Management of Impacted Canines

15

George Varghese

Impacted canines are one of the common problems encountered by the oral surgeon. Patients may present at different ages and many cases will be incidental findings. Close interaction with the paedodontist and orthodontist is required to get an optimal out come. Surgical removal may not be the best treatment in all the cases and particular treatement plan will have to be tailored for the needs of the patient. Localising the impacted canine seems not a challenge any more with the advent of CBCT, in indicated cases. This chapter elaborates on canine impaction, keeping in mind the basic principles mentioned in the chapter on third molar impactions. Premolars, incisors and other teeth may be impacted but most of the surgical principles and approaches mentioned for canine can be applied to them as well.

15.1 Introduction

Maxillary canine is the second most commonly impacted tooth, after the mandibular third molar. The permanent maxillary canine may be considered as impacted when the eruption of the tooth lags behind as compared to the eruption sequences of other teeth in the dentition. Diagnosis of maxillary canine impaction may be made by clinical examination and by radiography.

The normal path through which maxillary canines erupt may be altered due to changes in the eruption sequence in the maxilla, and also by space limitations due to crowding. It is essential to diagnose and treat this condition early, to prevent the development of complications. An ideal management protocol for impacted permanent maxillary canines should involve an interdisciplinary approach linking the specialties of oral and maxillofacial surgery, periodontology and orthodontics.

15.2 Aetiology of Canine Impaction

Although the exact cause of impacted maxillary canines remains unknown, multiple factors may play a role. Primary causes that have been linked to impacted maxillary canines include the rate at which roots resorb in the deciduous teeth, any trauma to the deciduous tooth bud, disruption of the normal eruption sequence, lack of space, rotation of tooth buds, premature root closure and canine eruption into a cleft. Secondary reasons include febrile diseases, endocrine disturbances and Vitamin D deficiency. Impacted canine can be concomitant with other conditions.

Except the third molars, maxillary canines are among the last teeth to erupt. They usually develop high in the maxilla and need to travel a considerable distance before they erupt.

Local factors may also play a role in canine impaction, and these include:

1. A longer eruption path that the tooth has to traverse from its point of development to normal occlusion [1].
2. Thick palatal bone and mucoperiosteum, which can obstruct eruption of palatally oriented canines.
3. More developed root at the time of eruption, which may minimize the eruptive force.
4. Disorder of the primary canine can affect the position of the permanent one. This is because the crown of the developing permanent canine lies just palatal to the apex of the primary canine root.

Electronic Supplementary Material The online version of this chapter (https://doi.org/10.1007/978-981-15-1346-6_15) contains supplementary material, which is available to authorized users.

G. Varghese (✉)
Principal, Professor and Head, Department of Oral and Maxillofacial Surgery, Pushpagiri College of Dental Sciences, Tiruvalla, Kerala, India

K. Bonanthaya et al. (eds.), *Oral and Maxillofacial Surgery for the Clinician*, https://doi.org/10.1007/978-981-15-1346-6_15

5. Canines are more susceptible to environmental influences as they are among the last teeth to erupt (except the third molars).
6. Limited space for eruption as the canines erupt between teeth which are already in occlusion. The second molar may further reduce the space.
7. The permanent canine has a greater mesiodistal width than the primary canine.

15.3 Classification of Impacted Maxillary Canines

15.3.1 The Following Classification Suggested by Archer (1975) [2] is Very Practical

Class I: Impacted canines in the palate.
1. Horizontal
2. Vertical
3. Semivertical

- *Class II: Impacted canines located on the labial surface.*
  1. Horizontal
  2. Vertical
  3. Semivertical
- *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*—Impacted canine can be in unusual positions like inverted position.

15.3.2 Field and Ackerman (1935) Classification [3]

Maxillary Canines
1. Labial position
   - Crown in intimate relation with incisors.
   - Crown well above apices of incisors.
2. Palatal position
   - Crown near surface.
   - Crown deeply embedded in close relation to apices of incisors.
3. Intermediate position
   - Crown between lateral incisor and first premolar roots.
   - Crown above these teeth with crown labially placed and root palatally placed or vice versa.
4. Unusual position
   - In nasal or antral wall.
   - In infraorbital region.

Mandibular Canines
1. Labial
   - Vertical
   - Oblique
   - Horizontal
2. Aberrant
   - At inferior border.
   - On the opposite side.
   - Mental protuberance.

Complications that Can Occur Due to Canine Impaction

1. Adjacent teeth may undergo internal or external resorption.
2. Change in alignment or proclination of lateral incisor (Fig. 15.1).
3. Odontogenic Cyst formation.
4. Development of Odontogenic Tumour.

The clinical signs that indicate an impacted maxillary canine include:

1. Prolonged retention of the primary canine [4] and or delayed eruption of the permanent canine.
2. Lack of a bulge on the labial side of the alveolus in the canine region.
3. Delayed eruption of the lateral incisor, or an incisor that is tipped distally or migrated.
4. Loss of vitality or increased mobility of the permanent incisors.

15.4 Radiographic Localization of Impacted Canine

The position of the impacted canine may be determined by visual inspection, palpating intraorally or by radiography.

Radiographic examinations may include periapical X-ray with cone shift technique, occlusal radiography, anteroposterior and lateral radiographic views of maxilla, OPG, CBCT, CT scan.

15.4.1 Radiographic Features to Consider

- Labiopalatal position of the canine relative to the erupted teeth—either labial, palatal or directly above the teeth.
- Orientation of the long axis of the canine in relation to the adjacent teeth.
- Size and shape of the canine, and its root pattern.
- Status and health of the adjacent teeth.

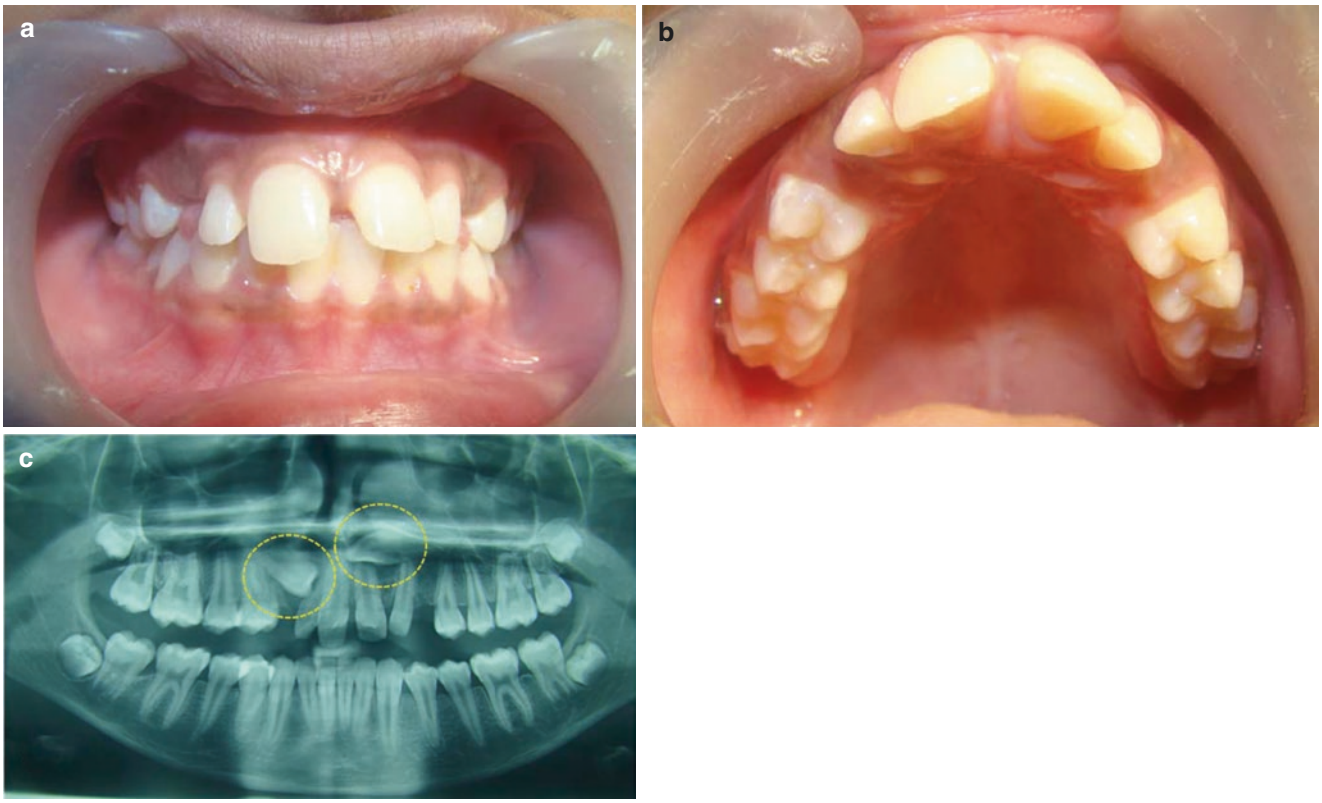

Fig. 15.1 Bilaterally impacted maxillary canine causing proclination and spacing of incisors. (**a**) Frontal view, (**b**) Occlusal view, (**c**) OPG showing impacted canines (yellow circle)

- Location and orientation of the crown and root in relation to the adjacent teeth, in three dimensions (vertical, mesiodistal and labiopalatal).
- Presence of associated cyst, odontomas or supernumerary teeth.
- Curvature of the root of impacted tooth.

Going into the fine details of localization of canine is beyond the purview of this chapter. It is an area which has been extensively studied with regard to the various imaging modalities and their advantages.

