Treatment of Labially Impacted Canine, Keys to Successful Outcomes in Periodontal Perspectives

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Abstract: Maxillary canines are the most commonly impacted teeth following third molars. Considered as the cornerstone of the dental arch, appropriate treatment of these impacted canines should be applied in order to maintain the function and esthetic integrity. Labially impacted canines are not uncommon in Asian countries, and it is often challenging to manage them without the esthetic or periodontal consequences. The apical positioned flap (APF) is one of the periodontal procedures that has been proposed to expose labially impacted canines. The APF technique can provide adequate attached gingiva, good visibility and faster canine retraction during orthodontic treatment; however, it is technique-sensitive. Therefore, in this article, two cases of labially impacted maxillary canines treated with an APF and orthodontic treatment are presented, and the keys to successful treatment outcomes in periodontal perspectives are discussed.

Keywords: Apically positioned flap, CBCT, Labially impacted canine.

INTRODUCTION

The spatial positions of the maxillary canines and incisors in relation to each other and to the mandibular anterior teeth play a critical role in harmonious occlusion and masticatory function [1]. The anatomy of the maxillary anterior teeth and their relationship to the surrounding soft tissue also determine the micro- and macro-esthetics of the face [2]. The canine is considered as the cornerstone of the dental arch. It is particularly important in providing mutually protected occlusion during lateral excursions and function of temporomandibular joint complex [3].

Maxillary canines are the most commonly impacted teeth following third molars, with a prevalence of about 1 to 5% of the population [4-7]. The incidence of impacted maxillary canines has been reported to be higher at the palatal aspect. Epidemiological studies have found more palatally impacted canines in European population and more labial impaction in Asian countries [8, 9].

Early diagnosis and treatment of an impacted canine avoid the potential risk of incisor roots resorption [10]. Generally, the maxillary canines erupt at the age of 10.8 – 11.6 years [11]. Seventy percent of the children clinically have buccally palpable maxillary canines at the age of 10 and the number increases to 95% at the age of 11 [12]. When the canine bulge is not palpable, radiographic images are indicated to determine a possible ectopic eruption of the canine. Most patients who have had a dental examination at 9-11 years of age by a general dentist do not have proper evaluation and documentation of the maxillary canine. Due to this oversight, a delay occurs in the diagnosis of impacted maxillary canines and a higher incidence of root resorption of adjacent teeth (13%) [13]. In order to prevent delayed diagnoses of impacted canines, a referral to the orthodontists should be considered if clinical signs of canine impaction are present. The American Academy of Periodontology (AAP) suggests that CBCT may be useful in the management of the patient who presents with impacted teeth requiring surgical exposure. Compared to two-dimensional (2D) radiographs, cone-beam computed tomography (CBCT) is superior in locating the position of ectopic canines, assessing their inclination in relation to the adjacent teeth, and evaluating the root conditions of adjacent teeth [14, 15]. Haney *et al*. [16] concluded that CBCT imaging can produce different diagnoses and treatment plans, compared to diagnosis based upon 2D radiographs. CBCT imaging is essential for a proper diagnosis and treatment plan involving a canine exposure and tooth movement.

Early interceptive treatment to prevent maxillary canine impaction can be successful if the etiologic factors are addressed and corrected [17, 18]. When the canine dose not response after addressing the etiologic factors, surgical exposure of the impacted canine

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E-ISSN: 2311-8695/20

should be considered in conjunction with orthodontic treatment to retract it into the arch in order to preserve the function and esthetic integrity. In order to expose a labially impacted maxillary canine, there are three well-accepted methods that have been proposed: gingivectomy, apical positioned flap (APF), and closed-eruption (CE) technique [4]. Gingivectomy is only indicated when the crown of the impacted canine is coronal to the mucogingival junction without any bone coverage of the crown and an adequate amount of keratinized gingiva can be predicted after soft tissue excision [19]. In most cases, either the APF or the CE technique has been selected based upon the clinician's preference [20-22].

The apical positioned flap is a technique-sensitive periodontal surgical procedure which requires thorough knowledge of periodontal anatomy, tissue response, and precise execution in periodontal plastic surgery. The purpose of this article is to (1) present two cases of labially impacted maxillary canines treated with an APF and orthodontic treatment, and (2) discuss the keys to successful outcomes in periodontal perspectives.

