

OPTIMIZING TREATMENT OF PALATALLY IMPACTED CANINES: EVIDENCE ON OPEN, CLOSED, AND GOPEX TECHNIQUES

ОПТИМИЗИРАЊЕ НА ТРЕТМАНОТ НА ПАЛАТИНАЛНО ИМПАКТИРАНИ КАНИНИ: ДОКАЗИ ЗА ОТВОРЕНА, ЗАТВОРЕНА И ГОПЕКС МЕТОДА

Chakar Kocovski S.¹, Gigovska Arsova A.², Gavrilovikj I.^{1,3}, Petrova E.¹

¹Department of Orthodontics, University Dental Clinical Center "St.Pantelejmon", North Macedonia, ²Department of Oral Surgery and Implantology, University Dental Clinical Center "St.Pantelejmon", North Macedonia, ³Faculty of Dentistry, Sts. Cyril and Methodius University, North Macedonia.

Abstract

Objective: Canine impaction is a common clinical challenge in orthodontic practice, with the majority of impacted canines located palatally. When interceptive treatment fails, surgical exposure followed by orthodontic treatment becomes necessary, typically using either open or closed exposure techniques. This review aims to compare the open versus closed exposure techniques, with a focus on optimizing clinical outcomes and patient-reported experiences. **Methods:** A comprehensive literature search was conducted using the following databases: Cochrane Library, PubMed, and Google Scholar. Reference lists from selected articles were hand-searched for additional relevant studies. The search focused on meta-analyses, systematic reviews, and clinical trials, evaluating of clinical outcomes such as orthodontic treatment duration, periodontal health, and pain levels. **Results:** The selected articles revealed comparable results between the open and closed exposure techniques, with a slight preference for the open exposure technique. The choice between these methods was often influenced by clinician preference. The modified open exposure technique demonstrated an average eruption time of 8.5 months for GOPEX compared to 11.5 months for closed exposure ($p = 0.002$). The GOPEX technique also resulted in reduced postoperative pain, with patients requiring fewer analgesics. **Conclusions:** Both the open and closed exposure techniques yield effective results. Although the GOPEX demonstrates advantages in treating palatally impacted canines, careful patient selection is crucial. This review highlights the importance of individualizing treatment plans based on clinical presentation and patient factors. **Keywords:** Orthodontics; Tooth, Impacted; Tooth Eruption; Oral Surgical Procedures; Glass Ionomer Cements.

Апстракт

Цел: Импакијата на канините претставува честа клиничка состојба во ортодонтската пракса, при што најголем процентод импактираните канини се палатално поставени. Кога интерцептивниот третман е неуспешен, неопходна е хируршка експозиција проследена со ортодонтски третман, најчесто со примена на отворена или на затворена техника на експозиција. Овој преглед има за цел да ги спореди отворената и затворената експозиција, со фокус на оптимизирање на ортодонтскиот третман на палатинално импактирани канини. **Методи:** Спроведено е сеопфатно пребарување на литературата во базите: CochraneLibrary, PubMed и GoogleScholar. Листата на референци на избраните трудови беше дополнително рачно проверена за релевантни студии. Пребарувањето беше насочено кон мета-анализи, систематски прегледи и клинички испитувања, од аспект на времетраење на ортодонтскиот третман, пародонтално здравје и болката. **Резултати:** Досегашната литература укажува на споредливи резултати меѓу отворената и затворената техника на експозиција, со преференца кон отворената експозиција. Изборот меѓу методите често е детерминиран од личниот избор на клиничарот. Модифицираната отворена техника покажа просечно време на ерупција на импактираниот канин од 8,5 месеци, наспроти 11,5 месеци кај затворената експозиција ($P = 0,002$). Техниката GOPEX, исто така, беше поврзана со помала болка по спроведената хируршка интервенција. **Заклучоци:** И отворената и затворената хируршка техника даваат ефективни резултати. Иако техниката GOPEX нуди одредени предности при третман на палатинално импактирани канини, клучна е внимателната селекција на пациентите. Овој преглед ја потенцира важноста на индивидуализирањена планот на третман според клиничката презентација и карактеристиките на пациентот. **Клучни зборови:** ортодонтска; импактиран заб; ерупција на заб; орално хируршки процедури; гласјономерни цемента.

