is often required to guide the canine into occlusion[4,5,6].

Surgical exposure and orthodontic alignment is indicated in patients beyond the age of interceptive treatment, in which the impacted canines are not severely ectopic, and the adjacent tooth shows no or mild resorption[7].

Accommodation of the canine within the arch can involve procedures of varying degrees of complexity, ranging from a simple interceptive treatment (removal of retained deciduous canine) or any impediments to exposure up to surgical reimplantation. A strategy that is commonly adopted is surgical exposure followed by orthodontic alignment. Two surgical methods for exposure are commonly used: open and closed. There is no general consensus about the choice of operative technique.

Search method

A review of the literature was carried out using the following search methods: PubMed, MEDLINE, EMBASE, the Cochrane Central Register of Controlled Trials (CENTRAL), and the Cochrane Oral Health Group's Trials Register. The search was focused on various keywords including: 'open surgical exposure', and 'closed surgical exposure', as well as manual literature searches.

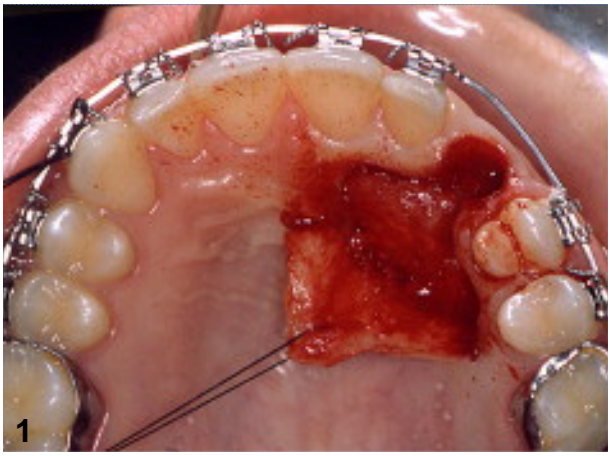
Open and closed surgical exposure techniques

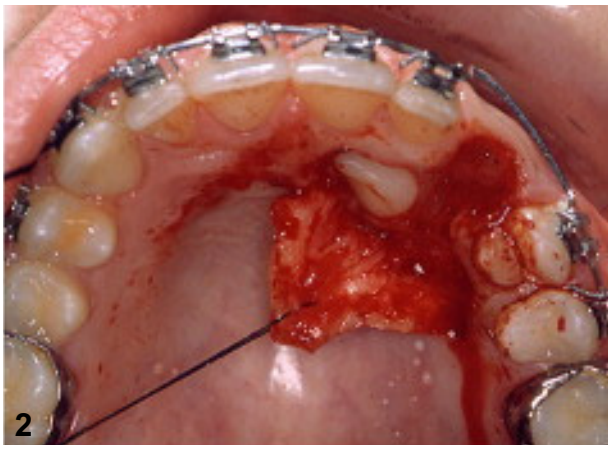
Open and closed surgical exposure techniques

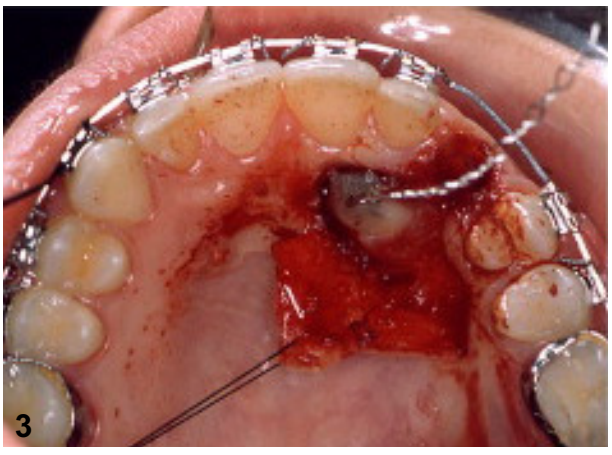
1. Closed exposure;
2. Open exposure;

Closed Exposure

A full-thickness palatal mucoperiosteal flap is raised, the tissues overlying the canine crown are removed, and a low-profile orthodontic bracket with a gold chain attached is bonded to the canine crown[8]. The soft tissue covering the canine is not excised, and bonding is usually placed on the most accessible surface of the impacted tooth. Then, the gold chain is applied and passed through the incision. The free end of the chain can be retained with composite to an adjacent tooth, sutured to the mucosa, or attached to the archwire, if present (Figures1, 2, 3, and 4).







