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Diagnosis and Management of Palatally impacted canine

A Project Submitted to The College of Dentistry, University of
Baghdad, Department of Orthodontics, in Partial Fulfillment for
the Bachelor of Dental Surgery

By:
Abdullah Abdulkareem Ismail

Supervised by:
Lecturer: Hiba M. Hussein
B.D.S , MSc. (Orthodontics)

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Certification of the Supervisor

I certify that this project entitled “**Diagnosis and Management of Palatally impacted canine** “was prepared by the fifth-year student **Abdullah Abdulkareem Ismail** under my supervision at the College of Dentistry/University of Baghdad in partial fulfillment of the graduation requirements for the Bachelor Degree in Dentistry.

Signature:

Supervisor name:

Lecturer. Hiba M. Hussein

Date:

Dedication

I would like to dedicate my humble effort to my sweet and lovely (**Father and Mother**) for their affection, love, encouragement and prays of day and night make me able, to get success and honor. My support in life (**my brothers**).

All friends for their unlimited encouragement and help. Finally, to all who encouraged me even through a word.

Acknowledgment

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Lists of Abbreviations

CBCT	Cone-beam computed tomography systems.
OPG	Orthopantomagram
SLOB	Same, Lingual, Opposite, Buccal.
TAD	Temporary anchorage devices.

Introduction

Canines are universally referred to as the “cornerstone” of the dental arches, and the maxillary canine has the longest root and has good bony support. Both maxillary and mandibular canines have canine eminence on their labial portion of the teeth which has a cosmetic value. Aesthetically, they help in normal facial expressions at the “corners” of the mouth. Functionally, the shape and position of the canines play a major role in intercuspation by “canine guidance” (**Ash *et al.*, 2007**).

During and after the eruption of teeth the dentition faces a number of problems that comprise the health and stability of the dentition. One of these common eruption problems is teeth impaction which means that a tooth for some reason has been blocked from breaking through the gum, and one of these impacted teeth and one of the most frequently impacted teeth is the maxillary canine (**Evans, 2018**).

Because the maxillary canine has a long pathway of eruption within the maxillary apparatus and bony structures has made upper cuspids prone to be disturbed during their normal emerging time at 11 to 12 years of age, alterations in the immediate environment of the unerupted maxillary canine by hard tissue bodies, soft tissue lesions, or developmental pathologic entities can cause the tooth to become impacted. (**Manne *et al.*, 2012**)

Tooth impaction is often diagnosed during routine dental examination, early detection, timely management, and appropriate surgical and orthodontic intervention can lead to esthetically and functionally acceptable outcomes because proper positioning and alignment of canines plays an extremely important role in establishing an acceptable facial contour, esthetic smile line, and occlusion especially for canine guidance or group function occlusion. (**Kokich and Mathews, 2014**)

Aims of the study

The aim of this study was to highlight the possible methods of diagnosis and localization of palatally impacted canine, in addition to review options of prophylactic, interceptive or corrective orthodontic treatment.

Chapter one

Review of Literature

1.1 Development of teeth: (Nanci and Elsevier, 2013)

Tooth development or **odontogenesis** is the complex process by which teeth form from embryonic cells, grow, and erupt into the mouth. For human teeth to have a healthy oral environment, all parts of the tooth must develop during appropriate stages of fetal development,

These stages are described according to the changes in the morphology and developing teeth in to the bud stage at 6week is characterized by the appearance of a tooth bud without a clear arrangement of cells, cup stage at 11 weeks and is the first signs of an arrangement of cells in the tooth bud and bell Stage is known for the histodifferentiation and morphodifferentiation of the tooth that takes place at 14 weeks.

1.1.1 Teeth eruption : (Gurkeerat, 2007)

Tooth eruption is the developmental process that moves a tooth from its crypt position through the alveolar process into the oral cavity and to occlusion with its antagonist.

During eruption of succedaneous teeth primary tooth resorbs, roots of the permanent teeth lengthen, increase in the alveolar process height and permanent teeth move through the bone, teeth do not begin to move occlusally until crown formation is complete. It takes 2-5 years for posterior teeth to reach the alveolar crest following crown completion and 12-20 months to reach occlusion after reaching alveolar margin.

1.1.2 Sequence of eruption of teeth:

The mandibular first permanent molars are often the first permanent teeth to erupt, the mandibular central incisors quickly follow them, then lateral incisor,

canine, first premolar, second premolar, and second molar (the most common sequence of eruption of mandibular permanent teeth), while the most common sequence for the eruption of the maxillary permanent teeth is: first molar, central incisor, lateral incisor, first premolar, second premolar, canine, and second molar (**Wise *et al.*, 2008**).

At 9 years of age, one-third root formation of mandibular canine and first premolar is complete and the root development of mandibular second premolar begins. At 10 years of age one-half root formation of mandibular canine and first premolar is complete, and significant root development of maxillary and mandibular second premolar as well as maxillary canine, mandibular canine erupts between 9 and 10 years. Mandibular canine, mandibular first premolar and maxillary first premolar eruption occur at 11 years of age and the maxillary first premolar erupts ahead of canine and second premolar (**Gurkeerat, 2007**).

1.1.3 Normal variations of teeth eruption with clinical significance:

There are several eruption variations of the teeth such as : (**Gurkeerat, 2007**).

