



Original Article



Comparison of Open and Close Exposure with Orthodontic Traction of Impacted Maxillary Canine in Orthodontic Treatments

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ABSTRACT

Labial impactions make maxillary canines the most affected permanent teeth after third molars, at one third. Orthodontic advice is often needed for impacted canines. **Objective:** To compare the outcomes of open and close exposure with orthodontic traction of impacted maxillary canine in orthodontic treatments. **Methods:** In this comparative prospective cohort study 54 patients with labial impacted maxillary canine were included in this study. Study was conducted from Jan 2023 - Jun 2023. Non-consecutive sampling technique was used. 27 patients were managed with open technique in group I and 27 patients with closed eruption technique in group II. The evaluation encompassed a comparison of two surgical exposure methods (open and closed) mobility, vitality, periodontal health, amount of impaction, length of orthodontic therapy, and postoperative discomfort. **Results:** Compared to the close eruption approach, the postoperative recovery time for open eruption was significantly greater ($P < 0.05$). Patients reported comparable levels of postoperative discomfort; but, the closed eruption approach resulted in a more rapid resolution of that pain. The open eruption approach required less time during surgery on average compared to the closed eruption technique ($P < 0.05$). In a direct correlation with the amount of impaction, the overall length of orthodontic treatment was shown to be longer for deeper levels of impaction. Both methods produced canines with comparable levels of energy and movement. **Conclusions:** In this study, the closed eruption approach took longer but reduced postoperative pain faster. Orthodontic therapy took longer with deeper impaction. Closed eruption surgeries improve periodontal tissues surrounding guided erupted teeth.

INTRODUCTION

When it comes to the structure, appearance, and function of the dental arch, canines play a pivotal role [1]. Impaction affects 2% of the population, making them the most impacted tooth in dental patient after third molars [2]. They tend to be unilateral and most often seen in the palatal area; they are more prevalent in the maxilla [3]. Impaction of the upper canine can be caused by a variety of circumstances, however the specific reason is unknown [1]. In order to diagnose impaction and plan and execute the therapy appropriately, clinical and radiographic exams are conducted, along with the determination of the site [4-6].

The location, canine angulation with respect to neighboring teeth, and presence or absence of ankylosis are factors that determine treatment prognosis [7]. Possible treatments include canine extraction and premolar relocation, auto-transplantation, prosthetic rehabilitation for occlusal harmony, or a combination of surgical and orthodontic procedures to bring the tooth into proper alignment with the jaw, among others [8]. A lack of room in the dental arch is the primary cause of buccal impaction. The genetic and guidance hypotheses have both been put out as possible explanations for palatal

impaction. Some dental abnormalities, including hypoplasia of the enamel, microdontia of the maxillary lateral incisor, and hypodontia of the second premolar, can coexist with the eruption anomaly of the maxillary canine, which, according to genetic theory, is the consequence of a developmental disruption of the dental lamina. There is evidence for this notion in gender differences, bilateral occurrences, and families [9]. As the maxillary canines glide along their roots during eruption, the root of the lateral incisors acts as a guide, according to the guiding theory. If the directed eruption is disrupted in any way, a palatal impaction might occur. So, palatal impaction can occur if this directed eruption is interrupted. The maxillary lateral incisor missing, extra teeth, odontomas, tooth bud displacement (transposition), and cystic or neoplastic development are all examples of disorders [10]. Early detection of impacted maxillary canines is critical for reducing treatment time, expense, and complexity [11]. Radiographic imaging and clinical examination (palpation and ocular inspection) can confirm the presence of impacted maxillary canines. The dental literature has documented several clinical signs of impaction, such as the delayed eruption of the permanent canine, distal tipping, abnormal migration of the lateral incisors, absence of a labial canine bulge, presence of a palatal bulge, prolonged retention of deciduous canines, or both [12]. Therefore, it is important to determine the normal eruption timing of teeth in the examined population [13]. When caught early, impacted teeth may be able to improve their position or even spontaneously erupt with the use of interceptive orthodontic therapy, such as space formation [14]. By utilizing an apically relocated gingival flap or by entirely removing the bone and soft tissue directly overlaying the affected canine, the crown can be surgically exposed in the open approach. The next step is to use a surgical pack to cover the incision. The canine can then be let to erupt on its own or orthodontic attachments can be bonded directly to the canine for direct traction. On the flip side, the modern closed approach entails bonding an attachment to the exposed canine crown after raising a complete mucoperiosteal flap. Following the first healing period, the orthodontic traction is applied and the flap is moved again. This process continues until the canine emerges in the mouth and is then directed to the dental arch. Although both methods have been around for a while, are flexible, and can be adjusted to fit any situation, there has been conflicting information on how well they compare. Pain, periodontal health, aesthetics, recuperation time after surgery, and overall performance have all been the subject of several research [15]. Using two distinct surgical exposure procedures, this study aimed to examine the final orthodontic alignment of patients with labially impacted maxillary canines and evaluate the post-treatment effects. Impacted maxillary canines are a common orthodontic