Various radiographic methods are considered routinely by practitioners for localization. A few of them are mentioned below.

15.4.1.1 Parallax

This was first introduced by Clark [5], and involves two radiographs taken at two different horizontal angles, but using the same vertical angulation. Owing to parallax error, the object that is further away appears to travel in the same direction as the direction in which the tube was shifted. The object nearer to the tube appears to move in the opposite direction [Same Lingual Opposite Buccal (SLOB) rule]. This technique can also be performed with differing vertical angulations (vertical parallax). There are different combinations of parallax techniques:

1. Clark technique: Two intra-oral periapical radiographs are taken using different horizontal angulations [5].
2. Southall and Gravely technique: One maxillary anterior occlusal radiograph and one maxillary lateral occlusal radiograph are taken [6].
3. Rayne technique: This involves differing vertical angulations, with one periapical and one maxillary anterior occlusal radiograph being taken [7].
4. Keur technique: This is also a vertical parallax method, in which one panoramic and one maxillary anterior occlusal radiograph are taken [8].

15.4.1.2 OPG

1. Magnification
   The magnification technique depends on a principle known as ‘image size distortion’. According to this, for a given ‘focal spot’—film distance, objects that are far away from the film will appear more magnified than those that are closer to the film. This has been applied using

OPGs for the impacted canine. (Wolf and Matilla [9]; Fox et al. [10]). In the OPG, if a canine looks bigger as compared to the adjacent teeth in the arch or the contralateral canine, it is probably located closer to the tube (palatal). If it is relatively small, it is located further away from the tube (labial). This method can be applied effectively only when the canine is not rotated, does not touch the incisor root and the incisor is not tipped [11].

Kuftinec [12, 13] asserts that if the canine's cusp is mesially at the root of the lateral incisor, the impaction is probably palatal but if the cuspid is found overlapping the distal half, a labial impaction is more probable.

2. Chaushu et al. [14] stated that a single panoramic radiograph could be used to assess the mesiodistal dimensions of the canine and the ipsilateral central incisors. The canine would be palatally placed if the ratio of the sizes between the canine and the central incisors is 1.15 or greater.
3. Katsnelson [15] et al. suggested a technique that used a horizontal line that extended from the mesiobuccal cusp tip of the right and left maxillary first molars, along the long axis of the impacted canines. The degree of inclination of the canine as compared to the midline is recorded. If the inclination is greater than 65°, the canine is 26.6 times more likely to be buccally placed than palatal.

15.4.1.3 Computed Tomography

Computed Tomography readily provides excellent tissue contrast and eliminates blurring and overlapping of adjacent teeth [16]. However, since CT exposes the patient to a high dose of radiation, the unfavourable relationship between cost and benefit to the patient determines its use only in particular cases, such as in the presence of craniofacial deformities. CT makes it possible to easily identify the position of impacted teeth and evaluate precisely the location of nearby anatomical structures and identify any root resorption in the adjacent teeth.

15.4.1.4 Cone Beam CT

Conventional CT imaging is associated with high radiation dose and high cost. Cone Beam Computed Tomography (CBCT) have been used instead for localization of the impacted canine. As CBCT uses cone-shaped radiation, the radiation dose is significantly reduced, and a high spatial resolution is achieved [17, 18].

Reason for Surgical Removal of Impacted Canines

- Associated cyst/tumour with the impacted tooth.
- Development of caries.
- For prosthetic replacement.
- For orthodontic reasons.
- Resorption of roots in adjacent tooth.
- Malalignment of adjacent teeth.
- Pain referred to other regions.

Treatment Options for Impacted Canines

1. Observation.
2. Surgical exposure.
3. Surgical exposure and orthodontic traction.
4. Surgical removal.

15.5 Modalities of Management of Impacted Canine

The impacted maxillary canine may be managed by several different techniques. The chosen method would depend on the degree of impaction, age of the patient, stage of root formation, presence of any associated pathology, dental condition of the adjacent teeth, position of the tooth, patient's willingness to undergo orthodontic treatment, available facilities for specialized treatment and patient's general physical condition.

1. *Extraction of primary canine.*
   This method is as an interceptive form of management. Extraction of the deciduous tooth may be considered when the maxillary permanent canine is not palpable in its normal position and the radiographic examination confirms the presence of an impacted canine. However, this treatment will not necessarily correct the problem. Surgical intervention may be required if the permanent canine fails to erupt within one year of the deciduous extraction.
2. *No treatment—Leave the tooth in situ.*
   In some asymptomatic cases, no treatment may be required apart from regular clinical and radiographic follow-up. There is a small risk of follicular cystic degeneration, although the incidence of this is unknown. Rarely, odontogenic tumours may develop in relation to the impacted tooth.

3. *Surgical exposure of the tooth.*
   This technique may be used in cases where there is enough space for the canine to erupt, and where the root formation is incomplete. Surgically exposing the crown of the canine may allow it to come into position by normal eruptive forces.
4. *Surgical exposure and orthodontically assisted eruption.*
   This is the most appropriate approach for an impacted canine. For attempting this technique, the case must fulfil the following criteria:
   (a) The impacted canine must be favourably positioned.
   (b) The patient must be compliant with both surgery and long term orthodontics.
   (c) The patient must not have associated medical problems.
5. *Surgical removal of the impacted tooth.*
   This technique is preferred for teeth that are in an unfavourable position, and which are likely to cause problems in the future. It may also be considered when a patient is not willing for orthodontic treatment or cannot afford it, even if the impacted tooth is in a favourable position.
6. *Surgical repositioning/Autotransplantation.*
   Impacted canines that are malpositioned, but have a favourable root pattern (without hooks or sharp curves) may be considered for autotransplantation into the dental arch. This may be done by utilizing the socket of deciduous canine or first premolar, depending on the amount of space needed and available.

15.5.1 Surgical Exposure of Impacted Canines

Surgical Exposure Techniques

- Gingivectomy and exposure of crown/ surgical window.
- Closed eruption method (Repositioned flap) [19, 20].
- Apically repositioned flap technique (window flap) [19, 20].
- Tunnel Technique [21].

Various studies have compared the effects of the different exposure techniques in the periodontium; however, a consensus is yet to be reached [22–24].

Chapokas et al. in 2012 have brought out a useful classification of maxillary canine impactions based on which the exposure technique may be decided [25].

15.5.1.1 Procedure

1. Palatally positioned canine
   The location of the crown of the impacted canine may be determined by radiographs. The possible position of the crown is determined, and a cruciform incision made over this. Along the incision arms, flaps are elevated on four sides so that the crown is uncovered. The flaps may be excised. If there is haemorrhage, it can usually be controlled by pressure application. If there is any bone overlying the crown, it is removed and sharp edges are smoothened so that the crown lies in a saucer-shaped bony cavity. To prevent soft tissue regrowth over the exposed crown, a pack (such as a perio pack or roller gauze impregnated with iodoform or antibiotics) may be inserted or sutured in place. Another alternative technique is to use a crevicular incision, expose palatally and place orthodontic brackets as shown in Fig. 15.2.
2. Labially positioned canines
   Any one of the following techniques may be employed depending on the depth and position of the impacted tooth:
   (a) *Creating a surgical window/Gingivectomy:* This is done if the tooth lies just underneath the gingiva. The overlying soft tissue is simply excised to expose the crown.
   If the impacted canine is close to the alveolar crest, or if a broad band of keratinized tissue covers the tooth, a surgical window may be created. Gingivectomy may be done when it is possible to uncover at least one

©Association of Oral and Maxillofacial Surgeons of India

Fig. 15.2 Exposure of a palatally impacted canine

half to 2/3 of the crown, leaving at least 3 mm of gingival collar. Usually in these cases, the tip of the impacted tooth lies near the cemento-enamel junction of the adjacent tooth (Fig. 15.3).

(b) *Closed eruption technique:* If the impacted canine lies in the middle of the alveolus, near the nasal spine, or high in the buccal vestibule or the palate, this technique may be indicated (Vermette et al., 1995) [19]. A flap is first elevated over the area of the impacted tooth. If necessary, the crown is then exposed after removal of the overlying bone. An orthodontic bracket may be bonded to the crown and to the bracket, a traction wire is affixed. The flap is then sutured, with the traction wire left exposed to the oral cavity. Sufficient time is given for the flap to undergo initial healing. Later on, the traction wire may be connected to an archwire and optimal force may be applied as needed for the tooth to erupt. Drawback of this technique is that the tooth cannot be inspected directly once the flap has been sutured (Fig. 15.4).

(c) *Apically positioned flap:* In cases where the cervical portion of the crown does not lie within the attached gingiva, removal of the soft tissue may cause the attached gingiva to be lost. Later on, this can lead to periodontal problems. In such a case, it may be better to use an apically repositioned flap.

The flap is designed in such a way that vertical incisions are placed on the soft tissue at the distal side of the lateral incisor and at the mesial side of the first premolar. Then a horizontal incision is made that links the two vertical incisions. Subsequently, after locating the crown of the impacted tooth, the flap may be sutured back into at the apical end, while the crown is exposed to the oral cavity (Fig. 15.5a, b).