CASE 1

A healthy Caucasian male aged 13 years 10 months presented with the chief complaint, "My left canine is stuck and there is a small gap between my front teeth." (Figure **1a** and **b**). He had unilateral Angle Class II molar on the left and Class I on the right molar relationships with a maxillary diastema. His maxillary midline coincided with his facial and mandibular midlines while the overjet and overbite were 3 mm. The

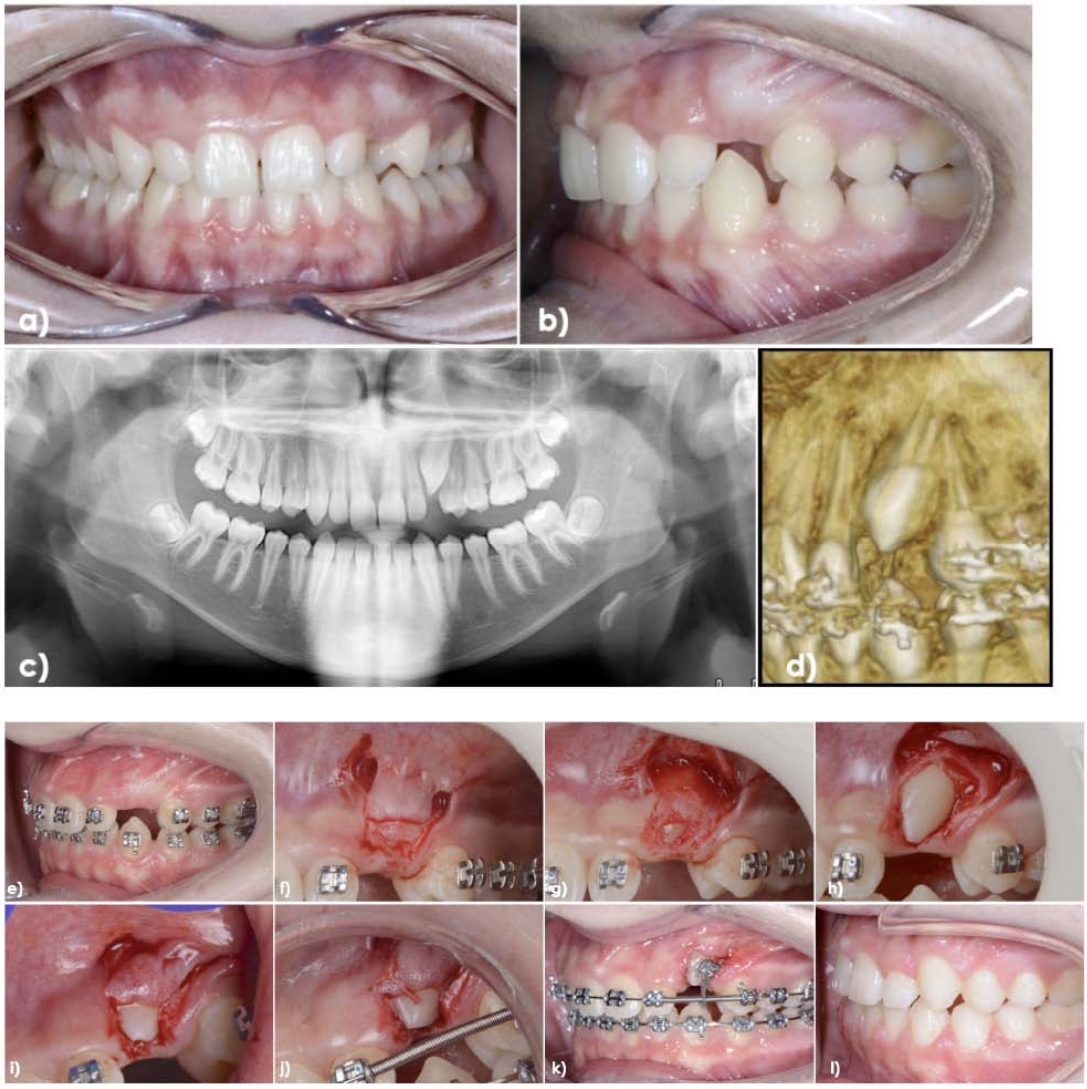

Figure 1: a) and **b**) initial intraoral photographs, **c**) panoramic radiograph in the initial visit, **d**) CBCT 3D reconstruction image, **e**) pre-surgery after space management, **f**) the flap design with intrasulcular and vertical-releasing incisions, **g**) the reflection of partial-thickness flap, **h**) the completion of bone removal, **i**) placement of flap margin over the CEJ and cover 2 to 3mm apical of crown, **j**) mucoperiosteal sutures, **k**) canine retraction after a week of the exposure, and l) post-orthodontic treatment.