challenge due to their functional, esthetic, and periodontal significance, yet the optimal surgical exposure technique remains controversial. Although both open and closed eruption methods are widely practiced, existing literature reports inconsistent findings regarding treatment duration, postoperative recovery, pain, and long-term periodontal outcomes, particularly in labially impacted canines within local clinical populations. There is limited prospective comparative evidence from Pakistan evaluating these techniques under similar treatment conditions. Therefore, this study aimed to compare open versus closed surgical exposure with orthodontic traction in terms of surgical time, postoperative discomfort, recovery, and periodontal health to identify the more effective treatment approach for impacted maxillary canines.

METHODS

This comparative prospective cohort study was conducted at CIMS Dental College/CMH Multan after getting approval on 7th Dec 2022 with reference no.786/CDC/IRB/12-04. After getting informed written consent detailed demographics were recorded. Non-consecutive sampling technique was used. The calculated sample size was via Open epi sample size calculator by taking mean surgical time in open technique 22.31 ± 1.98 min and in closed 30.87 ± 2.38 min by taking 95% Confidence interval and 80% power of test, was 4 which was too small to perform statistical test. So, 54 patients (27 in each group) were taken [16]. The inclusion criteria were impacted maxillary canines with A2 (tooth angulation to the midline $16^\circ - 45^\circ$), V1 (vertical height of the tooth crown above the cemento-enamel junction but less than half the length of the root of the maxillary lateral incisor), and O3 (medial position of the canine crown of more than half but less than the entire root width of the lateral incisor). Exclusion criteria were the medical issues that affect tooth movement or ability to use the required mechanics, the patients had no associated syndrome, alveolar cleft and/or palate, or previous tooth loss due to trauma, caries, periodontal disease, or orthodontic extraction. Over the course of six months (Jan 2023- Jun 2023) participants were chosen from a pool of patients who needed orthodontic eruption or instruction for labially impacted maxillary canines. The surgical step involved comparing two methods of guided eruption, one open and one closed. Patients were equally divided in two groups. Minor differences exist in open technique as compared to closed. In this procedure, the canine tooth is surgically exposed, but instead of bonding an attachment, a tissue window is removed to expose it. Covering the exposed area with a dressing or 'pack' After 10 days, the dressing is removed. The tooth is either left to erupt naturally or aligned with the other teeth with an orthodontic attachment above the gum. The closed method includes

surgically exposing the teeth and pasting a gold chain attachment. The chain exits the mucosa when the palatal flap is adjusted and sutured. While formerly hard in the surgical theater, new self-etch adhesive bonding solutions have simplified the bonding method. After surgery, an orthodontic brace gently moves the canine into the dental arch. After emerging through the mucosa, the canine positions itself. The research team advice an Orthopantomograph (OPG) measurement of the impacted tooth's distance from the alveolar edge as a means of categorizing affected maxillary canines. Level I was assigned to distances between 1 and 5 mm from the alveolar edge, Level II to distances between 5 and 7 mm, and Level III to distances more than 7 mm. Patients' perceptions of pain during and after surgery were evaluated using a visual analog scale. The analog scale was used to record the following levels of pain: severe (8-10), moderate(4-7), and mild(1-3). The evaluation encompassed a comparison of two surgical exposure methods (open and closed) in terms of pain, recovery time, complications and periodontal pocket depth. To ensure root resorption and lamina dura continuity, Radiovisiography (RVG) was performed on all instances at the end of therapy. In order to determine the periodontal status of the erupted canines, measured the pocket depth on each of the four sides of the guiding tooth. Data were entered and analyzed by SPSS version 25.0. All the qualitative variable was presented by frequencies and percentages and qualitative with mean ± SD. The comparison of two surgical exposure methods (open and closed) in terms of pain, recovery time was compared by independent sample t-test and complications and periodontal pocket depth with Chi-square test. P-value <0.05 was considered as significant.