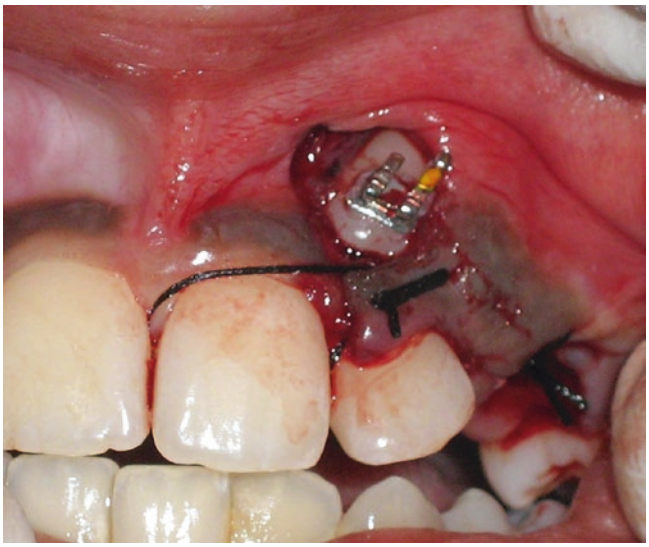

Fig. 15.3 Exposure of labially impacted canine by surgical window technique

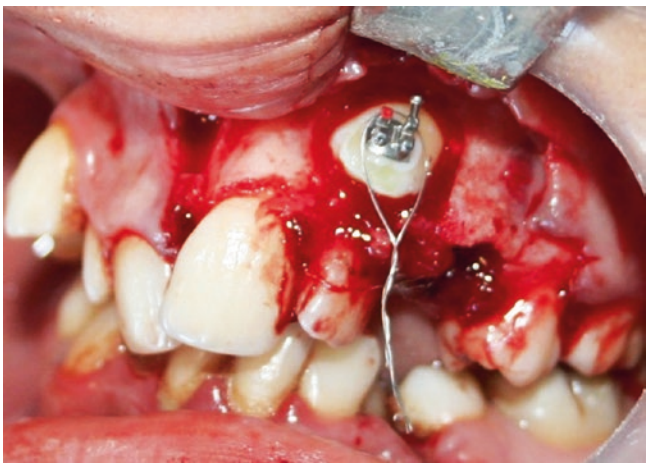

Fig. 15.4 Closed eruption technique for labially impacted canine

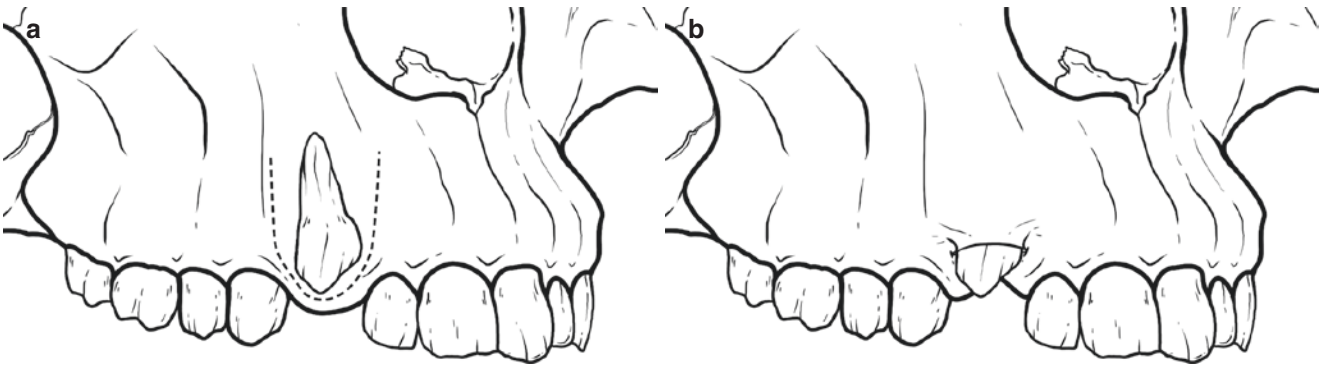

Fig. 15.5 (**a**, **b**) Schematic diagram of apically positioned flap for exposure of a labially positioned crown. (**a**) Incision, (**b**) Suturing

15.5.2 Surgical Removal of Palatally Impacted Maxillary Canines

If the impacted maxillary canine is in an unfavourable position, and cannot be brought into normal occlusion, it should be removed earlier rather than later. This is because increasing age increases the difficulty of the procedure, and by removing early, damage to the adjacent structures may be minimized.

15.5.2.1 Surgical Anatomy

The impacted canine is separated by a thin layer of the bone from the maxillary sinus and nasal cavity (Fig. 15.6). Infrequently, this bone may be absent. In these cases, the risk of tooth or root displacement into the maxillary sinus is high. It is also not uncommon to have the likelihood of creating a communication between the oral cavity and antrum, which may lead to post-operative nasal bleeding.

15.5.2.2 Procedure (Fig. 15.7a–d) (Fig. 15.8a, b)

The incision is initiated in the gingival margin on the palatal side from the ipsilateral first premolar and, depending on the position of the impacted tooth, is extended up to the contralateral lateral incisor or premolar.

In cases of unilateral impaction, instead of extending the incision to the contralateral side, a vertical incision may be given in the mid palatal region. In situations where there is bilateral canine impaction and both teeth are close to the midline, the incision should always extend between the first or second premolars of both sides (Fig. 15.8). Elevation of a single palatal flap not only avoids sloughing but also provides adequate visualization. This method may pose a risk of haemorrhage from the nasopalatine vessels which can, however, be controlled by pressure pack or by electrocautery.

The mucoperiosteal flap is then reflected to reveal the palatal bone and the tooth. Division of the nasopalatine vessels and nerve may be done for further exposure.

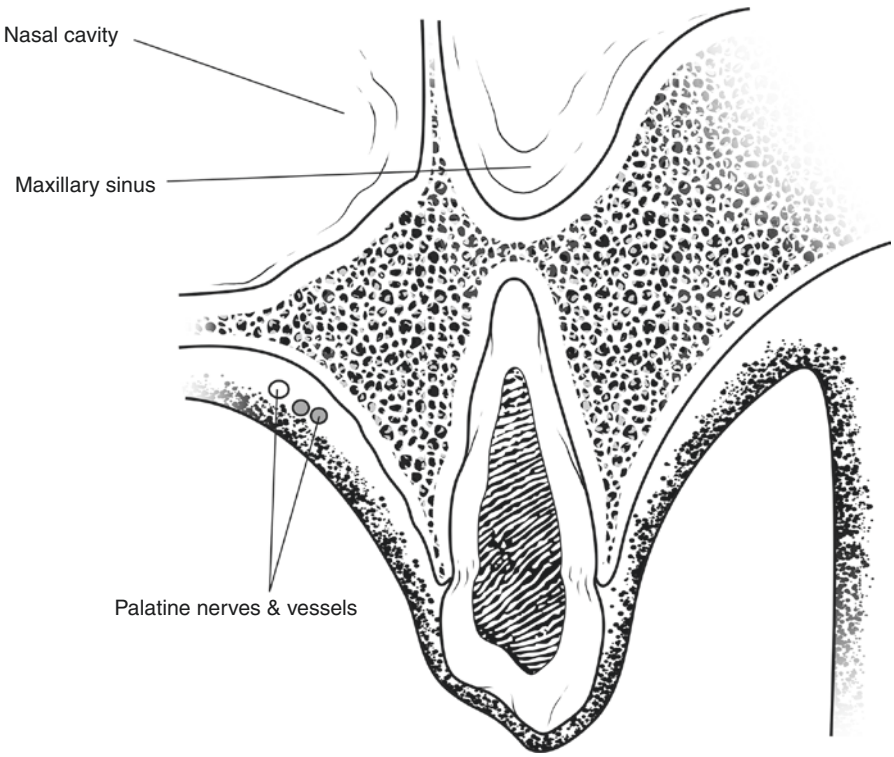

Fig. 15.6 Surgical anatomy of maxillary canine area. Note the close relationship of the root of the impacted canine to the floor of the maxillary sinus and nose

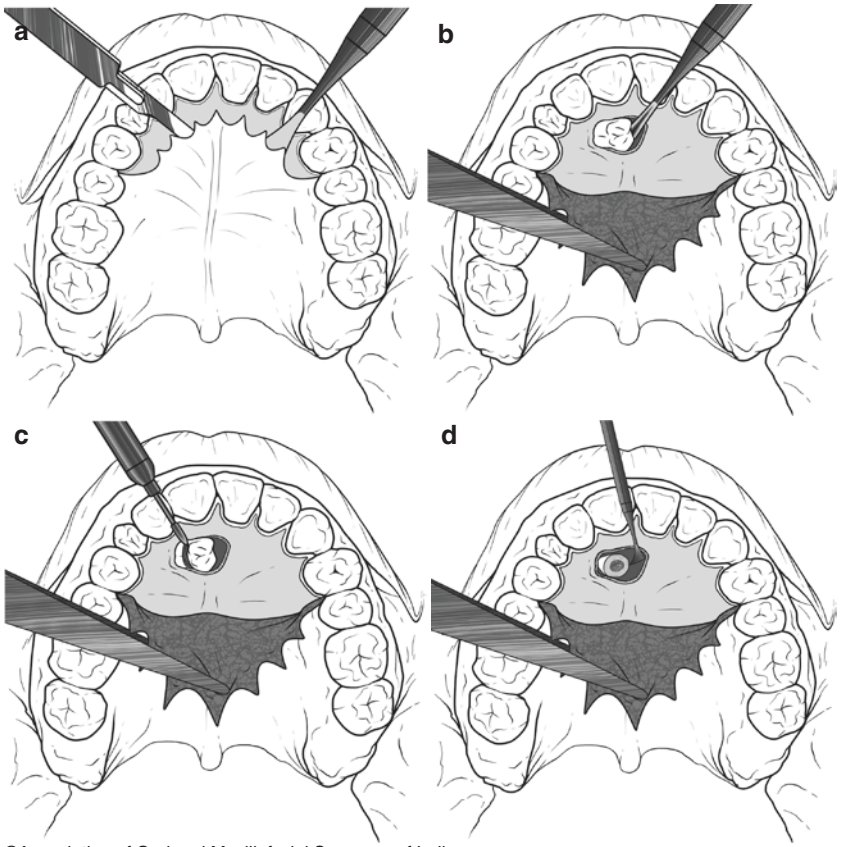

Fig. 15.7 (**a**–**d**) Schematic diagram showing steps in the surgical removal of palatally positioned impacted maxillary canine (**a**) Reflection of the flap, (**b**) Removal of bone to expose the crown, (**c**) Sectioning of the crown, (**d**) Removal of the root