- 1 Eruption of second molars ahead of premolars in the mandibular arch. this decreases the space for second premolars, which get partially blocked out.
- 2 Eruption of maxillary canines ahead of premolars will cause the canines to be forced out labially.
- 3 Asymmetries in eruption between the right and left sides occurs when there is lack of space to accommodate erupting teeth due to different pattern of mechanical obstruction, decreased space on one side compared to the other .

1.1.4 Post eruption problems and defects: (Decker *et al.*,2008)

1. Tooth structure related defects

- Tooth size defects e.g (microdontia and macrodontia).
- Tooth number defects e.g (supernumerary teeth, hypodontia, oligodontia).
- Tooth shape defects e.g (dilacerations, talon cusp, dens indente, fusion, germination).

2. Space related problems

- Crowding .
- Ectopic eruption .
- Premature loss of primary teeth .
- Prolonged retention of primary teeth .
- Delayed eruption of permanent teeth .

3. Others:

- Ankyloses .
- Trauma .
- Impaction .

1.2 Tooth Impaction

Impacted teeth are those with a delayed eruption time or those which are not expected to erupt completely based on clinical and radiographic assessment (**Richardson, 2000**).

Impacted teeth can be defined as the failure of the tooth eruption to the normal position, usually due to crowding or an obstruction (e.g. supernumerary tooth, fibrous tissue) (**Gill, 2008**). However, the most commonly impacted teeth are third molars, maxillary canines, maxillary and mandibular premolars, and maxillary central incisors (**Kokich and Mathews, 2014**).

1.2.1 Development of the maxillary canine

The maxillary canine begins its development and calcification high up in the maxilla at around the age of 4–5 months. The canine has a long path of eruption where it passes along the distal root surface of the lateral incisor and buccal to the deciduous canine, with eruption into its final position at around the age of 11–12 years and its root completed at the ages of 13-15 years (**Brand and Isselhard, 1986**).

Aslan and Neslihan *et al.* in 2014 suggested that if maxillary canine has not

appeared by the age of 13 in males or by 12 in females, the eruption may be considered late. And canines should be palpable high in the buccal sulcus by the age of 10 years.

1.2.2 Importance of the Maxillary canine teeth: (Taylor, 1998).

1. They play an important role in creating good facial and smile esthetics.
2. They are positioned at the corners of the dental arch, forming the canine eminence for support of the alar base and the upper lip.
3. When the maxillary canines are properly aligned and have good shape and size, pleasing anterior dental proportions and correct smile lines are achieved.
4. Functionally, they support the dentition, contributing to disarticulation during lateral movements in certain persons.

1.2.3 Canine impaction:

The second most common impacted tooth following third molar is the maxillary permanent canine (**Cooke et al., 2006**). Impaction of a canine is where there is failure of eruption due to crowding or an obstruction within the dental arch (**Borbély et al., 2015**).

1.2.4 Prevalence of maxillary canines impaction:

The incidence of canine impaction in the maxilla is more than twice that in the mandible, of all patients who have impacted maxillary canines, 8% have bilateral impactions canine (**Bishara et al.,1992**). Prevalence of canine impaction ranging from 0.92% to 2.2% of the population, and a predilection to affect females more often than males, at a ratio of 2:1(**Cooke et al.,2006**).

Approximately one-third of the impacted maxillary canines are located labially and two-thirds are located palatally (**Mitchell et al.,2007**), and total absence of missing upper and lower canines affects the caucasian population with the following prevalence the upper canines approximately(0.3%) and the lower canine (0.1%) (**Davies and John et al., 2020**).

1.2.5 Classification of Maxillary Canine impaction:

Archer in 1975 claimed that Canine impaction is generally classified into buccal or palatal impaction, and the classification helps much in the diagnosis and treatment planning, he suggested the following classification:

- Class I: Impacted canines in the palate and may occur horizontal, vertical and semi-vertical
- Class II: Impacted canines located on the labial surface and may occur horizontal, vertical and Semi-vertical
- Class III: Impacted canine located labially and palatally; crown on one side and the root on the other side
- Class IV: Impacted canine located within the alveolar process, usually vertically between the incisor and first premolar
- Class V: Impacted canine in edentulous maxilla

1.2.6 Etiology of maxillary canine palatally impaction :

There are two major theories associated with palatally displaced maxillary canines which are the guidance theory and genetic theory (**Richardson *et al.*, 2000**).

- **The Guidance Theory:** suggest that the root of the lateral incisor, which is important and serves as a guide for canine eruption along it, and when the lateral incisor is small, absent or malformation there is a predisposition to canine impaction. Nearly 6% of patients with impacted canines have small lateral incisors. (**Gill, 2008**).
- **The Genetic Theory:** The genetic theory points to genetic factors such as (Heredity, Malposed tooth germ, Presence of an alveolar cleft) as a primary origin of palatally displaced maxillary canines and includes other possibly associated dental anomalies such as missing or small lateral incisors (**Peck *et al.*, 1994**).

Several studies reported that palatally impacted maxillary canines are genetically reciprocally associated with anomalies such as enamel hypoplasia,

infra-occlusion of primary molars, aplasia of second premolars, and small maxillary lateral incisors. (**Baccetti *et al.*, 1998**).

1.2.7 Sequelae of Canine Impaction:

Migration of the neighboring teeth, loss of arch length and dentigerous cyst formation may occur (**Shafer *et al.*, 1968**). Other possible sequelae of impacted canine are resorption of the canine crown which is most likely to occur about 14% of adults. (**Azaz *et al.*, 1978**).