RESULTS

There were 34 (63.8%) females and 20 (36.2%) males among all cases(Figure 1).

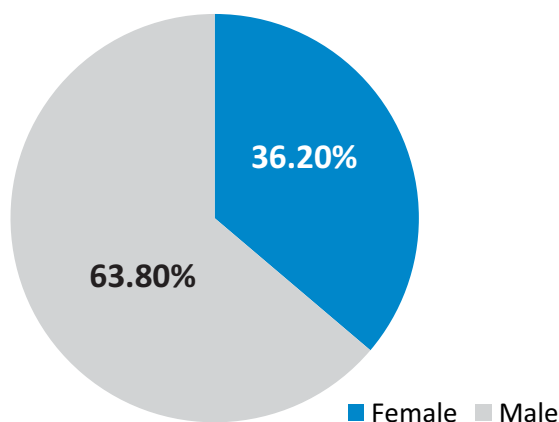


Figure 1: Gender Distribution of Presented Cases

Mean age of the cases in group I was 27.30 ± 5.75 years and in group II mean age was 25.17 ± 10.82 years. In group I right

canine impaction was found in 12 (44.4%) cases and left canine in 14 (51.9%) cases while in group II right canine in 11 (40.7%) and left canine in 15 (55.6%) cases. Surgical mean time in group I was 23.17 ± 8.28 minutes and in group II mean time was 31.17 ± 10.42 minutes(Table 1).

Table 1: Demographics and Surgical Time of both Techniques (n=27)

Variables	Group I (Mean ± SD)	Group II (Mean ± SD)
Mean Age (Years)	27.30 ± 5.75	25.17 ± 10.82
Canine		
Right	12 (44.4%)	11 (40.7%)
Left	14 (51.9%)	15 (55.6%)
Bilateral	1 (3.7%)	1 (3.7%)
Surgical Time (Minutes)	23.17 ± 8.28	31.17 ± 10.42

The average pain rating for patients who underwent a closed eruption process was 3.1 ± 0.3, whereas for patients who underwent an open eruption method it was 3.12 ± 0.4, and there was no statistically significant difference (P = 0.12). The time required for recuperation following open eruption surgery was more than that of the close eruption method with p value <0.05. Post-operative, there was no any significant different was observed in complication between both groups(Table 2).

Table 2: Comparison of Pain and Recovery after Treatment (n=27)

Variables	Group I (Mean ± SD)	Group II (Mean ± SD)	p-value
Pain Score	3.1 ± 0.3	3.12 ± 0.4	0.120
Recovery Time (hour)	74.8 ± 6.18	49.04 ± 3.14	<0.050
Complications			
Yes	1 (3.7%)	2 (7.4%)	<0.001
No	26 (96.3%)	25 (92.6%)	

No statistically significant difference was seen in the mobility and vitality of the guided canine between the two methods. Periodontal pocket depth evaluations revealed that closed method treated teeth exhibited superior periodontal health(Table 3).

Table 3: The Periodontal Pocket Depth

Variables	Open Technique (Mean ± SD)	Closed Technique (Mean ± SD)	p-value
Mesial (mm)	2.7 ± 1.5	2.4 ± 1.61	0.110
Distal (mm)	3.14 ± 2.12	2.3 ± 0.10	0.200
Buccal (mm)	1.9 ± 2.10	2.15 ± 10.6	0.130
Lingual (mm)	2.0 ± 0.55	2.18 ± 8.24	0.121

Independent T test was utilized

DISCUSSION

A tooth is considered impacted if it has lost its ability to erupt fully or partially into its proper location in the dental arch. The maxillary canine and third molars are among the permanent teeth that often go loose. Between one and two and a half percent of cases include the maxillary canine [17]. After a comprehensive clinical and radiographic assessment, the decision to keep or remove the impacted