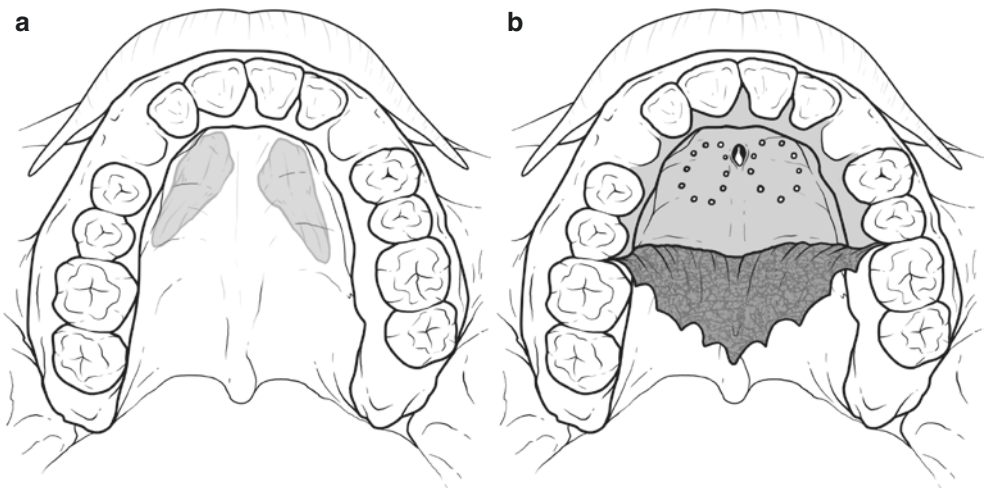

Fig. 15.8 (**a**, **b**) Palatal flap elevation for exposure of bilaterally impacted palatally positioned canine. (**a**) Flap outlined from the second premolar on one side to the second premolar of the opposite side, (**b**) Following reflection of the mucoperiosteal flap, multiple drill holes are placed in the bone overlying the crown. These drill holes are then connected together to remove the bone thereby exposing the crown

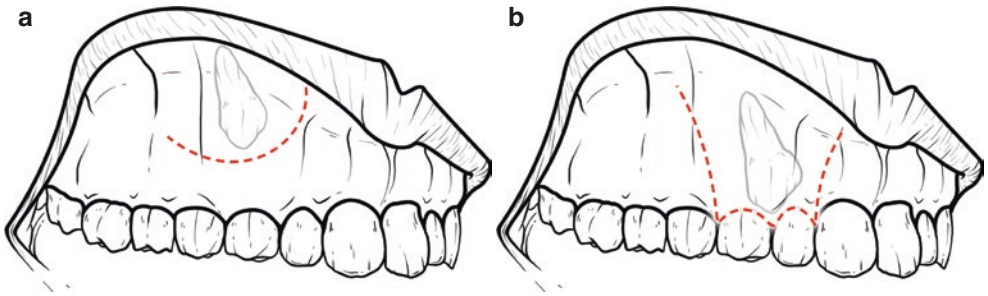

Fig. 15.9 (**a**, **b**) Incisions for removal of labially placed canine. (**a**) Semilunar incision, (**b**) Trapezoidal (3 sided) incision

The crown of the tooth may be visible occasionally, or a bulge may be felt. Bone around the area is removed with bur, taking care to protect the roots of the adjacent teeth from damage. Once adequate bone is removed, a groove is prepared on the mesial side and an elevator may be inserted into it. An attempt is made to luxate the tooth. Once the crown is moved out, it may be grasped using an upper anterior or premolar forceps. Dislodgement of the root apex may require a certain amount of torsion, as this is often curved.

If the tooth is resistant to elevation, more bone removal is done to enlarge the opening. Tooth sectioning (odontotomy) may be carried out using a straight fissure bur if there is any obstruction to movement (Fig. 15.7c, d). The crown portion is removed first. A portion of the root may then be visualized. If not, bone is removed to expose the root. A hole is created in the root and an elevator is used to engage this and remove the root.

Meticulous debridement and curettage is done to remove the tooth follicle. Saline irrigation is used to clear out bone debris. The flap is replaced and sutured into position. It is held in close contact with the palatal bone by pressing a gauze pack with the dorsum of the tongue, for an hour or two. Healing follows without any complications.

To decrease chances of hematoma formation, a prefabricated clear acrylic plate may be used to cover the palate post-operatively.

15.5.3 Surgical Removal of Labially Positioned Impacted Maxillary Canine (Fig. 15.9a, b) (Video 15.1)

15.5.3.1 Incision

A semilunar incision (Fig. 15.9a) is usually used, and it provides good exposure. The lower part of the incision must lie at least 0.5 cm away from the gingival margin.

For cases that are deeply impacted, triangular flaps (2 sided) or trapezoidal flaps (3 sided) may be used, with incisions along the gingival margin and relieving incisions. (Fig. 15.9b).

15.5.3.2 Operative Procedure (Fig. 15.10a–f) (Fig. 15.11a–i)

The mucoperiosteal flap is elevated and the bone with the tooth bulge is exposed. Using a bur, a window is created over the crown prominence. The window is enlarged so that the entire crown is exposed, taking care not to cause damage to the adjacent tooth roots. The tooth is then luxated using an elevator.

If there is any resistance during elevation, the tooth must be sectioned, so that the fragments can be removed easily. If three fragments are created, the middle one may be removed first, and the remaining two fragments may be elevate using the resultant space (Fig. 15.10a–f).

The area is carefully debrided and checked for a residual follicle, which must be removed. The mucoperiosteal flap is repositioned and sutured (Fig. 15.11a–i) shows the localisation and surgical removal of a labially positioned impacted maxillary canine.

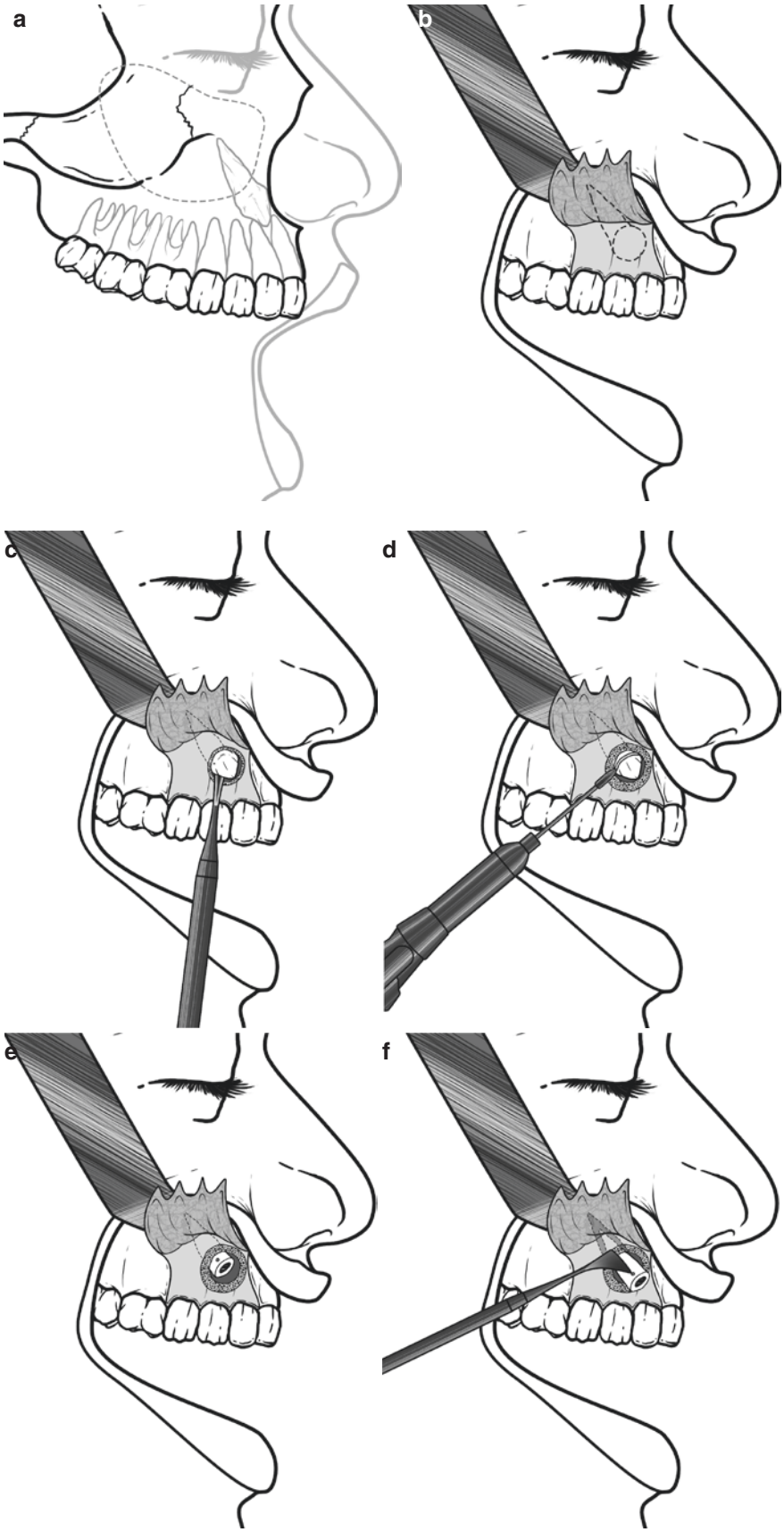

Fig. 15.10 (**a**–**f**): Schematic diagram showing surgical removal of labially impacted maxillary canine. (**a**) Impacted maxillary canine. Note the relationship of the cuspid to the roots of the adjacent teeth, nasal cavity and maxillary sinus. (**b**) trapezoidal mucoperiosteal flap reflected. (**c**) Drill holes placed in the cortical plate overlying the crown so as to expose the crown, after the full exposure of the crown, elevator is applied beneath the crown to mobilize the tooth, (**d**) If the tooth is resistant to elevation, the crown is sectioned using bur and it is removed, (**e**) Cavity created following removal of crown, (**f**) The root is moved into the space created by the removal of the crown and it is then removed