Root resorption of incisors by palatally impacted canine most frequently occur between 11 and 12 years (**Ericson *et al.*, 1988**) and rarely started after 14 years of age (**Houston *et al.*, 1992**). Root resorption of adjacent teeth is considered the main risk from ectopic canine usually root of the incisors, and one study detected root resorption in 66.7% of permanent lateral incisor adjacent to ectopic maxillary canine by using CBCT scanning. (**Walker *et al.*, 2005**)

1.3 Diagnosis of palatally impacted maxillary canines:

The diagnosis and localization of the impacted canines is the most important step in the management of impacted canines, and early detection and intervention for canine impaction can reduce the treatment time, complexity and complication. (**Lindauer *et al.*, 1992**). There for the diagnosis of an impacted maxillary canine is done by using both clinical examination and radiographic assessment. (**Littlewood and Mitchell, 2019**)

1.3.1 Clinical Examination

The patient's age and dentition should be firstly evaluation in the clinical examination to determine whether there is delayed eruption or not. Secondly, we searched about presence or absence certain diseases that may adversely affecting on tooth development, subsequently the amount of space in the arch for unerupted canine, the morphology and position of the adjacent teeth and the contour of the bone, (**Moss, 1972**).

When doing palpation and feeling an absence of the canine bulge at earlier age should not be considered as an only indicator of canine impaction, because they

found that at 10 years, 29% of the children had nonpalpable canines, but only 5% at 11 years of age, whereas at later ages only 3% had nonpalpable canines.(**Ericson *et al.*, 1986**). The dentist should suspect that a canine is ectopic if it is not palpable in the buccal sulcus by the age of 10-11 years.(**Armstrong *et al.*, 2003**).

Mobility of all present teeth should be assessed during palpation and clinical examination, because the mobile deciduous canines may indicate normal resorption of the roots by the permanent canines whereas mobility of the permanent lateral incisor may be the potential result of root resorption by the impacted canine. (**Ngan and Hornbrook *et al.*, 2005**).

There are several clinical signs of palatally impacted maxillary canine are listed as the following : (**Ericson *et al.*, 1986**).

- Delayed eruption of the permanent canine or prolonged retention of the primary canine beyond 14 to 15 years of age.
- Presence of a palatal bulge which indicating the presence of the underlying canine tooth .
- Delayed eruption, distal tipping, or migration of the lateral incisor.
- Increased mobility or non-vital maxillary central and lateral incisors could be an indicator of advanced root resorption of these teeth.

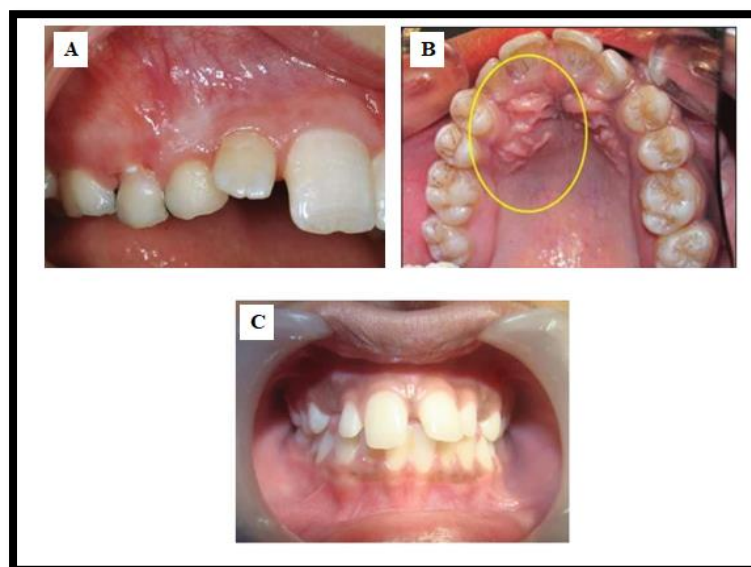


Figure 1: (A) An over-retained primary canine, (B) Palatal bulge in impacted palatal canine, (C) Distal tipping of the lateral incisor (**Ericson *et al.*, 1986**).

1.3.2 Radiographic examination : (Bedoya *et al.*,2009)

The radiographic verification is the most important part of the diagnostic process and is essential for successful treatment, accurate location of impacted canine and determining their relationship to adjacent incisor and anatomical structures and this required information can be partially obtained from conventional two-dimensional radiographs.

The radiographic assessment of impacted tooth should include:

- Location and position of both the canine crown and the root apex relative to adjacent teeth and the arch.
- The prognosis of adjacent teeth and the deciduous canine, if present.
- The presence of resorption particularly of the adjacent central lateral incisor .

According to Littlewood and Mitchell (2019), there are several views commonly used for assessing ectopic canines such as:

1. Periapical films: (Apostolos *et al.*, 2018).

A single periapical film provides the clinician with a two dimensional representation of the dentition. In other words, it would relate the canine to the neighboring teeth both mesiodistally and superoinferiorly. In order to estimate the buccolingual position of the canine, a second periapical film is obtained by using one of the following method:

- **Buccal-object rule**

Two periapical films are taken of the same area, with approximately 20° vertical angulation of the cone changed when the second film is taken, so the palatal object will move in the same direction as the source of radiation, on the other hand the buccal object will move in the direction opposite to the source of radiation. The basic principle of this technique deals with the for shortening and elongation of the images of the films as shown in figure. (**Apostolos *et al.*, 2018**).