Introduction

Maxillary canines play a vital role both functionally and aesthetically. In terms of occlusion, they are responsible for

canine guidance as well as arch form and stability. Their esthetic contribution includes the support of the upper lip and maintenance of facial contour¹. Due to their strategic position, canine impaction holds significant clinical importance.

Impaction of maxillary canines is a common clinical challenge, affecting approximately 2-3 % of the general population². They are the second most frequently impacted teeth after the third molars, with nearly two-thirds of these cases involving palatal impaction³. Maxillary canines are approximately twice as likely to be impacted as mandibular canines⁴.

While the etiology of the impacted canines is not fully elucidated, there are two main theories: the guidance theory, which suggests that the canine eruption path depends on the presence and correct development of the maxillary lateral incisor root and the genetic theory, which proposes that canine impaction is a manifestation of a broader genetic developmental pattern².

Even though impacted maxillary canines can be asymptomatic for a long period of time, they can pose a risk for the adjacent teeth. The most common complications include root resorption and cyst formation⁵. Root resorption associated with impacted canines is reported to occur more frequently in females and typically presents unilaterally. The maxillary lateral incisors are most commonly affected, although central incisors may also be involved in some cases⁶.

Impacted canines significantly increase the burden of orthodontic treatment as well. These cases often require a combination of surgical and orthodontic interventions, which can prolong treatment duration, increase cost, and increase both biological and patient-related complications⁷.

Interceptive treatment for palatally impacted canines between the ages of 10 to 13 most commonly involves extraction of the primary canine and/or gaining space with rapid palatal expansion and/or headgear traction. These treatment modalities have gained considerable popularity both historically and in current practice^{2,8}. This approach has been widely studied and can, in many cases, successfully redirect the eruption path of the permanent canine. However, it is not always effective, and when it fails, surgical exposure combined with orthodontic treatment becomes necessary.

There are two main surgical techniques for exposing palatally impacted canines: the open exposure technique and the closed exposure technique. Kokich and Mathews⁹ have outlined criteria to guide the choice between these methods, primarily based on the position of the impacted canine. Another important aspect is the timing of traction, whether immediate traction is applied or spontaneous eruption is allowed. However, in clinical practice, the decision is often less objective.

In reality, clinician preference plays a major role in selecting the exposure method. A study by Naoumova et al.¹⁰ evaluated which surgical technique orthodontists prefer for treating palatally impacted canines. The study reported an almost equal distribution among respondents:

28% preferred the open technique, 23% the closed, and 49% used both methods. This contrasts with findings from a UK-based survey, where 50% of clinicians favored the open exposure technique¹¹.

Therefore, the aim of this review is to analyze the latest literature comparing the open versus closed exposure techniques for palatally impacted maxillary canines, focusing on three key outcomes: orthodontic treatment duration, periodontal health, and pain.

Materials and methods

A comprehensive literature search was performed across the following databases: PubMed, Cochrane Library, and Google Scholar. The search aimed to identify relevant meta-analyses, systematic reviews, and clinical trials evaluating the management of palatally impacted canines, with particular focus on the open and closed exposure techniques. Search terms included combinations of “*palatally impacted canines*,” “*open exposure*,” “*closed exposure*,” “*GOPEX*,” “*pain*,” “*periodontal outcomes*,” and “*treatment duration*.”

Only studies published in English were included. Reference lists of the selected articles were manually screened to identify additional studies relevant to the topic.

Results

The findings from selected literature are presented based on the main outcomes investigated: orthodontic treatment duration, periodontal health and pain.

1. Orthodontic treatment duration

Three studies compared the overall orthodontic treatment duration between the open and closed exposure techniques^{12,10,13}.

In a randomized controlled trial, Björksved et al.¹² found that total treatment time was similar between open and closed exposure groups, with a mean difference of -0.1 months (95% CI -3.2 to 2.9; P = 0.93), averaging approximately 26.3 months in both groups.