15.5.4 Removal of Maxillary Canine in an Intermediate Position (Fig. 15.12a–h)

The impacted maxillary canine may be located in an intermediate position, with the root oriented labially and the crown palatally, or vice versa. Removing a maxillary canine in the intermediate position may be challenging and may take more time as it may require a labial and palatal approach. The risk of damaging adjacent teeth is also higher with teeth in an intermediate position. CBCT or CT scan is very useful to locate the exact position of such a tooth. Figure 15.12a–h illustrates the steps involved in removing an impacted canine that has its root oriented labially and crown palatally.

Complications of removal of maxillary canines:

- Perforation through the nasal or antral mucosa.
- Tooth or root displacement into the maxillary sinus
- Haemorrhage
- Adjacent tooth root damage
- Fracture of apical third of the root of the impacted tooth.

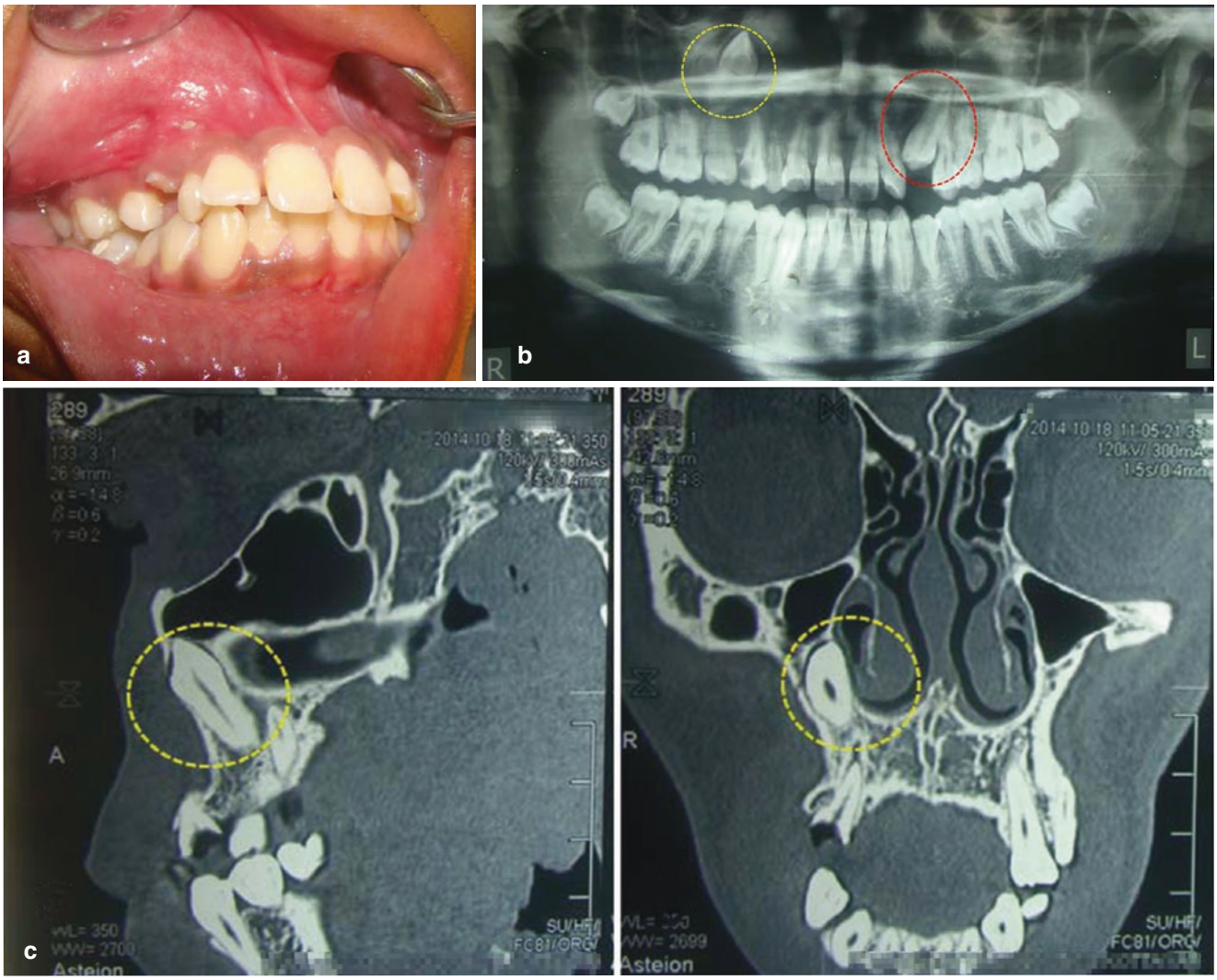

Fig. 15.11 (**a**–**l**) show the clinical and radiographic images of the steps in removing a labially impacted canine by odontectomy. Bilaterally impacted maxillary canines (**a**) Intra-oral right lateral view, (**b**) OPG showing 13 in inverted position (yellow circle) with close proximity to maxillary sinus and impacted 23 (in red circle). CT of the same patient showing the relationship of the inverted 13 (yellow circle) to adjacent structures such as maxillary antrum, nasal floor and nearby teeth. (**c**) Sagittal view, (**d**) Coronal view, (**e**) Axial view, (**f**) 3-D view. Steps in the surgical removal of impacted 13. (**g**) Incision marked, (**h**) Mucoperiosteal flap reflected, (**i**) Tooth division done, (**j**) Tooth removed and debridement (**k**) Suturing completed, (**l**) Specimen

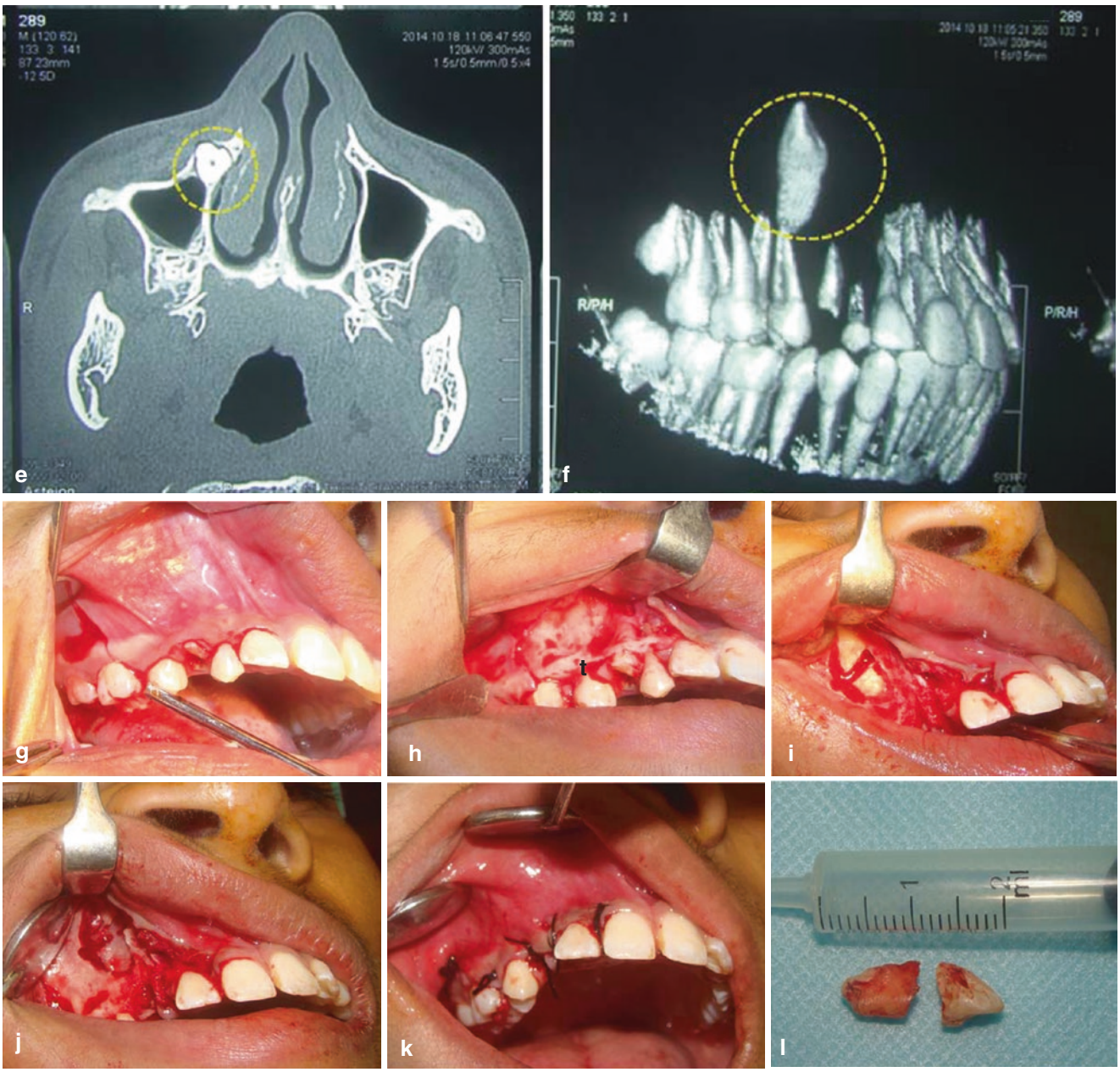

Fig. 15.11 (continued)