Figures 1, 2, 3, and 4. *An example of closed exposure of palatally impacted canine. A full-thickness palatal mucoperiosteal flap with minimal bone removal (courtesy of Michele Nieri, Aldo Crescini, Robert Rotundo, Tiziano Baccetti, Pierpaolo Cortellini, and Giovan Paolo Pini Pratoe -28.08.2008)cclusal carious lesions on tooth 85 and 84*

Open Exposure

This procedure can be done either by excising the overlying mucosa or by elevating the full-thickness mucoperiosteal flap and removing enough bone to allow for the placement of an orthodontic attachment, followed by the repositioning of the flap with a hole (with or without dressing, depending on the vertical position of the canine). If the tooth does not erupt, surgical removal of any cicatricle tissue surrounding the crown is recommended.

There are two approaches to consider regarding the timing of the attachment placement and application of orthodontic traction, with or without traction.

Open Exposure Without Traction

This involves the surgical exposure of the impacted canine in the late mixed dentition with no orthodontic traction[5,9]. This is done only when the tooth has a correct axial inclination assessed from the orthopantomogram[5,10]. Spontaneous attachment is placed on the tooth at the time of surgical exposure. The main advantage of this approach is that it avoids the delay in the application of orthodontic traction. Eruption can take up to 9 months postoperatively. The main advantage of this technique is that it allows for spontaneous eruption, thus reducing the time in active

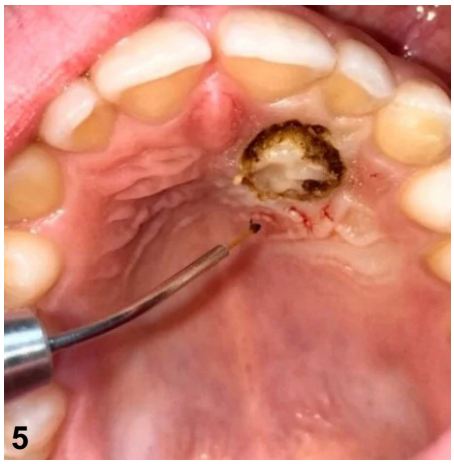


Figure 5, Figure 6. *An example of open exposure of palatally impacted canine without traction wherespontaneous eruption of the impacted canine is allowed (courtesy of Alessandra Impellizzeri, Gaspare Palaia, Gerardo La Monaca, Daniele Pergolini, Antonella Polimeni, Umberto Romeo, Gabriella Galuccio - 23.02.2023)*

orthodontic treatment[9]. However, it should be noted that spontaneous eruption of the surgically exposed canine might take longer than active eruption[10] (Figures 5,6). The main disadvantage of leaving the exposed canine to erupt passively is gingival regrowth and the need for re-exposure.

Open Exposure With Traction

Surgically exposed canines rarely erupt into a created space, without aid, if root formation is complete and the canine has unfavorable axial inclination, as determined from the orthopantomogram[5,10]. Therefore, after exposing the canine using the open technique, an attachment is bonded to the canine, and traction is applied. Bonding an eyelet was found to be more successful (94%) compared to an orthodontic bracket (75%), especially if it was bonded at the time of exposure[11].

Two options are suggested with regard to the timing of attachment placement[10]:

- Two-step approach: First, the canine is surgically exposed. Wound healing usually takes up to 8 weeks. At this point, an attachment is bonded to the crown of the impacted tooth[11,12]. This approach can be recommended when bleeding compromises attachment bonding during surgery.
- One-step approach: The attachment is placed on the tooth at the time of surgical exposure. The advantage of this approach is avoiding the delay in the application of orthodontic traction.

Factors to consider when choosing open vs. closed technique

The main factors to consider when exposing using the open or closed surgical technique is gingival biotype and amount of keratinization. When the gingiva is attached,thick, and keratinized, we can do both techniques.

There are four important factors when selecting one exposure method over the other.

These factors are:

1. Presence of a dentigerous cyst;
2. Age of the patient;
3. The vertical level of impaction; and
4. Resorption of adjacent incisors.

Presence of dentigerous cyst

When we want to preserve the tooth, and there is presence of a dentigerous cyst, we can enucleate the cyst and expose and bond the canine at the same visit.