A retrospective study by Naoumova et al.¹⁰ supported the finding that total treatment duration did not differ significantly between the groups. However, this study demonstrated a statistically significant (p = 0.002) shorter eruption time (8.5 months) and shorter active orthodontic treatment time in the modified open exposure group- GOPEX compared to the closed exposure group (11.5 months).

A controlled prospective study by Smailiene et al.¹³ supports previous literature that neither technique is clearly superior when looking at the total orthodontic treatment duration. In the study, the total treatment time was longer in the closed group, but the difference was not statistically significant (28.41±4.96 months in the open

exposure group and 32.19±11.73 months in the closed exposure group).

These findings are supported by the systematic review by Parkin et al.⁷, which concluded that while the total treatment time appears similar between techniques, the available evidence remains of low to moderate quality, and further well-designed RCTs are needed to confirm a true difference.

2. Periodontal health

Björksved et al.¹² found small but statistically significant differences between the groups. The open group showed deeper pocket depths at the lateral incisor: mesiopalatal: +0.5 mm (P=0.007) and palatal: +0.4 mm (P=0.042).

In contrast, alveolar bone levels were better preserved in the open group, with 0.3 mm less bone loss at the mesial surface of the previously impacted canine (P = 0.01).

Smailienė et al.¹³ evaluated periodontal parameters after the open and closed exposure of impacted canines. No significant differences were found in probing depth or clinical attachment level. However, the width of keratinized gingiva was significantly greater in the open group (4.05±1.57 mm) compared with the closed group (3.23±1.37 mm, P<0.05).

3. Pain

In the randomized controlled trial by Björksved et al.¹², patient-reported pain differed significantly between the open and closed exposure groups. During the initial phase from surgery to eruption (T1–T2), the closed group reported higher median VAS pain scores (19.0 mm; range 5–34) compared with the open group (2.0 mm; range 0–9; P<0.001). During the traction phase (T2–T3), pain scores remained higher in the closed group (10.0 mm; range 5–25.5) than in the open group (6.0 mm; range 1–12; P=0.014). Over the entire treatment period (T1–T3), cumulative pain was lower in the open group (median 4.5 mm; range 0–10.25) compared with the closed group (11.0 mm; range 5–27; P<0.001).

Discussion

This study aimed to evaluate the clinical efficiency of the open versus closed surgical exposure techniques in the management of palatally impacted maxillary canines, with a particular focus on orthodontic treatment duration, periodontal health, and pain.

While total orthodontic treatment duration was generally reported as comparable between the two methods, with most patients completing treatment in about 26 to 28 months, the underlying phases of treatment were distributed differently depending on the technique used.

Both Naoumova¹⁰ and Björksved¹² reported that eruption time was significantly shorter in the open exposure group, with a 3-month advantage observed from surgery to the point at which the canine crown became visible. In addition, active

traction time was shorter in the open group in Naoumova's study and supported by fewer appointments¹⁰.

So how is it possible that eruption is faster in the open group, yet total treatment time remains comparable? According to Björksved et al.¹², this is because the second part of treatment, from visible eruption to full alignment-takes longer in the open group. When the canine is left to erupt spontaneously, it often emerges more palatally or in a less controlled position, so it takes more time to align it correctly. On the other hand, in the closed group, traction starts early and guides the tooth more directly toward its final position in the dental arch.

One important point raised by Smailienė et al.¹³ is that the shorter eruption time observed in the open exposure group may not be entirely due to the surgical technique itself, but rather influenced by the fact that a higher percentage of canines in this group were more superficially positioned (81.8% vs. 61.9%). Although this difference was not statistically significant, these teeth may have required less time to erupt simply because they did not need to penetrate as much soft tissue.

This brings up a bigger issue: the differences between studies in how patients are selected and how outcomes are measured. As highlighted in the Cochrane review by Parkin et al.⁷, the heterogeneity in study design makes it difficult to compare results directly or to draw broad conclusions.

One of the key factors influencing the choice of a surgical exposure technique is the anatomical nature of the overlying soft tissue. In some cases, clinicians prefer to keep the tissue intact to support better healing. According to a survey by Naoumova et al., many orthodontists who preferred the closed technique believed it offered better protection for periodontal health¹⁰.