- **Tube-shift technique or Clark's rule (SLOP) rule:**

Two periapical films are taken of the same area, with the horizontal angulation

of the cone changed when the second film is taken. If the object in question moves in the same direction as the cone, it is palatally impacted. If the object moves in the opposite direction, it is situated closer to the source of radiation and is therefore buccally located (**Apostolos *et al.*, 2018**).



Figure 2: Periapical film SLOB Technique (**Apostolos *et al.*, 2018**).

2. Occlusal films:

Also help to determine the buccolingual position of the impacted canine in conjunction with the periapical films, provided that the image of the impacted canine is not superimposed on the other teeth as shown in figure (**Apostolos *et al.*, 2018**).



Figure 3: Occlusal film (**Apostolos *et al.*, 2018**)

3. Frontal and Lateral Cephalograms:

These can sometimes aid in the determination of the position of the impacted canine, particularly its relationship to other facial structures (e.g., the maxillary sinus and the floor of the nose) (Apostolos *et al.*, 2018).

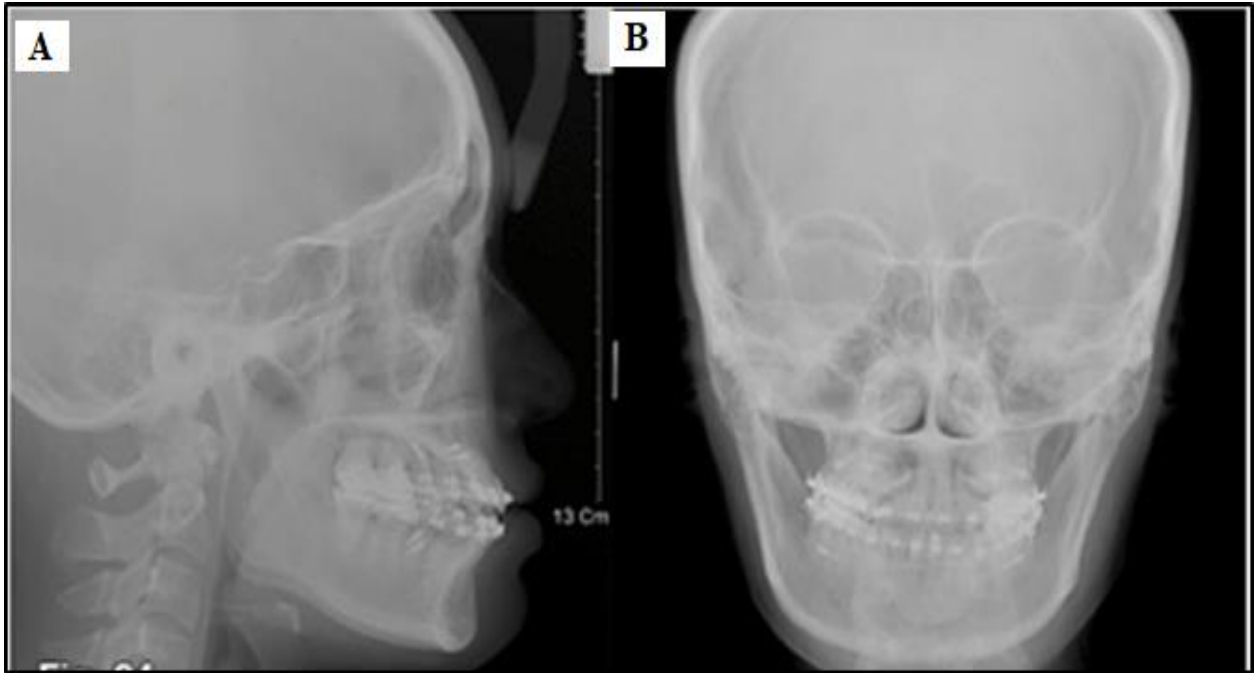


Figure 4: (A) Lateral cephalometric (B) Ant.post cephalometric (Apostolos *et al.*, 2018)

4. Panoramic films:

These are also used to localize impacted teeth in all three planes of space as much the same as with two periapical films in the tube-shift method with the understanding that the source of radiation comes from behind the patient, thus the movements are reversed for position (Manne *et al.*, 2012). Panoramic x-ray is more sensitive in detecting resorption and tooth position whereas occlusal and periapical imaging have higher specificity and positive predictive values (Apostolos *et al.*, 2018).

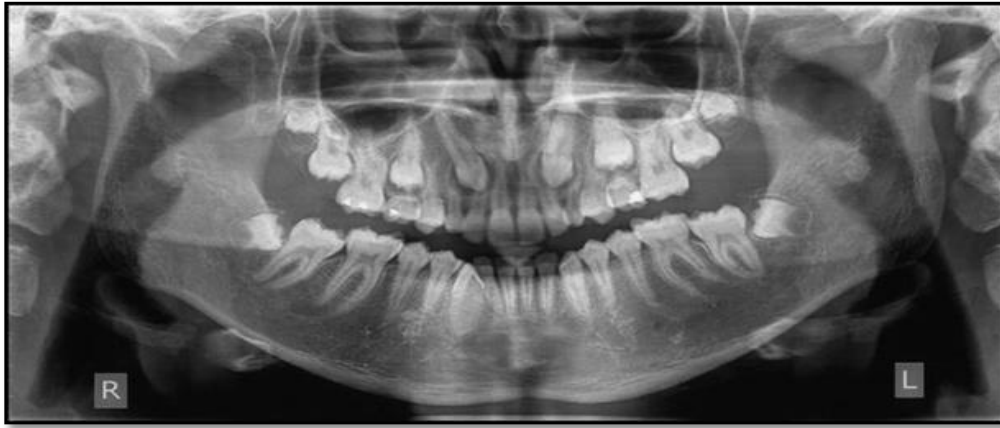


Figure 5: OPG (Apostolos *et al.*, 2018).

