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Maxillary Impacted Canines; Clinical Review

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ABSTRACT: Impacted canines are a common finding among patients, who demand orthodontic treatment. Diagnosis of impacted canine is achieved by clinical and radiographic examination. Treatment planning is based upon diagnostic findings and criteria that must be in consideration in order to assure minimal injury and periodontal health. So long as orthodontic treatment is decided on, the attraction of impacted canine is made by elastic chain applied directly to brackets of the adjacent to impacted canine teeth, to orthodontic wire, to orthodontic screw, to lingual or palatal bar vs transpalatal bar with extention. The last three are used like anchorage system of dental arch.
The aim of this study is to review the etiology of canine impaction and to emphasize the importance of imaging and data processing in diagnosis. To criticize different surgical methods and treatment options with the opportunity of dealing with ? cases presented in this paper. All cases were treated by interdisciplinary cooperation between an orthodontist and oral and maxillofacial surgeons

Keywords: Impacted canines, orthodontic treatment, techniques, transpalatal bar with extention,

I. INTRODUCTION

Ectopic eruption and impaction of the permanent maxillary canines is a significant problem of dental development, affecting an estimated 1-3% of the general population or more than 50,000 orthodontic patients in the United States each year. Radiographic examination plays an important role in the planning of surgical and orthodontic treatment to resolve canine impactions. Radiographic information is used to determine the relative buccopalatal positions of impacted canines and adjacent incisors, as well as the proximity of the teeth to one another{1}. Accurate knowledge of these spatial relationships is needed to assess the feasibility of reducing the impaction and to plan the surgical approach and orthodontic mechanics to minimize risks of iatrogenic injury and maximize the efficiency of tooth movement. In addition, radiographic examination should detect pathologic conditions, including incisor root resorption, because such findings may influence the treatment plan.{1,2}
Clinicians have various definitions of "impaction." Canine impaction can be defined as an unerupted tooth after its root development is complete; or a tooth still unerupted when the corresponding tooth on the other side of the arch has been erupted for at least 6 months and has a complete root formation; or a condition in which a tooth is embedded in the alveolus and is locked in by bone, adjacent teeth, or other obstacles and cannot properly erupt into the oral cavity. This includes teeth in which eruption is significantly delayed and there is no clinical or radiographic evidence that further eruption is likely to happen.{1,3,4}

Maxillary canine has the longest period of development and the most devious eruption path. Its final position in the occlusion is essential to complete the arch form, a functional occlusion and symmetry and harmony of the dentition. The maxillary canine is the most frequently impacted tooth except from third molars. The reported incidence of canine impaction varies from 0,8 to 5,2 percent in normal populations . Bilateral impaction is seen in 17 to 45 percent of the cases , and impacted canines are more common in females than males. The reported percentages of palatally impacted canines, varies between 41 percent and 93 percent among studies. Most of the palatally impacted canines (85 percent), have sufficient space for eruption into the dental arch.{5}

Ectopic eruption of maxillary canines can cause damage to the dentition, the most frequent adverse effect being root resorptions of adjacent teeth **(Fig. 1 a, b).** In addition bone loss, gingival recession, cyst formation, and malposition of teeth are possible negative effects of the ectopic eruption of maxillary canines

(Fig. 02a-c). Resorption of the roots of the maxillary permanent incisors has been reported in 12 percent of cases of ectopic eruption of maxillary canine in the age group 10 to 13 years using conventional 2D radiographic examination(13). When using CT scanning technique the detection of root resorptions of incisors adjacent to ectopically erupting maxillary canines was substantially increased and in the study by Ericson and Kurol , resorptions on the incisors were seen in 48 percent of children with impacted canines . Resorptions can be seen as early as the age of 9, but are most commonly seen in the age groups 11 to 12 years or later .{5,6}

Two common theories may explain the phenomenon of the palatally impacted canine, but the exact etiology of impacted maxillary canines is not yet known. The ―guidance theory of palatal canine displacement‖ suggests that palatal displacement is a result of local factors such as lack of guidance along the root of the lateral incisor due to congenitally missing lateral incisors, supernumerary teeth, odontomas, transposition of teeth, or other mechanical destining factors that influence the eruption path of the canine . The second theory for canine impaction is known as ―the genetic theory‖. In this theory palatal impaction of canines has been found to be related to congenital absence of teeth, and is suggested to be of the same genetic origin . In addition, there are some factors that are thought to cause canine impaction such as obstacles, abnormal position of tooth bud, dental crowding, long and complicated path of eruption, late eruption date, early loss of deciduous canine, prolonged retention of the deciduous teeth, and systemic disease . Palatally impacted maxillary canines are often present along with other dental abnormalities including tooth size, shape, number, and structure; hypoplastic enamel, infra-occluded primary molars and aplastic second bicuspids .{2,3,4}

In general, the causes for retarded eruption of teeth may be either generalized or localized Generalized causes include endocrine deficiencies, febrile diseases, and irradiation. The most common causes for canine impactions are usually localized and are the result of any one, or combination of the following
factors: (a) tooth size-arch length discrepancies, (b) prolonged retention or early loss of the deciduous canine, (c) abnormal position of the tooth bud, (d) the presence of an alveolarcleft, (e) ankylosis, (f) cystic or neoplastic formation, (g) dilaceration of the root, (h) iatrogenic origin (discussed earlier), and (i)idiopathic condition with no apparent cause **(Fig. 3a-e)**.

If orthodontic treatment is not provided for impacted canine, complications such as root resorption of the neighbouring lateral incisor and first premolar, and development of cyst may occur.{7,8,9}
A genetic predisposition was shown in some studies; the relatives of patients with palatal canines are likely to exhibit palatally displaced canines and anomalous lateral incisors. Peck et al concluded that palatally displaced canines appear to be a product of polygenic multifactorial inheritance{10}. Also Prinin et al found that palatally impacted canines are genetic and related to incisor premolar hypodontia and peg shaped lateralincisors.{11}
This article discusses the etiology, diagnosis, and clinical management of impacted maxillary canine teeth.