maxillary arch had a space between the maxillary left lateral incisor and first premolar, and the mandible had excessive spaces. Initial panoramic radiograph showed a maxillary diastema and an impacted canine on the left (Figure **1c**). All of the third molars were developing. CBCT imaging was taken to evaluate the location of the canine, the size of follicle, the relationship between the canine and lateral incisor, and the condition of the root on the left lateral incisor (Figure **1d**). The left canine impaction was confirmed, the follicle size was minimum, the lateral root resorption was not detected, and there was a sufficient distance between the lateral incisor and the canine. In this case, the etiology was arch length discrepancy, and there was minimum risk of damage to surrounding structures. The priority was space management to create enough room for the left canine retraction rather than the canine exposure. As a first step, it is critical to evaluate the urgency to expose the impacted canine. In general, the proper sequence is preparing adequate space to accommodate the canine into the arch followed by the canine exposure.

After placing a fixed appliance, leveling and aligning was begun and adequate space for accommodating the canine into the maxillary arch was prepared (Figures **1e**).

Since there was a sufficient amount of keratinized gingiva at the maxillary left canine area, a crestal incision and two vertical-releasing incisions were made under local anesthesia (Figures **1f**). A split-thickness flap was elevated with maintaining the same gingival dimensions as the adjacent teeth and all muscle insertions were eliminated in order to facilitate its apical reposition (Figures **1g**). The underlying connective tissue was removed from the labial surface of the bone. Special care was taken not to damage the enamel during the time of using rotary instruments, especially addressing the canine impaction with small or no follicle (Figures **1h**). It must be emphasized that bone reduction should not be performed beyond the CEJ. Damaging periodontal ligaments or cementum may result in partial ankylosis, external root resorption, or attachment loss. It is essential that the flap be placed 2 to 3 mm over the CEJ (Figures **1i**). We recommend placing the flap more coronally in order to prevent excessive apical migration or gingival recession during or after orthodontic treatment. Patients should be informed that gingivectomy may be required at the end of the treatment. Mucoperiosteal sutures with 4-0 chromic gut were placed at the mesial and distal area of the tooth to stabilize the flap, and the periodontal dressing was placed on the surgical site (Figure **1j**). The dressing was removed after a week and tooth movement was begun immediately (Figure **1k**). The total treatment time was 24 months to complete this case (Figure **1l**).

CASE 2

A 12-year-6-month old Caucasian male presented with the chief complaint of delayed eruption of the maxillary canines (Figure **2a** and **b**). Additionally, he complained about the gaps between his teeth. His medical history was noncontributory, and his oral hygiene was fair. On intraoral examination he had a bilateral Angle Class II molar relationships with a maxillary diastema, missing lateral incisors. His maxillary midline coincided with his face, and mandibular midline deviated 2 mm toward the right. The overjet and overbite were 1.5 mm and 4 mm, respectively. The maxilla and mandible had excessive spaces. Initial panoramic radiograph showed bilaterally impacted canines, congenitally missing lateral incisors, and partial development of all third molars (Figure **2c**). In order to evaluate the location of the canines, the relationship between the canines and central incisors, and the condition of the roots on the incisors, CBCT imaging was taken (Figure **2d**). Horizontal canine impaction was confirmed, and the root resorption of central incisors were observed. The patient was diagnosed as low mandibular plane angle, skeletal Class II, bilaterally Angle Class II div 2, congenitally missing maxillary lateral incisors, horizontal labially impacted canines, and deep bite.

His father requested no implants and restorations. After discussion with the patient and his parents, surgical canine exposures and canine substitution with minimum crown recontouring were included in the treatment plan.