5. Cone beam computed tomography (CBCT):

Clinicians can localize canines by using advanced three dimensional imaging techniques, cone beam computed tomography (CBCT) can identify and locate the position of impacted canines accurately by using this imaging technique, dentists also can assess any damage to the roots of adjacent teeth and the amount of bone surrounding each tooth and because of increase cost, time, radiation exposure, and medicolegal issues associated with using CBCT limit its routine use (Manne *et al.*, 2012).

CBCT images have an accurate dimensions of the impacted canines and accurate labiolingual localizations and images have been proven to be useful for the accurate diagnosis of the impacted canines, treatment planning and the identification of associated complications, such as root resorption in adjacent incisors (Alqerban *et al.*, 2014).

Although the popularity of CBCT use in orthodontics is increasing, skepticism still exists for its broad application to all orthodontic patients (Garib *et al.*, 2014), It is suggested that CBCT radiographs may be taken of certain patients such as those with clefts, those with impacted teeth for the assessment of the exact tooth position and identification of possible root resorption due to impaction, and those undergoing orthognathic surgery, figure 1.6 (Isaacson *et al.*, 2015).



Figure 1.6: Impacted upper canine CBCT image (Abraham, 2020)

Overall, CBCT seems to be the only reliable and accurate diagnostic method for the exact 3D localization of impacted maxillary canines and root resorption of the adjacent teeth (Apostolos *et al.*, 2018).

1.4 Management of palatally impacted canine (Bishara, 1992)

Permanent canine impaction usually needs multidisciplinary care which involves oral surgery and orthodontic treatment. It is essential that the various clinicians working on the case have good communication to provide optimal care for the patient.

There are various treatment options to a patient with an impacted permanent canine following a comprehensive evaluation of the occlusion, the options are :

1.4.1 Interceptive Treatment

Is that phase of the science and art of orthodontics, employed to recognize and eliminate potential irregularities and malpositions in the developing dentofacial complex. However, interception always recognizes the existence of a malocclusion or malformation whereas the prevention is aimed at preventing the malocclusion or malformation from occurring (Gurkeerat, 2007).

Sometimes extraction of the primary canine can be an effective way to

facilitate the eruption of the impacted canine, as long as the impaction is diagnosed at a young age and the crown of the impacted canine does not lie past the root of the adjacent lateral incisor. However, primary canine extraction will be ineffective when the impacted tooth is positioned too far toward the mesial. This is more likely to occur if the diagnosis is made at a later age. **(Baccetti *et al.*,2011)**

In addition, there is another preventive method that can be employed to erupt palatally impacted canines by extracting the primary canine and then opening space orthodontically between the maxillary lateral incisor and the primary first molar or permanent first premolar, depending on the dentition of the patient. This orthodontic space opening will allow the impacted canine to erupt toward the center of the alveolar ridge. However, the forcing apart of the lateral incisor and first molar will often require further treatment to close any remaining gaps between teeth. **(Olive, 2002)**

In Class I uncrowded cases the extraction of primary canines done at age of 8 and 9 for self-correction of a labial or intra- alveolar canine impaction **(Williams, 1981)**. Other study suggested that extraction of the primary canine before the age of 11 will normalized the position of the canines in 91% of the cases if the crown tip is distal to the midline of the lateral incisor, while only 64% of the cases can be normalized if the crown tip is mesial to the midline of the lateral incisor. Therefore, extraction of the primary canine before the age of 11 as an interceptive approach to prevent canine impaction can be concluded. Then clinical and radiographic reevaluation should be taken at 6 month intervals. If there is no improvement within 12 months, an alternative treatment is indicated **(Ericson *et al.*, 1986)**.

1.4.2 Corrective orthodontic treatment:

Corrective orthodontics, like interceptive orthodontics, recognizes the existence of malocclusion and the need for employing certain technical procedures to reduce or eliminate the problem and the attendant sequelae. The procedures employed in correction may be mechanical, functional or surgical in nature **(Gurkeerat, 2007)**.

1.4.2.1 Factors affecting treatment decision: (Bishara, 1992)

- Patient's opinion of appearance and motivation towards orthodontic treatment.
- Presence of spacing/crowding.
- Position of displaced canine: is it within range of orthodontic alignment?
- Malocclusion.
- Condition of retained deciduous canine if present.
- Condition of adjacent teeth.