15.5.5 Management of Impacted Mandibular Canines

Impacted mandibular canines are not as frequent as maxillary canines, and are usually found in a labial position. However, they may occasionally migrate to the mental protuberance or even the lower border of mandible, where they can lie in a transverse position. They can also drift to the opposite side of the mandible, referred to as transposition/transmigration of the canine. It must be noted that these teeth retain their original innervation, which is important to consider while administering local anaesthesia.

The diagnosis of an impacted mandibular canine is similar to that of the impacted maxillary canine, and it presents with similar features. These include retained primary teeth, proclination/displacement of adjacent incisors or clinical features associated with cyst formation. Impacted canines may not be associated with any symptoms, and may be accidentally discovered during the routine radiographic exami-

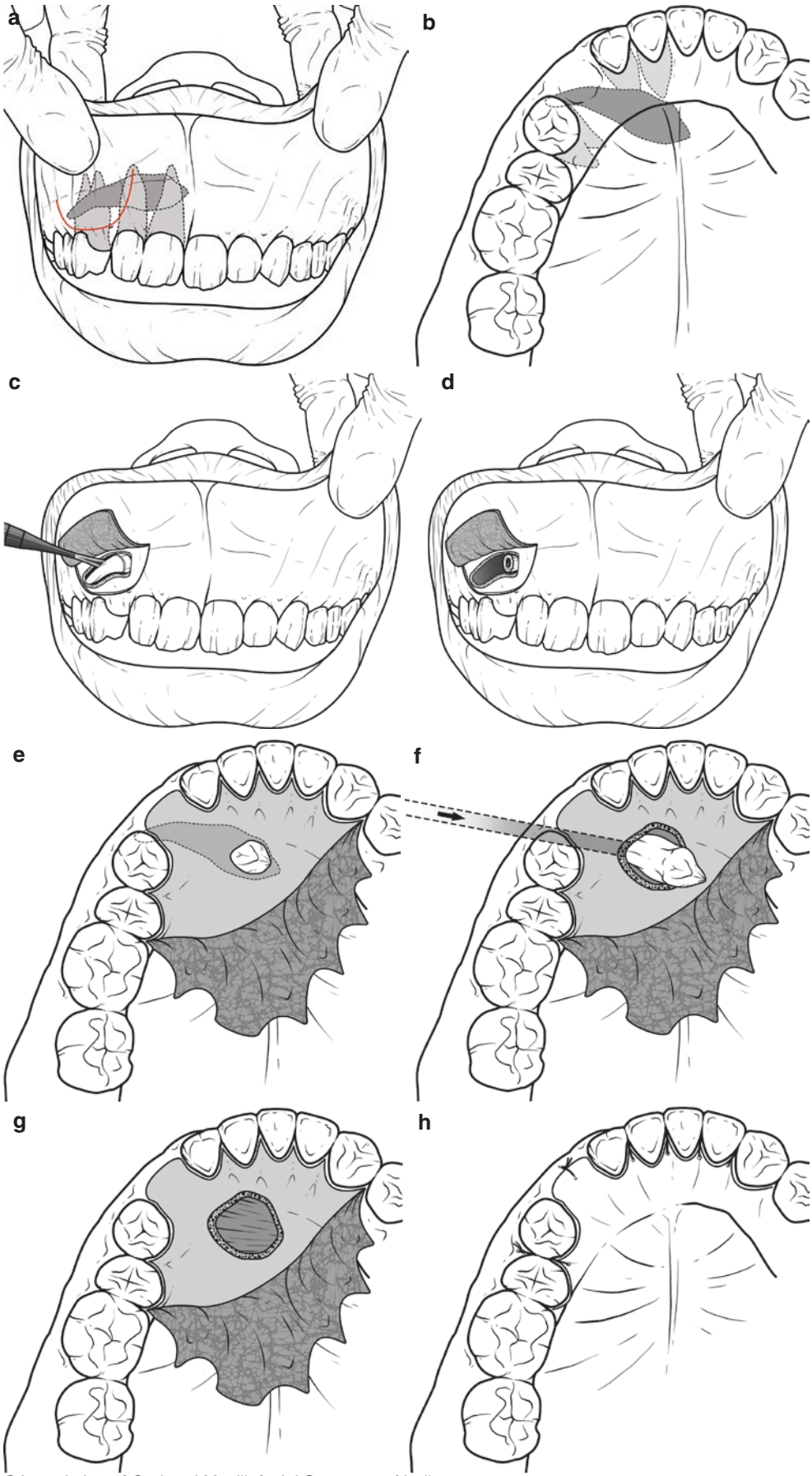

Fig. 15.12 (**a**–**h**) Schematic diagram showing the steps in the surgical removal of impacted maxillary canine with root on the labial side and crown on the palatal side. (**a**) Outline of the impacted canine and its relation to the roots of the adjacent tooth. Note the semilunar incision marked, (**b**) Outline of the crown of the impacted canine on the palatal aspect, (**c**) Mucoperiosteum reflected on the buccal side overlying the bone to be removed and the root of the impacted tooth sectioned. An elevator is being used to dislodge the root, (**d**) Empty socket after removal of the root. (**e**) Palatal flap is outlined and reflected. Bone covering the crown of the impacted tooth is removed using bur. (**f**) Using a blunt instrument placed in the socket of the tooth on the buccal side, pressure is exerted on the cut end of the crown (see black arrow) to push the crown palatally, (**g**) Empty socket on the palatal side after removal of the crown, (**h**) Flap is replaced back and suturing completed

nation, or during the investigation of other dental conditions. Sometimes, however, these teeth can cause recurrent pain and infection.

Dalessandri et al. in 2017 opined that the most common treatment strategies for the treatment of mandibular canine impactions are surgical extraction and orthodontic traction. Surgical extraction and radiographic monitoring were suggested for transmigrant mandibular canines: The authors proposed a decision tree in order to guide practitioners through the treatment plan of impacted mandibular canines [26].

15.5.5.1 Treatment Options

The impacted mandibular canine may be treated using one of the following strategies:

1. *Observation*
2. *Exposure and orthodontic repositioning*
3. *Surgical repositioning*
4. *Surgical removal of the tooth*—The impacted mandibular canine may be removed if one of the following conditions is present:
   (a) Pathology such as follicular cyst or tumour in relation to the impacted tooth.
   (b) Orthodontic reasons, such as the need to move an adjacent tooth into the area of impaction.

15.5.5.2 Surgical Anatomy (Fig. 15.13)

The bone in the mandibular canine region consists of a thick lingual cortex and a thin buccal cortex. The impacted tooth usually lies mesial or distal to the actual canine region. A buccal flap must ideally be used for surgical access, as a lingual flap may not provide adequate access, and is associated with increased post-operative morbidity. While raising the buccal flap, the mentalis muscle insertion (at the mental fossa) and incisive muscle insertion (at the height of the canine alveolus) are divided.

15.5.5.3 Removal of Mandibular Canine (Figs. 15.14 and 15.15)

For tooth exposure, a trapezoidal (3 sided) flap is used. Alternately, a horizontal incision may be made below the attached gingiva. If the tooth lies close to the lower border of the mandible, an additional incision may be needed extra-orally for proper exposure. As in the case of maxillary canine in the labial position, bone removal is done with bur. The tooth may be elevated in toto, or may require sectioning if resistance is met (Figs. 15.14a–h and 15.15).

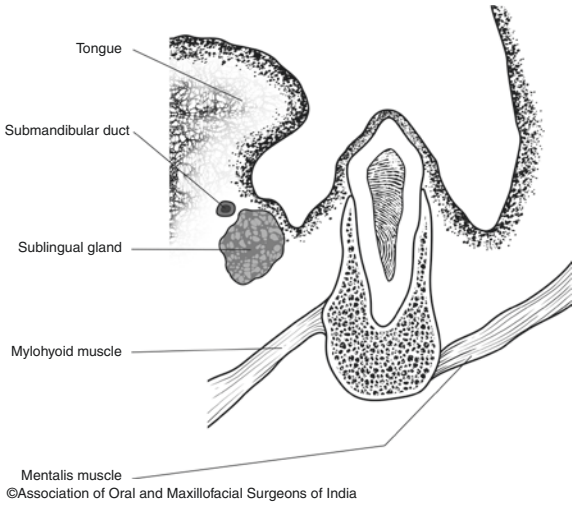

Fig. 15.13 Surgical anatomy of mandibular canine area

15.5.5.4 Complications of Surgical Removal

These Include the Following

1. *Injury/mobility of the adjacent tooth*—This can occur during bone removal, if the supporting bone of the lateral incisor is removed accidentally. This is managed by splinting the lateral incisor to the adjacent tooth.
2. *Mental nerve injury*—If the distal vertical incision is extended too far backwards and inferiorly, the mental nerve may accidentally be severed.