Due to the active canine eruption, active root resorption of central incisors, and large follicles, canine exposures were urgent and performed under local anesthesia (2% lidocaine with epinephrine, 1: 100,000) immediately after bonding brackets. In order to preserve the maximum amount of keratinized gingiva, an intrasulcular incision was employed around the deciduous canine, and two vertical-releasing incisions that extended into the alveolar mucosa were made (Figures **2e** and **f**). A split-thickness flap was carefully elevated while maintaining the same dentogingival dimensions as the adjacent teeth and all muscle insertions were eliminated in order to facilitate its apical displacement (Figures **2g**). The underlying connective tissue was removed from the labial aspect of the tooth, covering bone around the crown was removed, and the

Figure 2: **a**) and **b**) initial intraoral photographs, **c**) panoramic radiograph, **d**) CBCT 3D reconstruction image, **e**) pre-surgery incision design right after orthodontic appliance was placed, **f**) intrasulcular and vertical-releasing incisions, **g**) the reflection of partial-thickness flap, **h**) the completion of bone removal, **i**) mucoperiosteal sutures, **j**) canine retraction with a swinging gate after a week of the exposure, **k**) pre-orthodontic treatment, and **l**) post-orthodontic treatment.

canine was exposed (Figures **1h**). The flap was placed more coronal to the CEJ in order to establish proper dentogingival complex and accept some apical migration of the marginal tissue during the canine retraction (Figures **2i**). Mucoperiosteal sutures with 4-0 chromic gut were placed at the mesial and distal area of the tooth to stabilize the flap, and the periodontal dressing was placed to secure the flap. The dressing was removed after a week and tooth movement was begun immediately (Figure **2j**). The total treatment time was 37 months. Due to his father's requests, equilibration of the labial and palatal crown surfaces of the canines was minimal. Irregular gingival architecture which includes intrusion of central incisors and first premolars, and extrusion of the canines was not addressed. Figures **2k** and **l** showed pre- and post-orthodontic treatment.

DISCUSSION

The etiology of a labially impacted canine may be divided into 3 categories; pathology (supernumerary

teeth, cysts or tumors), trauma (history of dentoalveolar trauma), and arch length deficiency (transverse deficiency, mesial migration of posterior teeth). When pathological conditions or history of trauma are not present, labial canine impaction is mostly associated with transverse (dental and skeletal) deficiency [23].

Labially impacted maxillary canine is often challenging to manage without the occurrence of adverse esthetic or periodontal problems. The treatment outcome will be compromised once uneven gingival margin, inadequate attached or keratinized gingiva, scar formation, and periodontal attachment loss occur after healing [22]. Providing adequate width and thickness of keratinized gingiva around the canine is key to successfully maintain a healthy periodontal apparatus in the long-term. The APF and the CE techniques are the two most common surgical procedures to treat labially impacted canines. The CE has been believed to provide the best esthetic and periodontal results in cases where the impaction is significantly apical to the mucogingival junction or deep in the alveolar bone [22-24]. The disadvantages to this technique are the difficulty of controlling the direction of canine retraction, unexpected gold-chain disengagement from the crown surface during the orthodontic treatment, and longer treatment time, which might cause failure of tooth retraction and root resorption on the adjacent teeth.

The APF technique is a commonly used surgical technique in periodontal surgery which allows periodontists to control the amount and thickness of keratinized gingiva around the canine. The APF is applied for most of labially impacted canines. This technique provides an adequate attached gingiva, good visibility during retraction, and faster canine retraction [22]. In systematic reviews, it has been shown that the APF seems to be superior in treatment duration and ankylosis risk over the CE technique [25] with periodontal outcomes comparable to untreated teeth [26].

In our experience, the APF can be used in an even deeper labially impacted canine with a successful outcome. When performing the APF to expose the impacted canine, the following key factors should be considered: [21]

1. Flap design- The length of the coronal horizontal incision should be 1 to 1.5 mm wider than the crown width of the impacted canine, the width of the keratinized band should be determined by the amount of existing attached gingiva on the adjacent teeth. The vertical incisions are made to ensure the base of the flap is not narrower than the length of horizontal incision. The partial thickness flap can then be raised, leaving the periosteum or a thin layer of connective tissue on the exposed bone surface.