II. CLINICAL DIAGNOSIS

Impacted canine teeth can be detected as early as age 8 years. Clinical examination includes overall arch inspection, palpation of canine bulges **(Fig. 4a-e)**, mobility of primary canines, and a review of the patient's chronological age and history of eruption/exfoliation patterns of the dentition. Clinicians should be aware that there is a possibility of canine impaction in the absence of canine bulges, abnormality in shape, missing lateral incisors, or less mobility of primary canines.{1,4}

Unusual movement of lateral or central incisors can also be a sign of root resorption due to pressure from malposed canines. When there is the clinical presence of any of these signs, radiographic examination should be performed to confirm the diagnosis.{1,3,5}

III. RADIOGRAPHIC DIAGNOSIS

Early methods for localization of impacted maxillary canines involved the use of intraoral radiographs. A simple but useful method was proposed by Clark and is now referred to as the tube-shift or parallax method and utilizes the so-called buccal object rule **(Fig 5)**. This technique involves taking two periapical radiographs of the same teeth from different angulations. Basic geometry dictates that the buccal object will appear to move in the same direction that the x-ray beam is directed.The direction of the beam can be shifted in either the horizontal or vertical plane{11,12,13}. Armstrong et al reported that a correct diagnosis (buccal or lingual) was made 83% of the time using the horizontal parallax method and 68% of the time using the vertical parallax method. {14}

Another useful intraoral radiograph is the maxillary occlusal film **(Fig. 6)** . The anterior occlusal is taken at an angle of 60 degrees to the occlusal plane,2,23 is simpler to execute and provides a lower radiographic dose than the vertex occlusal, which is taken at 110 degrees to the occlusal plane, parallel to the long axis of the central incisors.7,2,25,26 Either film allows the clinician to simultaneously visualize the impacted tooth in the anteroposterior and transverse planes of spac .{15}
In addition to intraoral films, cephalograms and panoramic radiographs have also been used to localize impacted teeth **(Fig. 7a, b)** . In the case of the cephalogram, it is important to note that both the lateral and posteroanterior

(PA) cephalogram can be used to discern the position of the impaction.21,27,28 The lateral view can provide information about the anteroposterior position of the canine, the vertical position, and the angulation in the sagittal plane. The PA cephalogram can clarify the transverse position of the canine and its angulation in the frontal plane. In theory, by using both lateral and PA cephalograms one should be able to determine a fairly accurate three dimensional location of the impacted tooth. Weaknesses of this method include the presence of anatomical structures that interfere with the projection of the canine and in the case of the lateral cephalogram, the lack of resolution between left and right sides {16}.

Since the development of the panoramic radiograph, practitioners have relied heavily on this method for the localization of impacted canines.The vertical position of the canine is readily assessed, as is basic information regarding the location of the cuspid in relation to the roots of the adjacent teeth. {17}

The palatal versus labial determination can be attempted based on the magnification of the impacted tooth on the panoramic film.Palatally impacted canines are located further from the film or sensor than the other the teeth in the arch, so they appear magnified relative to their expected size. By contrast, a canine located labial to the arch will appear reduced in size compared to the adjacent teeth. In one study utilizing two radiologists, this determination was made correctly 89 percent of the time using a panoramic radiograph only{17}. In another study also using only panoramic radiographs, researchers were able to accurately predict the position of palatally displaced crowns 80 percent of the time{18}. Chaushu et al found a similar success rate of 88 percent. In addition, when their sample was restricted to canines whose crown overlapped the middle or coronal third of the adjacent teeth (eliminating those found in apical areas), the rate of successful localization increased to 100 percent. {9}

One of the most widely used methods for objectively describing the location and angulation of an impacted canine as viewed on a panoramic radiograph was developed by Ericson and KurolTwo angular measurements were measured, relating the long axis of the canine to the vertical midline and the long axis of the lateral incisor. A linear measurement was made from the cusp tip to the occlusal plane at a 90 degree angle, and the anteroposterior position of the cusp tip was assessed and assigned to one of five zones (Table1).{5,6}

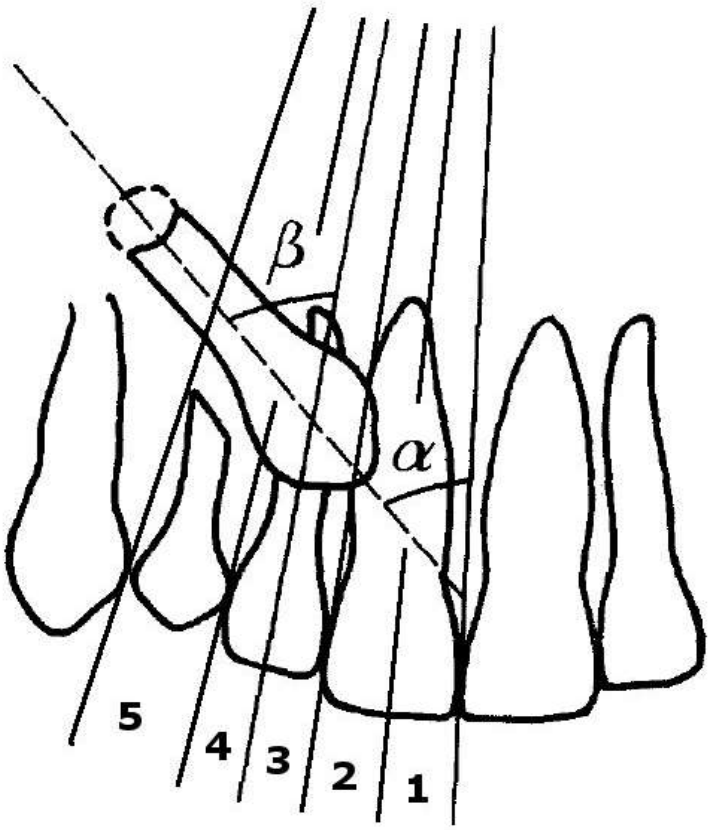

Table1.: Ericson and Kurol's classification of canine position. Adapted from Ericson and Kurol

The method of objectively classifying canines by their appearance on panoramic radiographs has been used in attempts to predict root resorption,treatment success, periodontal outcomes and treatment duration.