1.4.2.2 Corrective orthodontic treatment options:

1.4.2.2.i Surgical removal of impacted canine

The extraction of the canine, although seldom considered, might be a workable option in the following situations: **(Bishara, 1992; Gurkeerat, 2007)**

- The retained deciduous canine has an acceptable appearance and the patient is happy with the aesthetics and/ or reluctant to embark on more complicated treatment. The clinician must ensure that the patient understands that the primary canine will be lost eventually and a prosthetic replacement is required
- The upper arch is very crowded and the upper first premolar is adjacent to the upper lateral incisor, provided that the first premolar is not mesio-palatally rotated and the aesthetic result can be acceptable
- If any pathology, for example: resorption of adjacent teeth or cyst formation, so the removal should be arranged as soon as possible.
- If the impaction is severe (e.g., the canine is lodged between the roots of the central and lateral incisors and orthodontic movement will jeopardize the teeth).
- If the occlusion is acceptable, with the first premolar in the position of the canine and with an otherwise functional occlusion with well-aligned teeth.
- If it is ankylosed and cannot be transplanted
- If it is undergoing external or internal root resorption of impacted canine.
- If its root is severely dilacerated.

- If the canine is horizontally placed

1.4.2.2.ii Autotransplantation of the canine:

This involves surgical removal of an impacted canine and implantation of this tooth into the normal position within the maxillary alveolus, this could be performed as a treatment option when interceptive treatment is inconvenient or when there is an adequate space is available for the canine and the patient refuses a conventional orthodontic therapy, failure of orthodontic alignment due to immobility (**Sherry *et al.*, 1998**). Or has failed because the degree of malocclusion is too severe to achieve orthodontic alignment, crown tip mesial to the mid-line of the lateral incisor or mesial angulation greater than 55° (**Aslan *et al.*, 2015**).

Endodontic treatment of autotransplanted teeth with closed apices is considered as mandatory analog of traumatically avulsed teeth with closed apices (**Arikan *et al.*, 2008**). If the tooth has open apices, a wait-and-see strategy is accepted due to the considerable potential of revascularization. In such a case, endodontic treatment is performed only if signs of pulp necrosis or root resorption are detected (**Gonnissen *et al.*, 2010**).

The main causes of failure of transplanted canines are replacement resorption and inflammatory resorption, replacement resorption, or ankylosis, occurs when the root surface is damaged during the surgical procedure and is promoted by rigid splinting of the transplanted tooth, which encourages healing by bony rather than fibrous union (**Littlewoods and Mitchell, 2019**).

A more recent study has indicated that a careful surgical technique is essential to prevent damage to the root surface and the transplanted canine should be positioned out of occlusion and splinted with a sectional arch wire for 6 weeks. Autotransplantation is not commonly done due to increased risk of ankyloses (**Davies *et al.*, 2020**).

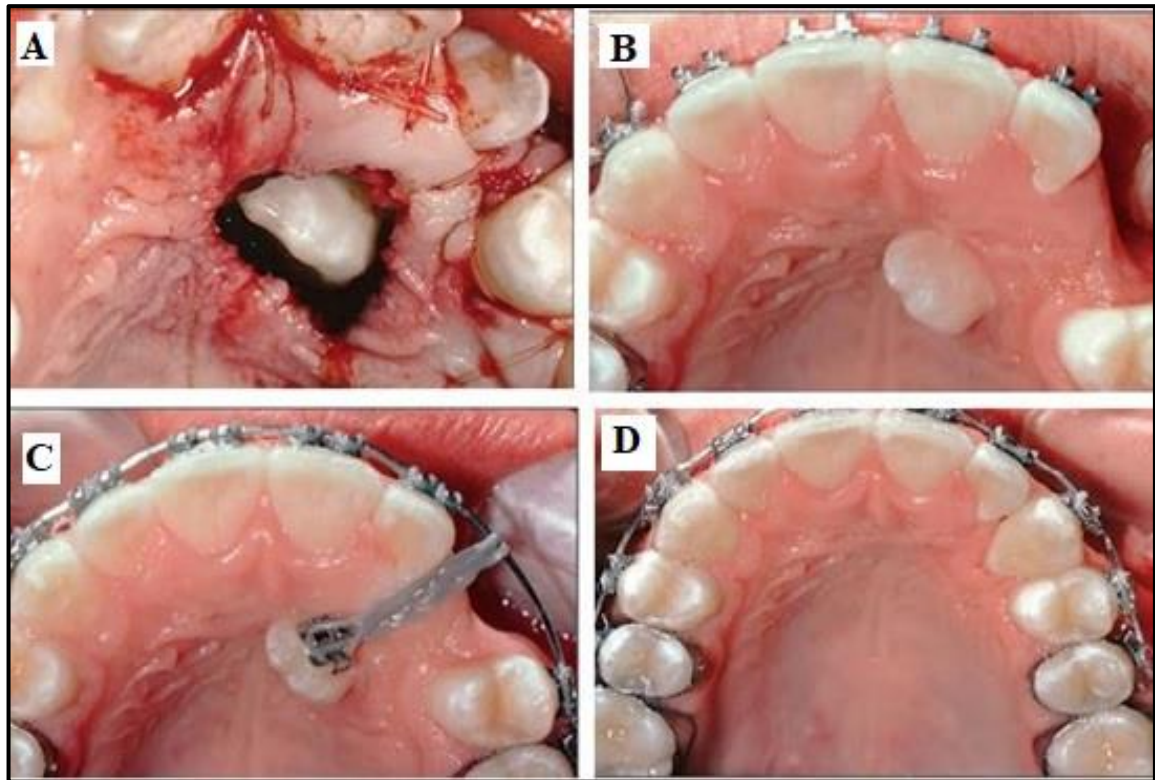
1.4.2.2.iii Surgical exposure and orthodontic alignment

With palatal impactions it is critical to recognize that the entire palate is covered with specialized mucosa and a graft is not necessary, and the most commonly used surgical methods for exposing the impacted canine are :(**Graber, 2000**).