2. Bone contouring- After flap elevation, the bone and dental follicle are carefully removed from the crown surface but not beyond the CEJ. Then the soft tissue flap can be adapted to cover 2 to 3 mm over the CEJ. This can permit some apical migration of the gingival margin during the canine retraction.

3. Suture- The margins of the flap are sutured to the adjacent mucoperiosteal tissue mesial and distal to the tooth. The stability of the flap should be evaluated by pulling the lip up and down to make sure the flap does not move during lip movement. The final step is to place the periodontal dressing on the recipient site to protect and stabilize.

4. Follow up- The dressing is removed, and the orthodontic bracket or attachment can be bonded to the tooth about 7 to 10 days postoperatively. Allow another 1 to 2 weeks of wound epithelization prior to orthodontic tooth movement.

Finally, the sequence of orthodontic treatment and periodontal surgery is another important key factor to prevent some complications. In urgent cases where the impacted canine is in close proximity to the adjacent roots with a large follicle or root resorption, surgical exposure must be performed immediately, and the canine has to be retracted away from the adjacent teeth. On the other hand, when the cases have no pathology, no active eruption of the canine, and sufficient distance between the canine and the adjacent teeth, orthodontic leveling and alignment can be completed first. Surgical intervention can follow after adequate space is created to accommodate the impacted canine.

Careful 3D-diagnosis, adequate treatment planning, and proper treatment sequence are essential to provide optimal outcomes in the management of labially impacted canines. Unerupted canines cannot always be salvaged; however, numerous labially impacted canines can be treated successfully by proper case selection and accurate execution of apical positioned flap.

REFERENCES

[1] Kahn AE. The importance of canine and anterior tooth positions in occlusion. J Prosthet Dent 1977; 37(4): 397-410. https://doi.org/10.1016/0022-3913(77)90141-X

[2] Morley J, Eubank J. Macroesthetic elements of smile design. J Am Dent Assoc 2001; 132(1): 39-45. https://doi.org/10.14219/jada.archive.2001.0023

[3] Dewell BF. The upper cuspid: its development and impaction. Angle Orthod 1949; 19: 79-90.

[4] Kokich VG, Mathews DP. Surgical and orthodontic management of impacted teeth. Dent Clin North Am 1993; 37(2): 181-204.

[5] Ericson S, Kurol J. Radiographic assessment of maxillary canine eruption in children with clinical signs of eruption disturbance. Eur J Orthod 1986; 8(3): 133-40. https://doi.org/10.1093/ejo/8.3.133

[6] Celikoglu M, Kamak H, Oktay H. Investigation of transmigrated and impacted maxillary and mandibular canine teeth in an orthodontic patient population. J Oral Maxillofac Surg 2010; 68(5): 1001-6. https://doi.org/10.1016/j.joms.2009.09.006

[7] Hou R, Kong L, Ao J, Liu G, Zhou H, Qin R, et al. Investigation of impacted permanent teeth except the third molar in Chinese patients through an X-ray study. J Oral Maxillofac Surg 2010; 68(4): 762-7. https://doi.org/10.1016/j.joms.2009.04.137

[8] Oliver RG, Mannion JE, Robinson JM. Morphology of the maxillary lateral incisor in cases of unilateral impaction of the maxillary canine. Br J Orthod 1989; 16(1): 9-16. https://doi.org/10.1179/bjo.16.1.9

[9] Kim Y, Hyun HK, Jang KT. The position of maxillary canine impactions and the influenced factors to adjacent root resorption in the Korean population. Eur J Orthod 2012; 34(3): 302-6. https://doi.org/10.1093/ejo/cjr002

[10] Ericson S, Kurol J. Resorption of maxillary lateral incisors caused by ectopic eruption of the canines. A clinical and radiographic analysis of predisposing factors. Am J Orthod Dentofacial Orthop 1988; 94(6): 503-13. https://doi.org/10.1016/0889-5406(88)90008-X

[11] Hagg U, Taranger J. Timing of tooth emergence. A prospective longitudinal study of Swedish urban children from birth to 18 years. Swed Dent J 1986; 10(5): 195-206.