Posterior-anterior radiographs arealso useful. Normal canines in this type of radiograph should angle medially,and crowns should be lower than the apex of the lateral incisors and the lateral border of the nasal cavity. However, this method still provides only 2-dimensional images with some degree of superimposition. Nevertheless, thistype of radiograph is not usually taken unless there are skeletal asymmetryand/or transverse width issues. If there is any concern of impaction with otheranomalies, it might be better to utilize cone beam computed tomography (CBCT) instead. CBCT has the great advantage of showing hard-tissue reconstruction in the area of interest in 3 dimensions, presenting a view without any superimposition, and also providing a 1:1 magnification which can be used to reproduce panoramic or cephalometric images. Its use in orthodontics includes impacted teeth and TMJ evaluations, 3-dimensional views of upper airways, assessment of maxillofacial growth, and development and dental age estimation.CBCT scans are far better than conventional panoramic radiographs in verifying the orientation and location of the impacted canine and its relationship to neighboring structures{15}. This technique makes identification of the exact position and shape of impacted canines possible, which is crucial in treatment planning. Furthermore, it is very helpful in evaluating damage to adjacent teeth and the amount of surrounding bone **(Fig. 8a-b, Fig. 9a-c)**. The major disadvantage of CBCT is the increased amount of radiation exposure, which is at least 4 times higher than with ordinary panoramic radiograms There - fore, orthodontists should consider cost-benefit outcomes before ordering this radiograph{15,18}.

IV. MANAGEMENT OF IMPACTED CANINE

The ectopic or impacted canine often requires a multidisciplinary treatment involving oral surgeons and orthodontists. Localization of the impacted canine and prognosis for alignment is important when deciding the management options for patients.{1}

Localization of the unerupted canine involves inspection, palpation and radiographic evaluation. The position of the crown of the lateral incisor can give a clue as to the position of the unerupted canine; that is the crown of the lateral incisor may be proclined if the canine is lying on the labial aspect of the lateral incisor root.{2,3,13}

Maxillary canine impaction usually needs multidisciplinary care, which involves oral surgery and periodontics along with orthodontic treatment. It is essential that the various clinicians working on the case have good communication to provide optimal care for the patient. The management of impacted canines can be divided into treatment categories: **interceptive treatment and corrective treatment**.{1,3,4,13}

Interceptive Treatment;

Selective extraction of the deciduous canines as early as 8 or 9 years of age has been suggested by Williams, as an interceptive approach to canine impaction in Class I uncrowded cases. Ericson and Kurol suggested that removal of the deciduous canine before the age of 11 years will normalize the position of the ectopically erupting permanent canines in 91% of the cases if the canine crown is distal to the midline of the lateral incisor. On the other hand, the success rate is only 64% if the canine crown is mesial to the midline of the lateral incisor.{6}

Several other methods are proposed in the literature like use of cervical headgear to create maxillary arch length use of apalatal expander to increase maxillary arch length, and use of brackets and arch wires to create extra space in the alveolar ridge during the mixed dentition so that the maxillary canine will erupt naturally. Other methods can also be used for space gain. As an example, the pendulum can be used **(Fig 10a-c)** {1,3,4,6,13}.

Corrective Treatment

Corrective treatment is performed in situations where orthodontists cannot render preventive or interceptive treatment for some reason, or patients present beyond the point of prevention. There should be an attempt to bring impacted maxillary canines down to occlusion if possible, because permanent canines are important for both functional and aesthetic reasons. There are numerous surgical methods for exposing the impacted canine and bringing it to the line of occlusion. Two of the most commonly used methods are (I) surgical exposure, allowing natural eruption and surgical exposure with placement of an auxiliary attachment. {2,4} Orthodontic forces are subsequently applied to the attachment to move the impacted tooth .

Three techniques have been proposed by Kokich for uncovering a labially unerupted maxillary canine (gingivectomy, apically positioned flap, and closed eruption technique).He also suggested that orthodontists should evaluate 4 criteria to determine the correct method for uncover uncovering the tooth so the outcome achievesthe optimum periodontal health.

These criteria include the distance between the canine cusp and the mucogingival junction; the labiolingual position; the mesiodistal position;

and the amount of gingiva in the area of the impacted canine.

In palatally impacted canines, the concern about the lack of keratinized gingiva disappears because palatal tis sue is a dense connective tissue.

Bishara suggested 2 surgical methods for exposing the impacted canines:{2,4,8} surgical exposure followed by allowing spontaneous eruption; and surgicalexposure with auxiliary attachment for further orthodontic treatment.{4,8,13}

The first method is useful 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. Kokich suggested performing this method 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 gingival{19}.

Schmidt and Kokich also reported that this technique had minimal effects on the periodontium and that the overall effects on the impacted canine appeared better than those from the closed exposure and early traction techniques{13,20,21}.

The second method 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.After sufficient space has been created, surgical exposure is performed and the attachment is placed. 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 techniques **(Fig. 11a-g)** {13,19,20,21}.