After cyst enucleation, spontaneous eruption can be anticipated depending on canine eruption potential.

Age of the patient

The root formation of maxillary canines is usually completed by the age of 13−15. If the impacted canine's root is not fully developed, spontaneous eruption using open exposure without traction might be anticipated. If the root apex is fully developed, there is little chance for the canine to erupt. Therefore, the tooth must be exposed (open or closed) with the application of active traction.

Resorption of adjacent tooth

External root resorption of teeth (especially incisors) adjacent to the impacted is not uncommon[13]. The inci-

dence of root resorption of the adjacent lateral incisor caused by PICs was found in 68% of the cases when cone-beam computer tomography (CBCT) was used[14]. Therefore, CBCT should be considered in cases where the prognosis of the impacted canine and/or adjacent incisors is uncertain to justify whether exposure of the canine or removal of severely resorbed incisors is indicated[15]. If the impact is associated with severe resorption of the roots of incisors, then an open exposure method is contra-indicated since it might endanger the vitality of the incisors[14]. In this case, closed exposure is used to prevent the vitality of the impacted canine and incisor.

Vertical level of impaction

The radiographic findings of the position of the impacted canine can determine the decision of which method is preferable. Taking the 'rule of thirds' into account, the closed exposure method is recommended for deeply impacted canines in vertical level III[16]. For canines positioned in level I or II, the open exposure method can be selected if the other three factors favor this method.

Outcomes of open versus closed exposure

The advantages of the closed-exposure surgical technique are patient comfort during the healing process and better periodontal outcome. The advantages of the open exposure technique and spontaneous eruption of the canine are: the ability to observe the impacted tooth movement during treatment, no need for attachment bonding at the time of surgery, fewer failures, and less need to re-expose the impacted canine[17]. However, the latest Cochrane review concluded that there is a lack of high-quality evidence in this area, and further studies are needed in order to compare the outcomes of the two techniques[18].

It seems apparent that the evidence is equivocal, and these factors are less likely to influence the decision when selecting one exposure method over the other[17].

Patient comfort and perception of recovery

The latest Cochrane review found a lack of high-quality evidence to support one technique over the other in terms of patient-reported outcomes[18]. Gharaibeh and Al-Nimri carried out a randomized prospective trial to compare patient perceptions of pain one week after having open exposure and closed exposure. It was found that clinically and statistically, there was no significant difference between the two methods. However, post-operative recovery seemed to be faster in the closed exposure group[19]. Londhe et al. suggested that the postoperative pain experienced by patients was similar, but the regression of pain was faster in the closed eruption technique[20]. The recovery period with the closed technique was significantly less than with the open technique. The perception of pain after surgical exposure of canines has been investigated in previous studies, which reported that there is no difference in the amount of pain between closed and open techniques. A moderate degree of discomfort was observed after the procedure, which disappeared a few days later[21,19]. A more recent multicenter randomized controlled trial reinforced the previous findings that there was no statistical difference between the two groups[21]. Chaushu et al. prospectively assessed patient perceptions of immediate postoperative recovery after the surgical exposure of impacted maxillary teeth with open exposure and closed exposure techniques. The comparison revealed that patients receiving an open exposure had a slightly longer recovery time[22]. However, no previous qualitative studies exploring patient perception and experiences with both techniques were found[17]. The postoperative recovery was longer after open eruption than the closed eruption technique. The mean recovery period was 72 ± 4 and 48 ± 3.5 h for open and closed eruption techniques, respectively ($P = 0.000$). Postoperative pain experienced by patients was similar, but regression of pain was faster in the closed eruption technique[20].

Periodontal health

Parkin et al. carried out a multicenter, randomized controlled trial. Periodontal health was assessed three months after the removal of fixed appliances. More specifically, the level of attachment, crown height, bone support, and gingival recession were investigated in terms of comparisons of mean differences between previously impacted canines and their normal contra-laterals for closed and open eruption techniques. The results showed that there was no difference between canines exposed with open and closed surgical techniques[23]. The other trial involved palatally impacted canines exposed using open exposure without traction and closed exposure. A study found that there was no statistical difference in periodontal outcomes in terms of mean pocket depth, gingival recession, bone support, and width of keratinized gingiva between the closed and open exposure technique[24]. During the assessment of periodontal pocket depth, it was found that teeth that were treated with the closed technique had better periodontal health. The distal aspect of the erupted canine showed increased periodontal breakdown[20].