The first method is open surgical exposure and allowing for natural eruption, and it used when the canine has a correct axial inclination and needs no upright correction during its eruption, but this method may increase treatment time and be unable to control the path of eruption, and this method performing before the beginning of orthodontic treatment or during the late mixed dentition because the tooth will erupt in a more favorable location, which will facilitate orthodontic movement without dragging the crown through the palatal gingiva (**Kokich, 2004**).

The second method is the open surgical exposure and packing with the subsequent bonding of an auxillary is used when there is no eruption force left or the tooth does not lie in a favorable direction and orthodontic force is required to move the impacted tooth away from the roots of the adjacent teeth and bring it to the proper position (**Becker and Chaushu *et al.*,2013**).

After sufficient space has been created, surgical exposure is performed in which a flap is elevated and enough amount of bone is removed to expose the tip of the impacted crown and the attachment is placed, the flap is then repositioned and sutured with a small window cut into the flap of the palatal soft tissue, covering the embedded crown packed with surgical dressing, and light orthodontic force (not to exceed 60 g,or 2 oz) is then applied to move the tooth to the desired position by various orthodontic technique as shown in figure 1.7 (**Kokich, 2004; Watted *et al.*, 2015**).



Surgical exposure

Figure 1.7 : (A) Palatal flap was fenestrated and repositioned using resorbable sutures.(B) The canine had erupted autonomously. Brackets were placed on the maxillary teeth, and space was created for the left canine(C) An elastomeric chain was used to move the canine laterally toward the maxillary archwire.(D) Crown had been moved into the dental arch (**Graber. et al.,2000**)

The third method is closed surgical exposure with the placement of an auxiliary attachment intraoperative and used when the canine is associated with severe resorption of incisor root, an open exposure is not indicated since it endangers the vitality and existence of the incisor. In this technique sufficient space should be created before the procedure, and usually uncovering a palatally impacted canine occurs after the first 6 to 9 months of orthodontic alignment of the maxillary dentition (**Aslan. et al., 2015**).

Mucoperiosteal flap is reflected and a minimum of bone is removed and certainly not down to the cemento-enamel junction, a small eyelet, threaded with soft twisted ligature wire is then bonded while hemostasis is maintained. The flap is then sutured and the ligature wire drawn through the flap at a point strategically

placed to permit traction in the direction that will have been confirmed when the orthodontist actually sees the tooth in situ (**Becker and Chaushu. et al., 2013**).

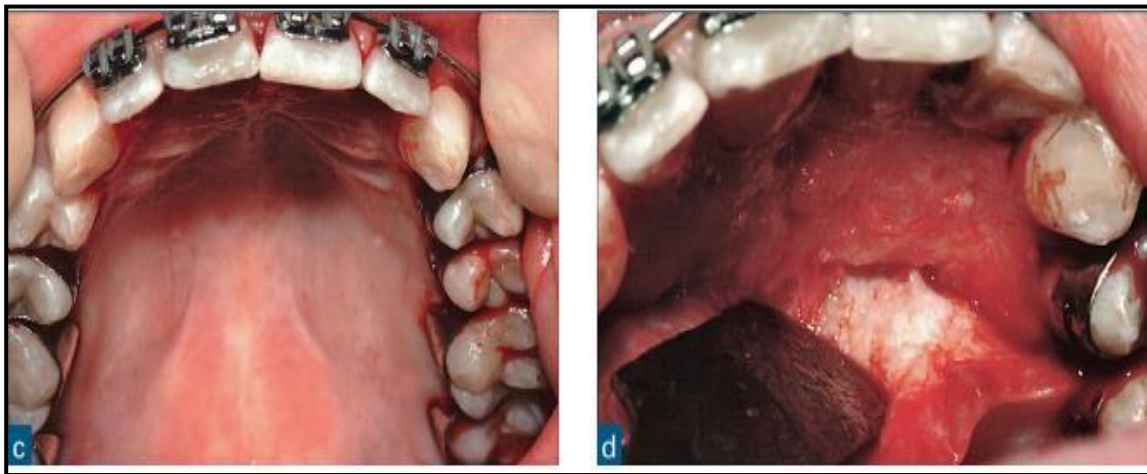


Figure 1.8 (c) Brackets and bands were initially placed on all teeth, and the dental arches were aligned. (d) full-thickness palatal flap reflected from the maxillary right to the left premolar. Both canines were completely covered with bone (**Graber. et al.,2000**).



Figure 1.9 (e) Bone removed over the crowns of both canines.(f) Ligating wires were attached to the brackets, and the flap repositioned with resorbable sutures (h), the canines have been moved into their proper position (**Graber. et al.,2000**)

1.4.3 Treatment of Palatally impacted Canines Using Miniscrews:

In any case, proper anchorage preparation and management are key factors for efficient canine movement and reducing undesirable changes in the posterior teeth and skeletal anchorage has been proposed to increase the stability of anchorage unity and to solve canine impaction alone or along with other appliances such as brackets or aligners. (**Heravi *et al.*,2016**).