Surgical exposure

The individually selected surgical procedure for each of the canine position in which the exposure ‘s the first step is to secure periodontally and aesthetically pleasing result. It is now generally recommended, again to cover the palatal displaced canines after adhesion of the attachment with the mucoperiosteal flap previously formed, to perform a closed elongation. The Attachment with the best chance of success, the titanium head with titanium necklace is by Watted.mit the best chance of success is the titanium head with titanium chain by Watted. **(Fig. 12 a, b)**{13,21,22,23,24,25} Exposure of palatal displaced canines

In the surgical exposure of impacted palatal canines the cut is marginal **(Fig. 13a-e)** or paramarginal . Because of better wound healing after adaptation of the mucosa to mucosa the paramarginal incision is preferred. If the displacement permits this, incision around the Incisive foramen in an asymmetric (unilaterally extended to canine) or symmetrical formed (bilaterally extended to canine){13,21}. After careful mobilization of the mucoperiosteal flap, only so much cortical bone is removed until the crown portion of the retained tooth is exposed enough to secure fixation of attachments **(Fig. 13 b, c)**. Extensive milling leads to a larger post-therapeutic bone loss. To limit the bone loss after cessation of the canine to a minimum, the cemento-enamel border must not be exceeded. The dental follicle is carefully debrided in the immediate circumference of the exposed crown area since often it emanates from the highly vascularized tissue and frequently bleeds, which makes the attachment difficult to be fixated {21,22}.

In general, the most reliable bonding technique is the acid etching technology without the usual pre-treatment of the enamel with rubber cups and polishing paste, since the post-eruptive enamel maturation has not been yet taken place and pre-eruptive enamel porosities increase the composite adhesion. In addition, the use of rotary instruments would easily cause bleeding and thus the Attachment fixation is difficult . A sufficient flushing of the surface is necessary to avoid gingival necrosis or permanent fixation of the attachment that is endangered by remaining etchant.{13,21,22,23}

After careful hemostasis - often all it takes is a short compression by means of a swab soaked with H2O2 - the exposed tooth surface is blown dry and slightly etched for 30 seconds with phosphoric acid. Following a copious lavage with isotonic NaCl solution, the surface must be carefully dried. An adequate flushing of the surface is necessary to avoid the result of gingival necrosis or permanent fixation of the attachment that is endangered by remaining etchant. The attachments with fine clinical prospects are for example the Eyelet and Pressing with the gold chain.{21,22}

The new attachment with the best Chance of success in terms of stability and biocompatibility is the titanium head with titanium chain by Watted (titanium head with chain DENTAURUM) **(Fig 13 d)**. The knobs base was treated with the laser, that significantly increases detention accuracy. The attachment with the best resistance to the liability of knobs or eyelet is substantially larger than that of a brackets. Due to the bracket size and base, it is not suitable to be glued on the palatal surface. The fixation of gold or titanium chains to the attachment ensures secure transmission of orthodontic forces in one to three days after the applied surgical exposure for the first time können. After hardening the composit, the operation field is finally rinsed with ISO toner NaCl solution. The repositioned mucoperiosteal flap is fixed by sutures and covering the entire surgical field **(Fig. 13 e)**. After the exposure of palatally impacted tooth, if the exposed area is open or is it only covered by a surgical dressing, according to Becker et al.15 the following complications can occur: soft tissue overgrowth and plaque accumulation which lead as soon as the adjustment has been completed in association

with the secondary healing to a chronic infection and to compromise- afflicted periodontal conditions. The fixed knobs of titanium chain project at the desired breakdown location at the alveolar ridge level several millimeters above the seam area. The passage point must be necessarily determined in consultation with the orthodontist, since otherwise the soft tissue may undergo unnecessary trauma during orthodontic setting. If necessary, a maxillary association board can be incorporated. Several days after the surgical exposure of the impacted tooth, it was moved by the action of suitable orthodontic appliances with the mucous membrane in the desired position. In palatal displaced canines, the closed elongation is carried out in the rule. If the canine is moved directly under the palatal mucosa, a fenestration is possible and sufficient.{13,21,22,23,24,25}

V. DISCUSSION

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{26,27}.Wriedt et al suggested that if the inclination of impacted canines in panoramic radiographs is more than 45°, they will more likely require surgical removal.
If this is the final decision, the orthodontist must consider alternative treatments to substitute for the missing canine. The options can be premolar substitution, autotransplantation, or prosthetic substitution by working together with other specialties. The patient should be informed of all these treatment outcome possibilities before beginning the treatment.{28}

Early extraction of the primary canine in order to correct the malerupting maxillary permanent canine has considerable advantages for the child, both economically and in terms of the discomfort that result from more traditional treatment approaches. In fact, periodontal damage to the ectopic canine after surgical exposure and orthodontic alignment has been reported compared to control canines . Incisor devitalization and some loss of alveolarbone support may also occur.{29,30,31}

Basdra et al., investigated the relationship between different malocclusions and tooth anomalies including the canine impaction. Two-hundred Class III (110 females and 90 males) and 215 Class II Division 1 (101 females and 114 females) patients were examined for the presence of congenital tooth anomalies such as maxillary incisor hypodontia, maxillary canine impaction, transpositions, supernumerary teeth, and tooth agenesis. Canine impaction was recorded in 9% of Class III subjects, and in 3.3% of Class II Division1
subjects. However, they did not differentiate the palatal from buccal canine impaction which are different clinical situations.

The authors stated that both malocclusions showed patterns of congenital tooth anomalies similar to those observed in the general population. When the occurrence rate of all congenital tooth anomalies was compared between the two malocclusions, Class III subjects showed significantlyhigher rates ($p < 0.05$).{32}
Maxillary expansion protocol as another treatment option in early mixed dentition period was suggested by Baccetti et al., {33}. Their prospective randomized clinical trial was based on Sambataro et al., {34} investigation that introduced a formula to diagnose the canine displacement at an early mixed dentition period. Sixty patients were randomly assigned to the treatment group or the control group. All the patients belonged to pre-peak period, had Class II or Class III tendency and maxillary dentoalveolar, not skeletal (Jugulare-Jugulare) constriction. The prediction of canine displacement was derived from analysis of posterior-anterior radiographs according to the method of Sambataro et al. Rapid maxillary expansion protocol was applied and according to their results the prevalence rate of successful eruption (65.7%) in the treatment group was significantly higher ($p<0.001$) than the control group (13.6%). The intra-osseous improvement of canine position after rapid maxillary expansion could be the possible mechanism that involved in the favorable eruption process.