Duration of the surgical exposure procedure

Gharaibeh, Al-Nimri, and Pearson et al. compared the operating times required to expose impacted canines surgically using the closed exposure method with the operating times required for the open exposure method. They reported that the closed exposure technique took longer to complete than the open exposure method[19,25]. Parkin et al. found the differences between the operating times not to be statistically significant[21]. The mean surgical time for the open eruption technique was 22.31±1.98 min, compared to 30.87 ± 2.38 min. for the closed eruption technique. The difference in time required for the two techniques was statically significant (P = 0.000)[20].

Orthodontic treatment time

Two retrospective studies found that the duration of orthodontic treatment of impacted canines treated by the open exposure method or by the closed exposure technique was not significantly different between the groups[26,27]. The time needed for the canine's eruption, more specifically the duration from the surgical exposure of the canine until it was well positioned in the line of the arch, did not differ between the two exposure techniques[26]. On the other hand, it was reported that the eruption of the impacted canine was quicker for the patient group treated with the open technique. These researchers assessed the duration from surgery until a bracket can be bonded on the middle of the canine's labial surface[24]. The total duration of the orthodontic treatment depends on the level of impaction. Patients who had Level I impaction required guided eruption by orthodontic traction for an average period of 3±1.3 months, patients with Level II took an average of 5±1.4 months, while Level III impactions required 7±1.43 months to attain their proper position in the dental arch[20].

Aesthetics

Parkin et al. recently carried out a multicenter randomized clinical trial to compare the aesthetic judgments of orthodontists and laypeople regarding the appearance of the impaction three months after treatment with either a closed or an open surgical exposure and orthodontic alignment[28]. The authors concluded that there is an aesthetic impact of aligning impacted canines, but it is mostly minor and unlikely to be detected by laypeople. Therefore, the aesthetic outcome is unlikely to affect the selection process of the exposure method. The results showed that there were no differences between the closed and open groups. The assessment of the inclination, shape, and color of the treated canines did not show any difference between the open and closed procedures[24].

Re-exposure

Concerns exist about the frequency of repeat surgery with both the open and closed exposure techniques. If the closed method is used, failure of the bonded attachment usually means that repeat surgery is required to uncover the impacted canine so that a new bonded attachment can be placed. When the open exposure technique is used, overgrowth of the healing wound margins surrounding the surgical defect can necessitate further surgery to provide adequate access to the impacted canine[17]. Pearson et al. compared 52 consecutive cases treated by the open exposure technique with 52 patients treated by the closed exposure method[25]. His study found that 8 of the patients (15%) treated by open exposure required repeat surgery as a result of gingival overgrowth or failure to erupt. However, nearly one-third (31%) of the 52 patients treated by the closed exposure method required a second operative procedure. Six patients (12 %) needed repeat surgery as the result of the failure to erupt; bond failure occurred in 3 patients (6%), and in 7 patients (13 %), the wire ligature attached to the orthodontic bracket fractured. Although repeat surgery (re-exposure) can be required with both the open and closed exposure methods, the published evidence appears to indicate that this problem is more often associated with the closed eruption method[21].

Ankylosis - related root resorption

Three main factors can cause trauma to the periodontal ligament or the cementum of the root of the impacted tooth and lead to ankylosis-related resorption:

1. The low-speed bur during exposure (both open and closed);
2. Chemical trauma to the periodontal ligament from the 35% phosphoric acid (this applies to open exposure as well as closed exposure);
3. Trauma to the periodontal ligament in the cervical region because of the direction or magnitude of the orthodontic force[17]. Thus, cervical root resorption can be a possible complication associated with both exposure techniques, especially if extensive bone removal is carried out beyond the cemento-enamel junction of the impacted canines[29].

Conclusions

The surgical procedure was longer in the closed technique as compared to the open technique.Postoperative pain experienced by patients was similar, but the regression of pain was faster in the closed eruption technique. The recovery period with the closed technique was significantly less than with the open technique. The total duration of orthodontic treatment depends on the level of impaction; the deeper the impaction, the longer the duration of treatment. Canines managed with the closed method had better periodontal health compared to canines managed with the open method.

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