[12] Ericson S, Kurol J. Longitudinal study and analysis of clinical supervision of maxillary canine eruption. Community Dent Oral Epidemiol. 1986; 14(3): 172-6. https://doi.org/10.1111/j.1600-0528.1986.tb01526.x

[13] Brorsson Y, Naoumova J. Delayed diagnosis of displaced and impacted canines - a prospective longitudinal study. Acta Odontol Scand. 2020; 78(3): 165-7. https://doi.org/10.1080/00016357.2019.1667527

[14] Serrant PS, McIntyre GT, Thomson DJ. Localization of ectopic maxillary canines - is CBCT more accurate than conventional horizontal or vertical parallax? J Orthod 2014; 41(1): 13-8. https://doi.org/10.1179/1465313313Y.0000000076

[15] Walker L, Enciso R, Mah J. Three-dimensional localization of maxillary canines with cone-beam computed tomography. Am J Orthod Dentofacial Orthop 2005; 128(4): 418-23. https://doi.org/10.1016/j.ajodo.2004.04.033

[16] Haney E, Gansky SA, Lee JS, Johnson E, Maki K, Miller AJ, et al. Comparative analysis of traditional radiographs and cone-beam computed tomography volumetric images in the diagnosis and treatment planning of maxillary impacted canines. Am J Orthod Dentofacial Orthop 2010; 137(5): 590-7. https://doi.org/10.1016/j.ajodo.2008.06.035

[17] Leite Hde R, Oliveira GS, Brito HH. Labially displaced ectopically erupting maxillary permanent canine: interceptive treatment and long-term results. Am J Orthod Dentofacial Orthop 2005; 128(2): 241-51. https://doi.org/10.1016/j.ajodo.2004.04.024

[18] de Mendonca MR, Verri AC, Martins LP, Fabre AF, Cuoghi OA. Interceptive approach to treatment of impacted maxillary canines. J Craniofac Surg 2012; 23(1): e16-9. https://doi.org/10.1097/SCS.0b013e31824207bb

[19] Bedoya MM, Park JH. A review of the diagnosis and management of impacted maxillary canines. J Am Dent Assoc 2009; 140(12): 1485-93. https://doi.org/10.14219/jada.archive.2009.0099

[20] Levin MP, D'Amico RA. Flap design in exposing unerupted teeth. Am J Orthod. 1974 65(4): 419-22. Epub 1974/04/01. https://doi.org/10.1016/0002-9416(74)90273-5

[21] Vanarsdall RL, Corn H. Soft-tissue management of labially positioned unerupted teeth. Am J Orthod 1977; 72(1): 53-64. Epub 1977/07/01. https://doi.org/10.1016/0002-9416(77)90124-5

[22] Vermette ME, Kokich VG, Kennedy DB. Uncovering labially impacted teeth: apically positioned flap and closed-eruption techniques. Angle Orthod 1995; 65(1): 23-32.

[23] Crescini A, Clauser C, Giorgetti R, Cortellini P, Pini Prato GP. Tunnel traction of infraosseous impacted maxillary canines. A three-year periodontal follow-up. Am J Orthod Dentofacial Orthop 1994; 105(1): 61-72. https://doi.org/10.1016/S0889-5406(94)70100-8

[24] Lee JY, Choi YJ, Choi SH, Chung CJ, Yu HS, Kim KH. Labially impacted maxillary canines after the closed eruption technique and orthodontic traction: A split-mouth comparison of periodontal recession. J Periodontol 2019; 90(1): 35-43. https://doi.org/10.1002/JPER.18-0034

[25] Cassina C, Papageorgiouis SN, Eliades T. Open versus closed surgical exposure for permanent impacted canines: a systematic review. Eur J Orthod 2018; 40(1): 1-10. https://doi.org/10.1093/ejo/cjx047

[26] Incerti-Parenti S, Checchi V, Ippolito DR, Gracco A, Alessandri-Bonetti G. Periodontal status after surgical-orthodontic treatment of labially impacted canines with different surgical techniques: A systematic review. Am J Orthod Dentofacial Orthop 2016; 149(4): 463-72. https://doi.org/10.1016/j.ajodo.2015.10.019

Received on 12-6-2020 Accepted on 2-7-2020 Published on 10-7-2020

DOI: https://doi.org/10.12974/2311-8695.2020.08.5