Authors recommended clinical and radiographic re-evaluation every 6 months, but if the patient exceeds 13 years of age alternative treatment modalities should be considered{34}. Olive carried out a study of 28 children (13.5 years) with 32 palatally impacted canines in order to determine the success rate of canine eruption without surgical intervention. The primary canines were extracted and orthodontic treatment with fixed appliances to create space for permanent canines was deferred for at least six months if an impacted canine was the main reason for treatment, otherwise treatment was commenced according to the needs of the patient. 75% of the canines erupted successfully while in 94% of the cases, the severity of impaction lessened following extraction of the overlying primary canines and orthodontic treatment.{35}

Leonardi et al., in a prospective randomized clinical trial of 46 subjects with 62 palatally displaced canines evaluated the effectiveness of extraction of the primary canines alone and in association with the use of a cervical pull headgear. The extraction of the primary canine as an interceptive treatment
measure to prevent palatal canine displacement had a success rate of 50%, which was not significantly greater than the success rate in untreated controls. On the other hand, the prevalence rate of successful eruption of the

canine in subjects treated by headgear in addition to primary canine extraction was 80%, a rate which is more than three times greater than the percentage of spontaneous eruption of the canine in untreated subjects{36}
Al-Nimri and Gharaibeh reported that palatal canine impaction occurred most frequently in subjects with a Class II Division II malocclusion (44 percent). evaluating the panoramic radiographs, cephalograms and pretreatment study models of 199 patients (12.7 yrs) with impacted canines, found that45% of the patients had Class II, Division II malocclusion.

This heritable malocclusion associated with an increased transverse dimension of the upper arch, deep bite, upright and small incisors could be regarded as a risk factor for canine impaction {37}.

Today, clinicians are beginning to appreciate the advantages that the third dimension gives to clinical diagnosis and treatment planning. Although the cone beam computed tomography principle has been in use for the last twenty years, only recently have affordable systems become commercially available. Walker et al., carried out a study on 27 impactedMcanines from 19 patients (15 female, 4 male) in order to describe the spatial relationship of impacted canines by CBCT images. It was supported that CBCT provides elements for the impacted teeth such as the size of follicle, the amount of the bone covering the tooth, buccal or palatal position and 3D proximity of adjacent teeth, which are advantageous in the management of impacted canines. {38}
Haney et al., comparing the traditional 2D images to CBCT imagesin patients with maxillary impacted canines, found a 21% disagreement in the mesio-distal location and 16% in the labial-palatal position of the impaction. However, even if the effective radiation dose reduced by 98% compared with conventional CT systems, it remains 4 to 15 times greater than that of a single panoramic radiograph .{39}

Surgical-orthodontic treatment of the impacted teeth may also have an undesired effect on the alveolar bone and on the root of the transpositioned teeth. Serious resorption of a permanent canine in a 19-year-old patient coexisting with radiologically diagnosed atrophy of the alveolar process was due to the reaction against orthodontic force involved in a 180° tooth rotation in the alveolar process. In the study material, 4 out of the 102 impacted teeth had to be chiseled out. In one case, this procedure was necessary due to abnormal tooth position and advanced age of the patient (39 years), in another patient tooth transposition failed and the revision of the site of retention revealed ankylosis, in the other two cases extraction was indicated to improve occlusion, i.e. the contact between tooth four and two ensured both functional and esthetic occlusion. In such cases, canine extraction, accordingto Masztalerz {40}, is the best option. However, as revealed by Suri et al. {41}, extraction is not recommended in the case of vestibular retension of the canines, since surgical intervention can damage soft tissues and bones, causing scar formation on the alveolar process and thus worsening aesthetic appearance of the frontal segment of the dental arch.

Robert Harry and Harridane described a sectional approach to maxillary canine using transpalatal arch for anchorage. They used a 0.017" x 0.025"TMA sectionalarchwire from first molar to canine providing low force over a long range.{42}

Application of force can be in the form OF elastic or wire traction. "The ballista spring" system for impacted teeth has been described by Harry Jacoby. It employs a wire loop constructed using a 0.014", 0.016"or 0.018" round wire.{42,43}.

Bowman and Carano designed monkey hook as well as kilroy spring for guiding the eruption of impacted tooth.They described two types of kilroy springs. Kilroy I applies lateral and vertically directed forces to direct the impacted tooth. Kilroy II spring was designed to produce more vertical eruptive forces for eruption of buccally impacted tooth. Magnetic forces have also been advocated by some authors to align impacted tooth. Regardless of the method of traction used, the direction of applied force should initially move the impacted tooth away from roots of the neighbouring teeth. In addition, Bishara recommends - a) use of light force(< 60gms) to move the impacted tooth b) creation and maintenance of sufficient space within the arch c) the use of base archwire of sufficient stiffness (0.018"x0.022") to resist deformation by the tractional forces applied.{1,44}

Some authors believe asymptomatic impacted teeth can be left in place, but in these patients a series of successive radiographs should be taken periodically.Surgical extraction is indicated in the following situations. a) The existence of infection, cyst, or tumor related to the impacted canine, b) impacted tooth causes the periodontal disturbance of the adjacent teeth, c) presence of neuralgic symptoms, d) crowding of the mandibular arch requiring therapeutic extractions to correct crowded incisor teeth, e) impacted canine is ankylosed and cannot be transplanted, f) root resorption affecting the adjacent teeth, g) root of impacted canine is severely dilacerated, h) severe impaction of canine tooth and i) patient's unwillingness to orthodontic treatment or transplantation.{1,45,46}