tooth is made. Although there is a common agreement on how to remove an impacted third molar tooth from the mandible or maxilla, a canine tooth requires a distinct approach. Because teeth are so important to the dentition, preserving them is the greatest way to keep the dental arch looking good and functioning well [18]. Collaboration is key when guiding the tooth into proper occlusion. A full-thickness mucoperiosteal incision is made and the affected tooth is exposed under local anesthetic during surgical extraction. There are two ways to accomplish this: the open technique and the closed method [19]. Re-exposure in the event of bonded connection failure is one of the key drawbacks of the closed approach, although faster healing and less aggressive bone removal are two of its primary benefits. Although the open approach has its benefits, such as the ability to easily rebound attachments in the event of bond failure, it also has certain drawbacks, including as the increased exposure of bone, the increased risk of infection, and the worsening of periodontal health. When all the teeth are erupted, orthodontic treatment of a malocclusion takes less time. The average pain rating for patients who underwent a closed eruption process was 3.1 ± 0.3 , whereas for patients who underwent an open eruption method it was 3.12 ± 0.4 , and there was no statistically significant difference ($P=0.12$). Results were in line with studies conducted in past in post-operative pain score among both groups were insignificant [20-22]. The time required for recuperation following open eruption surgery was more than that of the close eruption method with p value <0.05 . Post-operative, there was no any significant different was observed in complication between both groups. These were comparable to the study conducted in past [23]. In current study, surgical mean time in group I was 23.17 ± 8.28 minutes and in group II mean time was 31.17 ± 10.42 minutes. These results were agreed with previous studies conducted by Izadikhah I and Cassina C et al [14, 15]. However, when the maxillary canine is impacted, the process takes longer. Contrary to the findings of a previous study, which found that the time required by closed technique was significantly less than open technique, this study found that the open technique was the more time-consuming of the two surgical techniques [21]. The current study utilized MIP, which shortened the attachment bonding period. Various techniques for applying physiological pressure on impacted teeth in the upper jaw were detailed. Other supplementary mechanics enable the traction of an impacted maxillary canine into the dental arch, in addition to the standard golden chain and elastic techniques. Because the incisor is guided near to the resorptive follicle of the impacted canine and experiences a significant torque during conventional alignment, the surrounding lateral incisors may be at risk of resorption [22]. Preventing

root resorptions of lateral incisors requires careful movement management of impacted maxillary canines. The temporary anchoring device described by past study can make this possible [24]. Another useful approach that may be employed both before and during the leveling process was published by Raghav et al [25]. The segmented arch technique's static mechanics allowed to claim an efficient and predictable output [26]. Using two distinct approaches, the initial stage of this investigation involved making enough room for the affected canine to be traced into its proper location in the arch. According to previous study, a simple biomechanical exercise can be used to tip the crown of an impacted maxillary canine into the proper position within the dental arch if its apex is in line with the arch in the buccopalatal and mesiodistal planes [27]. This study was able to include the same biomechanic because of the angulation, tilting, and vertical orientation inclusion criteria for the location of the impacted maxillary canine. In current study, no statistically significant difference was seen in the mobility and vitality of the guided canine between the two methods. Periodontal pocket depth evaluations revealed that closed method treated teeth exhibited superior periodontal health. When it comes to treating impacted canines, previously proposed that the open technique would yield better periodontal outcomes than the closed technique. This is because the former allows for better cleansability and causes less trauma to the periodontal tissue during the canine's natural eruption [28]. The results from this investigation show the opposite to be true. A Gingival Index (GI) score was used to quantify the results of a clinical assessment of gingiva color, size, and texture. The GI score was much greater in the open group compared to the closed surgical groups, indicating a worse result for the open group individuals. The dogs in the open group also showed a significantly higher plaque index compared to those in the closed group. One possible explanation for the contradictory findings is that the sample size is too small to draw any firm conclusions from the data we have collected thus far. No evidence found that participants in the open surgical group had better outcomes than those in the closed surgical group with respect to clinical attachment level. This agrees with previous study [29].

This study has several notable limitations, including a relatively small sample size of 54 patients and a short follow-up period of only six months, which may restrict the generalizability of the findings. The non-consecutive sampling technique further introduces potential selection bias, and the single-center design limits applicability to broader clinical populations. Future studies should incorporate larger, multi-center randomized controlled trials with longer follow-up periods to better assess long-term periodontal outcomes, relapse rates, and patient

satisfaction. Additionally, incorporating three-dimensional imaging such as CBCT and patient-reported quality-of-life measures would provide more comprehensive and objective comparative data between open and closed eruption techniques.

CONCLUSIONS

In this comparative study, the closed eruption approach took longer but reduced postoperative pain faster. Orthodontic therapy took longer with deeper impaction. Closed eruption surgeries improve periodontal tissues surrounding guided erupted teeth.

Authors' Contribution

Conceptualization: NW

Methodology: MAB, T

Formal analysis: AHK

Writing and Drafting: MAK, SL

Review and Editing: MAK, SL, MAB, T

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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