15.6 Summary

The management of impacted canine teeth requires skilful handling and careful observation on the part of an oral and maxillofacial surgeon. If any tooth is absent in the dental arch after the normal time of eruption has lapsed, the surgeon must investigate. The management of an impacted tooth is simple if the basic principles of surgery are followed appropriately for all the teeth. The case must be evaluated carefully for proper diagnosis and treatment planning. Treatment planning requires a multidisciplinary approach, and the general dental surgeon must consult with the oral and maxillofacial surgeon, orthodontist and paedodontist for achieving optimal results.

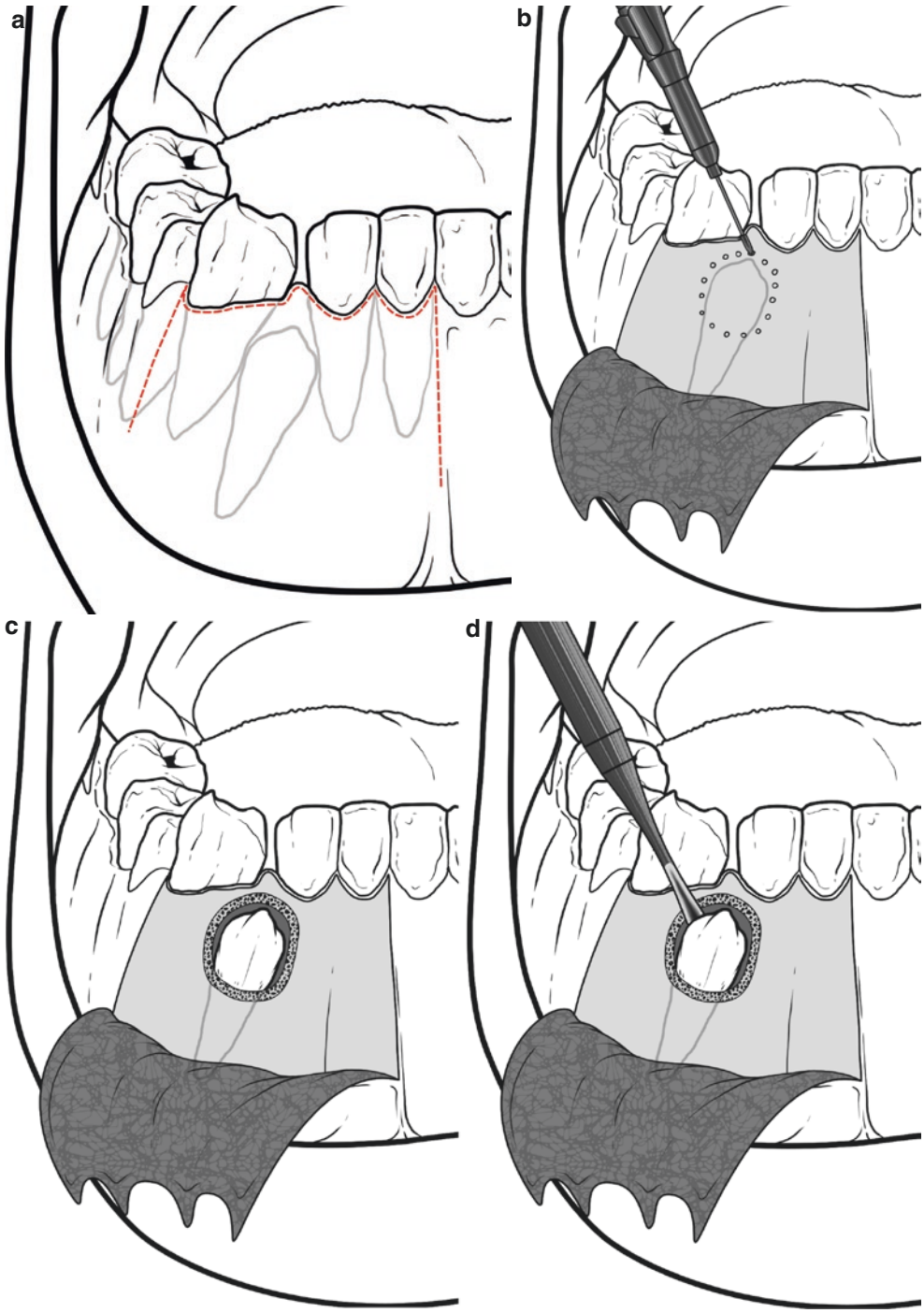

Fig. 15.14 (**a**-**h**) Schematic diagram showing steps in the surgical removal of impacted mandibular canine. (**a**) Incision to raise a trapezoidal flap, (**b**) Mucoperiosteal flap reflected and the bone overlying the crown removed using bur and chisel, (**c**) Crown of impacted canine exposed, (**d**) Elevator is applied in an attempt to luxate the tooth. (**e**) if elevation unsuccessful tooth division is performed using bur, (**f**) Crown removed and more of the root exposed to create a purchase point on the root using bur, (**g**) Root removed using an elevator applied at the purchase point, (**h**) Closure of the incision

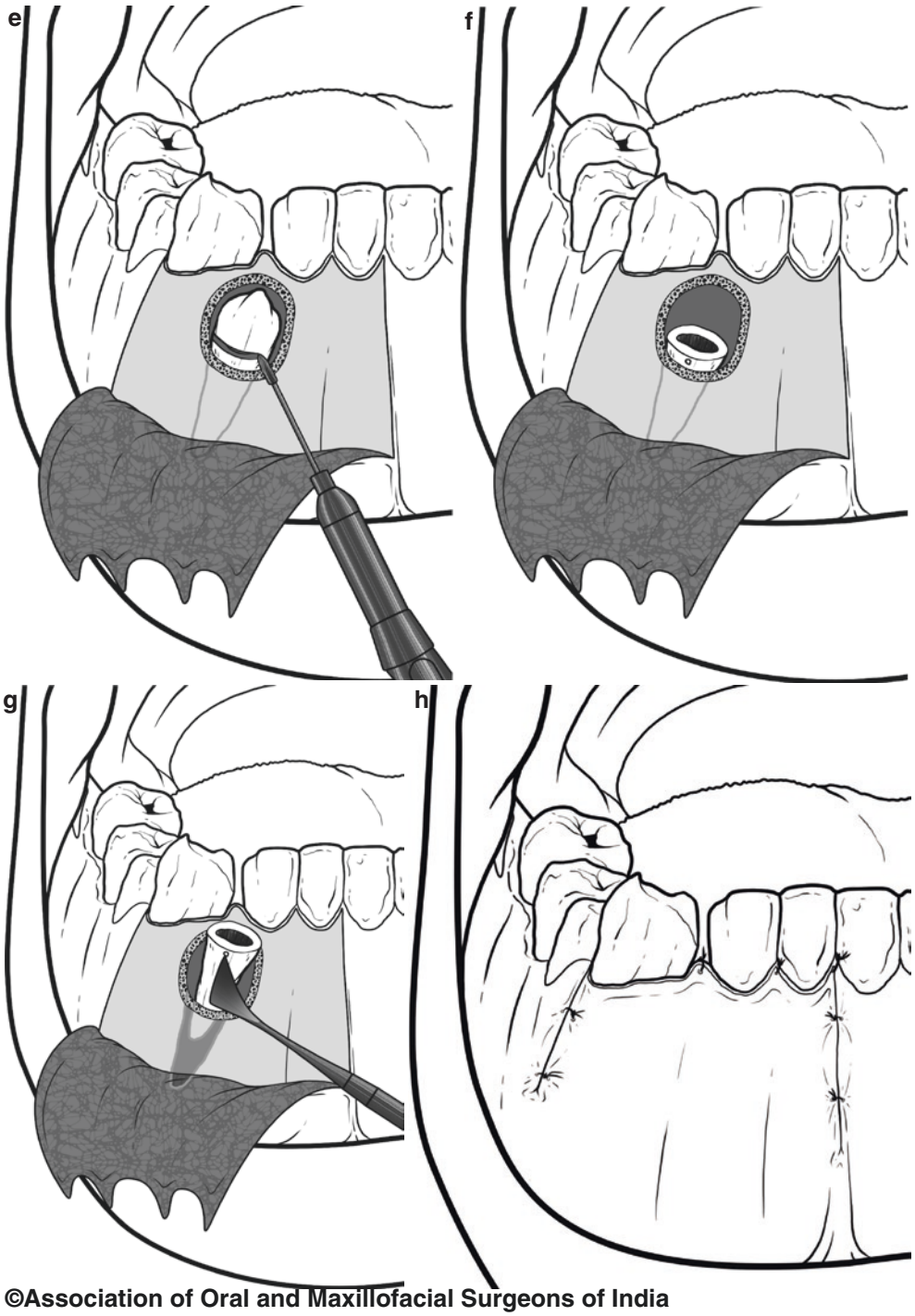

Fig. 15.14 (continued)