The diagnosis of the impacted canine accompanied by resorption of lateral incisor roots requires immediate separation of both teeth in order to stop resorption progression. Examinations of 5 resorbed lateral incisors confirmed their vitality and resorption arrest. These observations are consistent with the data reported by Becker and Chaushu {47}, who performeda comparative study in order to evaluate resorption progression in the incisors in which severe resorption was related to maxillarycanine retention.{47} always a risk of retention and also of resorptionof the roots of the permanent incisors. Such resorptions have recently been reported to occur in 12 percent of cases of ectopic eruption of the maxillary canines in the age range 10-13 years[48}. Resorptions maybe found as early as 10 years of age but occurmost often in the age groups 11 to 12 years{49}.

In a recent study, Schubert et al found significant results for all angular and linear measurements taken from a panoramic radiograph when a regression analysis was performed against treatment duration. These correlations were relatively strong and individually were capable of explaining between 28.4% and 39.1% of the variability in treatment time. Due to strong correlations between variables, the maximum variability that could be explained by combining measurements was 39.3%. The strongest correlation was a linear measurement between the cusp tip and its intended target position on the occlusal plane. The average treatment time for unilateral impaction cases was 25.4 months and the average time for bilateral impaction cases was 30.4 months. {50}

In the case of the impacted maxillary canine, accurate localization of the impacted tooth is vital in diagnosis, treatment planning, and implementation of surgical and orthodontic treatment modalities. The initial position of an impacted canine can affect the duration of orthodontic treatment, knowledge of which is important to the practitioner and patient. {13,21,22}

No study to date has attempted to use a three-dimensional radiograph to correlate the initial position of an impacted maxillary canine with treatment time. Although studies using panoramic films have shown some promise, the distortions and lack of data inherent in these approaches have undoubtedly diminished their accuracy and applicability. CT radiographs have eliminated many of the problems associated with conventional images. This new technology enables a revisitation of the question of treatment duration in cases of palatally impacted maxillary canines with a more powerful and accurate instrument. {13,21,22,23,24,25}

Becker et al evaluated the post-treatment results of impacted canines. They observed an increased incidence of rotations and spacings on the impacted side in 17.4% of the cases, whereas on the control side the incidence was only 8.7%. The control side had ideal alignment twice as compared to the impacted side. To minimize or prevent rotational relapse, circumferential supracrestal fiberotomy or a bonded fixed retainer is required completion of the treatment and sometimes even before the appliances are removed. Clark suggested that after the alignment of palatally impacted canines, lingual drift can be prevented by removal of a half-moon shaped wedge of tissue from the lingual aspect of the canine{4,51,52}

VI. CONCLUSION

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

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

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LEGEND

Fig. 1a, b: Pictures of a 14.5-year-old female
a: The X-ray image shows the strong resorption on the teeth 12 and 22. The tooth 23 lies directly under the root of the tooth 22.

b: The tooth 22 was extracted to adjust the displaced tooth 23. The tooth 22 is highly resorbed.

Fig.02a-c: The cyst is the cause of the displacement in the maxilla and mandible

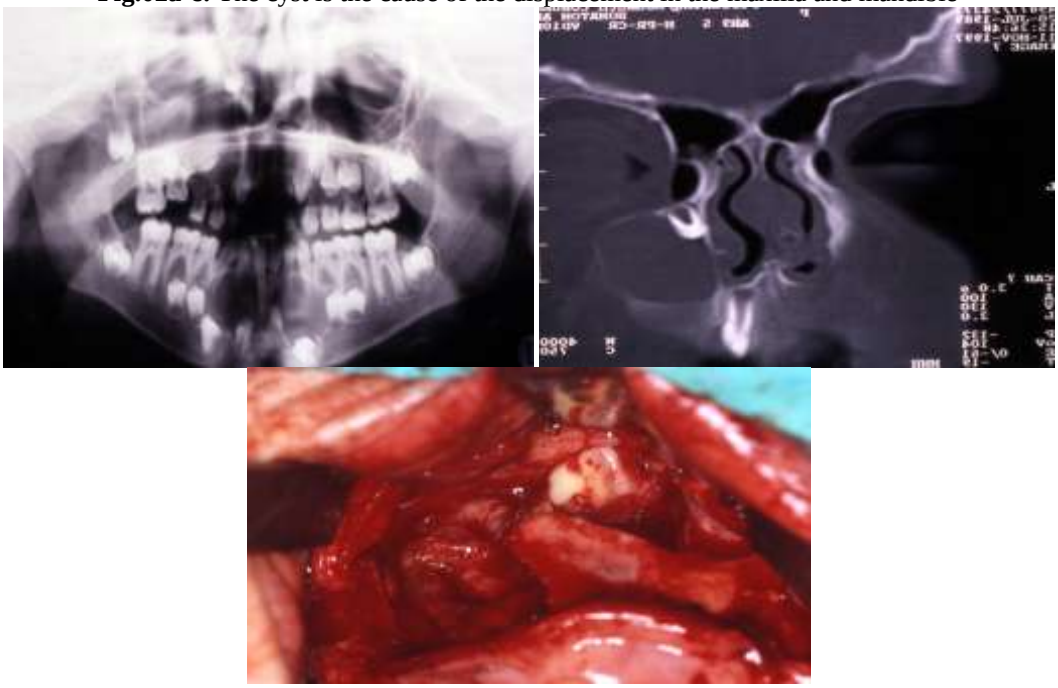
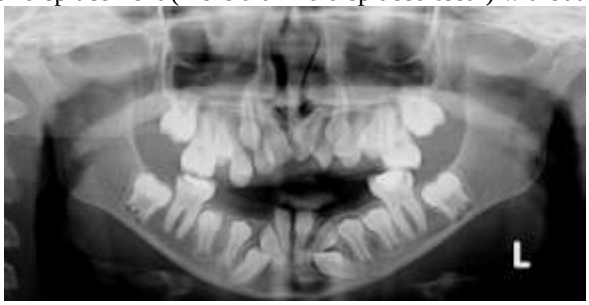