Björksved et al. reported statistically significant differences in pocket depth and alveolar bone levels between groups; however, these differences were small and considered not clinically relevant, as they did not exceed 3 mm. Specifically, deeper pockets were observed at the lateral incisor in the open group, while lower mesial bone levels were found in the closed group at the site of the previously impacted canine. Ideally, surgical-orthodontic approaches should mimic the natural eruption pathway through the attached gingiva. Since the palatal mucosa primarily consists of attached gingiva, both open and closed exposure techniques are considered periodontally acceptable in this region¹³.

Although pain is a subjective outcome, it provides valuable insight into the patient's overall experience during orthodontic treatment. Patients treated in the closed exposure group reported statistically significantly higher levels of pain and discomfort compared with those in the open exposure group, particularly during the orthodontic traction phase¹². From a clinical perspective, these findings high-

light the importance of effective patient communication and expectation management throughout treatment. Patients should be informed that discomfort may occur at different stages depending on the chosen technique: open exposure tends to be associated with greater pain immediately after surgery due to the open wound, whereas closed exposure is associated with greater pain during the active orthodontic traction phase. This distinction has practical implications for the timing of pain management strategies and patient support, ensuring that discomfort is anticipated and appropriately managed at the stage when it is most likely to occur.

While both open and closed exposure techniques have shown comparable outcomes, modifications of the open technique have recently been introduced to enhance biological healing and patient comfort, most notably the GOPEX approach.

The GOPEX (Glass Ionomer Open Exposure) technique is a modified version of the standard open exposure method. Unlike the conventional approach, which uses a surgical dressing, GOPEX employs a glass ionomer as a long-term biocompatible dressing. Glass ionomer is strong, resistant to salivary dissolution, and can safely remain in the oral cavity until the canine erupts onto the palatum. This modification provides a stable and durable exposure, supporting the spontaneous and physiological eruption of the impacted canine¹⁰.

From the results, the open exposure technique has been shown to provide faster eruption and lower pain levels compared with the closed technique. The GOPEX builds on these benefits and offers several additional advantages. It promotes spontaneous and more physiological eruption, reduces the risk of root resorption in adjacent teeth, and, importantly, allows for effective pre-orthodontic surgical exposure. This means that the technique can be performed even before comprehensive orthodontic treatment begins, making it suitable for use in the mixed dentition stage. Because GOPEX shortens the period of active orthodontic traction, it reduces overall chair time, which indirectly translates into lower costs for both the healthcare system and the patient^{10,14}.

Nevertheless, as with all techniques, GOPEX has limitations. Its success is closely related to patient age, being most appropriate for individuals up to approximately 16 years of age, since the risk of ankylosis increases with advancing years. Furthermore, it is not recommended in cases of complex impactions or when the canine is positioned very close to the roots of the central or lateral incisors, where the risk of resorption is higher. In such situations, a preliminary orthodontic distalization of the impacted canine should be considered before exposure.

These findings emphasize that refinements such as GOPEX could represent an important step forward in opti-

mizing outcomes, though proper case selection remains essential.

Conclusion

Both open and closed exposure techniques are well-established and effective approaches for the treatment of palatally impacted canines, with evidence supporting their clinical validity. The GOPEX technique, although not entirely novel, has been the subject of increasing investigation in recent years and appears to confer additional advantages that are clinically significant. By integrating the principles of open exposure with the use of a glass ionomer as a durable and biocompatible dressing, GOPEX facilitates spontaneous eruption and may reduce treatment-related discomfort and chair time. These findings suggest that GOPEX represents a valuable adjunct to current clinical practice, warranting careful consideration in appropriately selected patients.

At the same time, the evidence base remains limited by methodological constraints. The Cochrane Review⁷ emphasized the lack of stratification by the severity of impaction as a major limitation in the literature. Supporting this, Grisar et al.¹⁵ found that the initial canine position, particularly vertical height and sector location, significantly affects eruption outcomes. Together, these findings highlight the need for future studies to classify cases by impaction severity when comparing open and closed techniques, allowing for more personalized and clinically relevant treatment decisions.

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