There are two different anchorage units can be used for movement of impacted canines either directly anchored to the temporary anchorage devices (TADs) or by means of a miniscrew reinforced transpalatal arch (mTPA), and miniscrews can be placed either in the inter-radicular space or alternatively in the paramedian area of the palate where high success rates and effectiveness of treatment have been documented. (**Annarumma *et al.*, 2021**).

- **TAD direct anchorage**

When possible is the preferable option, since the collateral effects and detrimental forces deriving from canine traction dissipate on mini-screws, thus avoiding undesired movements of the adjacent teeth. The force on the TAD could lay on the same plane when the canine is palatal or crossing from palatal to buccal when a more labial position is needed (**Migliorati *et al.*, 2021**).

One miniscrew per impacted canine was placed in an area between the first premolar and the first molar, on the buccal side or palatally depending on the position of the canine and the other teeth. The inclination of the miniscrew was tilted at 45° with respect to the alveolar bone, depending on the clinical and anatomical conditions. Pre- and post-insertion radiographs of the interradicular implant sites were taken to check the distance of the screws from the neighboring roots. Under local anesthesia, a type IV titanium miniscrew with a diameter of 1.7 mm and a length of 8–10 mm was inserted. (**Migliorati *et al.*, 2022**).



Figure 1.10 : Direct anchorage group (**Migliorati et al., 2022**).

- **Tad indirect anchorage**

is not a preferable option, since it means that the traction of the impacted canine could generate collateral forces on the adjacent teeth that need to be connected to the mini-screws to cope with these reactional forces (**Migliorati et al., 2021**).

1.4.4 No active treatment

Successful treatment of impacted canines is dependent on the position of the tooth in both the sagittal and transversal planes, ankyloses and dilacerations of the tooth. It has generally been accepted that the more a canine is horizontally impacted, the less successful the tooth will be brought into its correct positions (**Odegaard, 1997**).

The clinician may leave and observe the condition of the impacted canine if the patient does not desire it. Or if there is no radiographically evidence of root resorption of adjacent teeth, there are ideally and good contact between the lateral incisor and first premolar and if the primary canine has a good prognosis. But It should be remembered that the long-term prognosis for retaining the deciduous canine is poor, regardless of its present root length and the esthetic acceptability of its crown. This is because, in most cases, the root will eventually resorb and the deciduous canine will have to be extracted. (**Littlewood and Mitchell, 2019**).

Chapter two

Discussion

An impacted maxillary canines is the second most frequent impaction, early diagnosis and intervention make the best solution because it can cause arch length discrepancies, loss of vitality of adjacent teeth, follicular cysts, canine ankylosis, infections, and pain to the patient, if orthodontic treatment is not provided for impacted canine, complications such as root resorption of the neighboring lateral incisor and first premolar and the development of cyst may occur.

Accurate localization of the impacted tooth by palpation and inspection the impacted canine at age 10-11 years and take a radiographical image such as CBCT or OPG and periapical is vital in diagnosis, treatment planning, and implementation of surgical and orthodontic treatment modalities, because the initial position of an impacted canine can affect on duration of orthodontic treatment. **(Walker,2005)**

The keys to treat the impacted canines successfully include accurate localization, use of appropriate surgical procedure and orthodontic biomechanics and way to management of impacted canine dependent on several factour such as condition of the adjacent teeth, retained deciduous canine if present and the position of impacted canine and crowding, spacing within the arch **(Frank, 2018)**

Removal of an impacted canine is one approach that is rarely used but might need to be considered if the impacted canine is ankylosed, has internal or external root resorption, severe dilaceration, or the position is undesirable and it is impossible to bring it to the occlusion but extraction of the primary canine in order to correct the mal-erupting maxillary permanent canine has considerable advantages for the child both economically and in terms of the discomfort that result from more traditional treatment approaches.**(Bishara, 1992)**

Asymptomatic impacted teeth can be left in place, but in these patients a series of successive radiographs should be taken periodically and this treatment approache

is indicated when the patient is poorly motivated, and they should be warned about the potential risk of resorption of the adjacent incisor roots(**Odegaard, 1997**).

Autotransplantation of the canine involves surgical removal of an impacted canine and implantation of this tooth into the normal position within the maxillary alveolus. this could be performed as a treatment option when interceptive treatment is inconvenient or when there is an adequate space is available for the canine and the patient refuses a conventional orthodontic therapy(**Sherry *et al.*, 1998**).

Chapter three

3.1 Conclusions

1- The management of impacted canines is important in terms of esthetics and function and, requires a qualified experience of a number of clinicians.

2- Canine impaction is a relatively frequent clinical presentation in dentistry, with challenges that should be resolved.

3- A good understanding by the clinician of the situation and treatment options can have a significant impact on the treatment outcome. Therefore, clinicians should be competent to perform the proper investigation, provide a correct diagnosis, develop an optimum treatment plan, and render appropriate treatment for each individual patient so each patient realizes the best outcome possible.

4- Successful completion of the procedures depends on the expertise of the orthodontist as well as oral surgeon.

5- If signs of ectopic eruption are detected early, every effort should be made to prevent impaction and its consequences. Early intervention eliminates the need for surgical intervention and complex orthodontic treatment.

3.2 Suggestions

1- Conduct a survey to determine the prevalence of maxillary canine impaction in class I, class II Division 1 and division 2 and class III malocclusion patients.

2- Conduct a survey among Iraqi orthodontists to reveal the most effective method of canine impaction treatment of different age groups.

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