Fig.03a-e: Multiple tooth displacement (more than 20 displaced teeth) without the presence of crowds.



a: OPG of a 14-year-old girl with displaced teeth in both jaws.

b: The intraoral imaging shows sufficient space for the unerupted teeth

c, d: Situation after the opening of the mucoperiosteal flap and fixation of all attachment on the teeth displaced

e: OPG after exposure of all teeth

Fig.4a-c: Bulges on the buccal (a) and palatal (b) sides

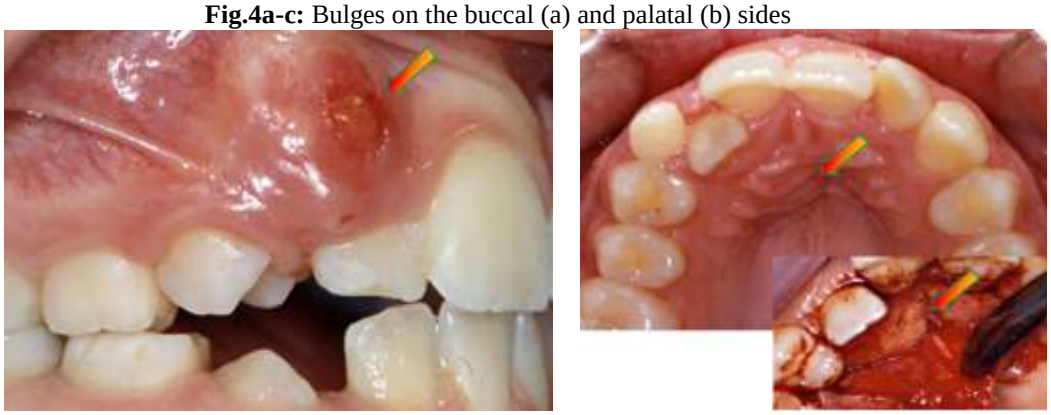


Fig.5: radiographic Diagnosis, parallax method

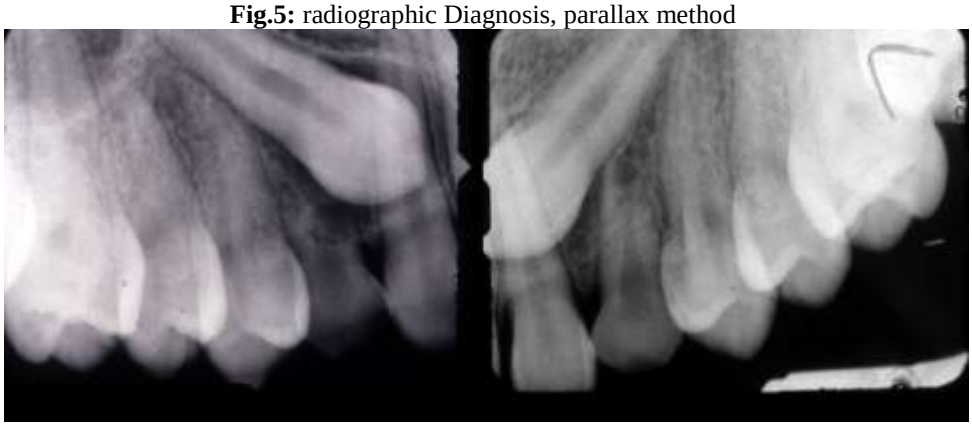


Fig.6: maxillary occlusal film

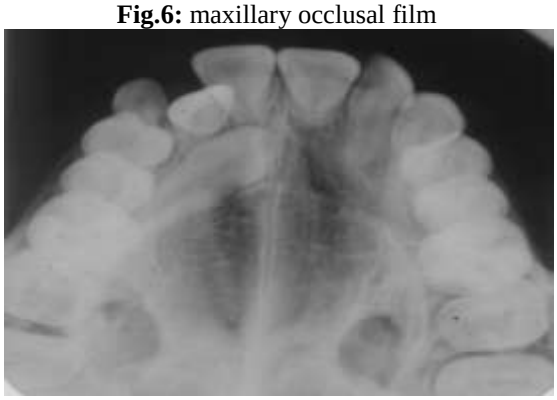


Fig.7a, b: panoramic (a)and cephalograms (b) radiographs have also been used to localize impacted teeth

Fig.8a, b: Unilateral impacted canine, cone beam computed tomography (CBCT) shows an accurate visualization of what the surgical field will look like, when the exposure is undertaken. b:

Fig. 9a-c: Bilateral palatally impacted canine: Cone Beam Computerized Tomography (CBCT) shows an accurate visualization of what the surgical field will look like, when the exposure is undertaken.

Fig. 10a-c: As an example, the pendulum can be used for space gain

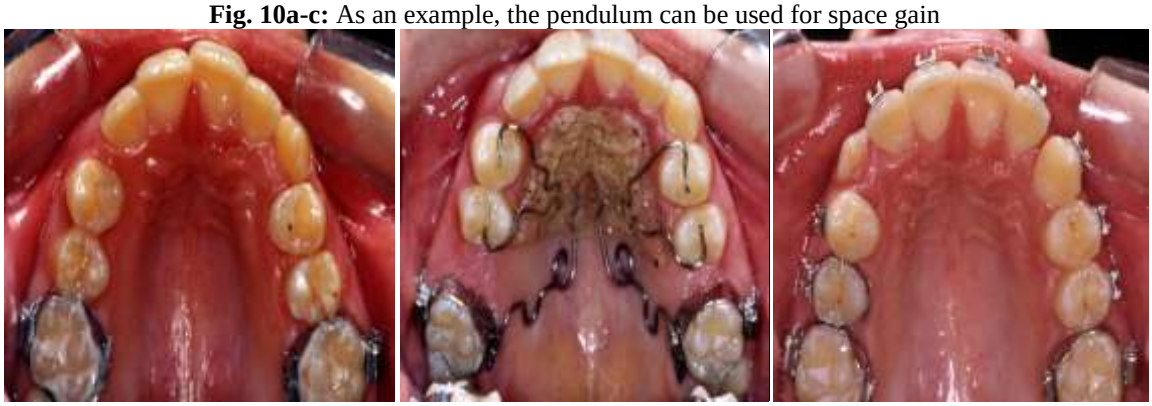
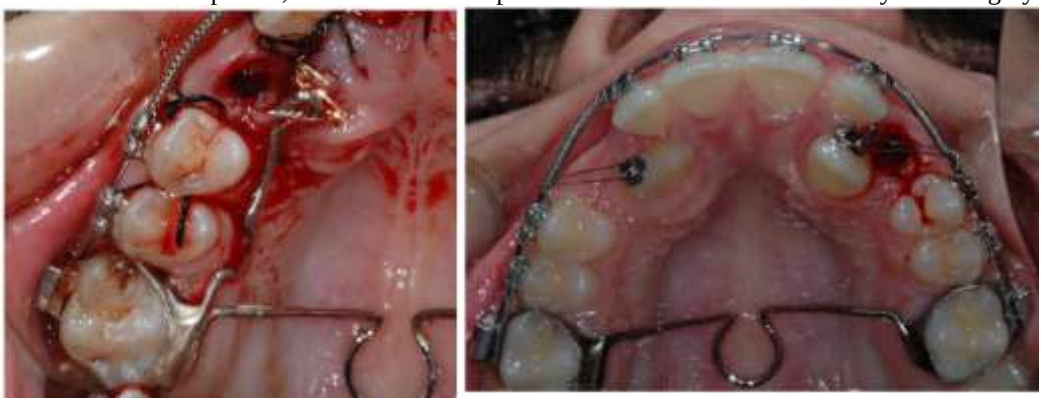


Fig.11 a-g: a 16-year-old patient with impacted canine

a, b: Clinical situation in occlusion and in the supervision of the upper dental arch before the treatment

c: The OPG shows the displacement and retention of tooth 13 and 23 with persistence of the tooth 53 and 63

d: Situation after exposure, mobilization of displaced tooth was started immediately after surgery



e: Status after initial mobilization of the canine

f: Clinical situation after the treatment

g: OPG at the end of treatment

Fig. 12 a, b: titanium chain by Watted (DENTAURUM).

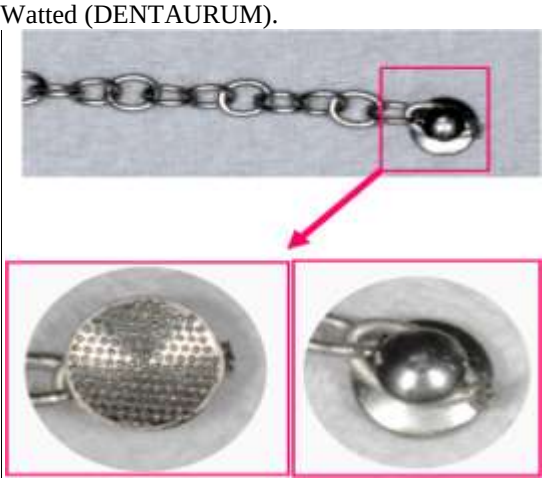
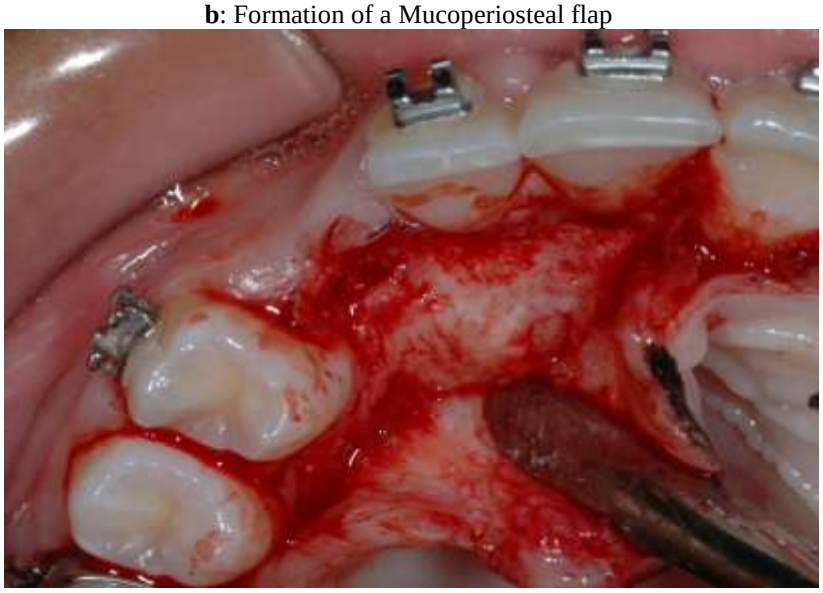


Fig. 13a-e

a: Clinical situation of the upper dental arch

b: Formation of a Mucoperiosteal flap



c: expose the crown of an impacted canine with substantial protection of the bone.

d: Fixation of the attachment by means of ligh tcuring resin after etching technique.

e: the full flap is now re-sutured into its former place and the titanium chain may be seen through the flap

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