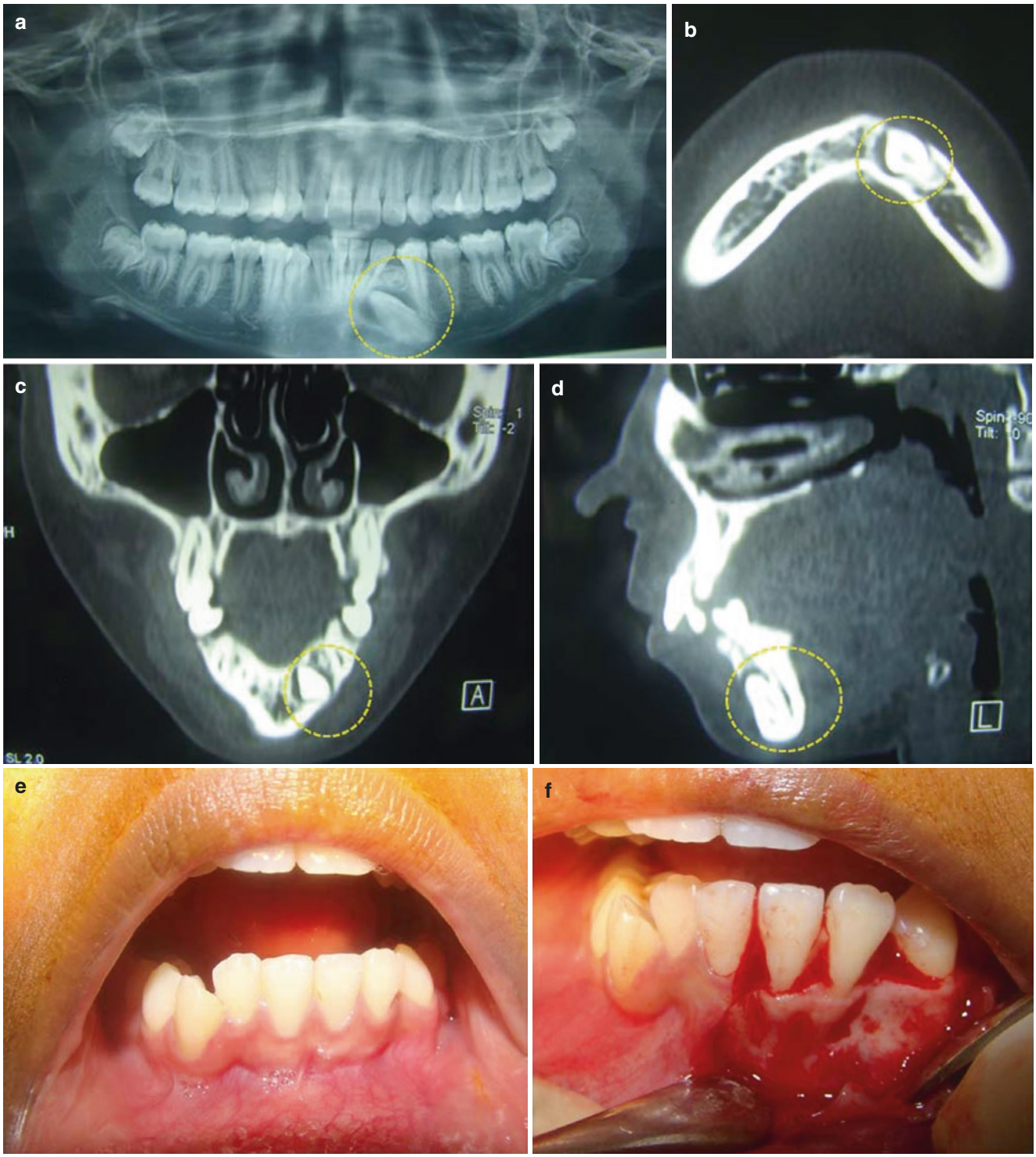

Fig. 15.15 (**a**–**m**) Shows the clinical and radiographic images of the steps in removing a labially impacted canine by odontectomy. Impacted left mandibular canine (yellow circle) with an associated odontome (**a**) OPG showing impacted 33, (**b**) CT Axial view, (**c**) Coronal view, (**d**) Sagittal view. (**e**) Intra-oral view, (**f**) Mucoperiosteal flap reflected, (**g**) Overlying odontome exposed, (**h**) Odontome removed and crown of 33 exposed. (**i**) Sectioning of crown of 33, (**j**) Removal of crown and root of 33 followed by debridement, (**k**) Suturing completed (**l**) Specimen of 33 with follicle and odontome, (**m**) Pressure dressing applied to reduce oedema

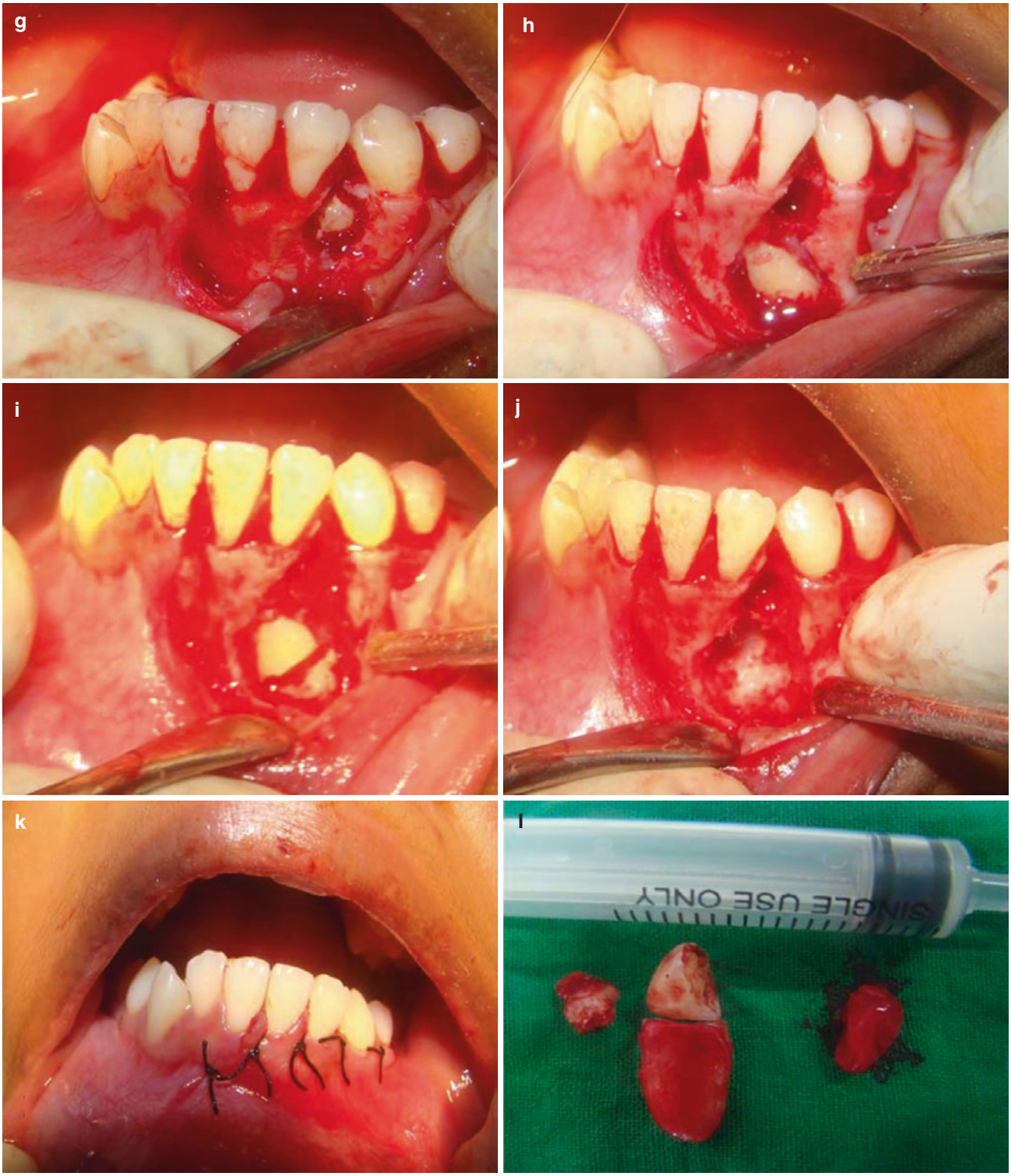

Fig. 15.15 (continued)

Fig. 15.15 (continued)

References

1. Dewel B. The upper cuspid: its development and impaction. Angle Orthod. 1949;19:79–90.
2. Archer WH. Chapter 5, Oral and maxillofacial surgery, vol. 1. 5th ed. Philadelphia, PA: WB Saunders; 1975. p. 325.
3. Field HJ, Ackerman AA. The impacted upper Cuspid. Dent Cosmos. 1935;77:378.
4. Thilander B, Jakobsson SO. Local factors in impaction of maxillary canines. Acta Odontol Scand. 1968;26(2):145–68.
5. Clark C. A method of ascertaining the position of unerupted teeth by means of film radiographs. Proc R Soc Med. 1909;3:87–90.
6. Southall PJ, Gravely JF. Vertical parallax radiology to localize an object in the anterior part of the maxilla. Br J Orthod. 1989;16:79C.
7. Rayne J. The unerupted maxillary canine. Dent Pract. 1969;19:194Ñ.
8. Keur JJ. Radiographic localization techniques. Aust Dent J. 1986;31:86H.
9. Wolf JE, Mattila K. Localization of impacted maxillary canines by panoramic tomography. Dentomaxillofac Radiol. 1979;8:85–9.
10. Fox NA, Fletcher GA, Horner K. Localizing maxillary canines using dental panoramic tomography. Br Dent J. 1995;179:416.
11. Mason C, Papadakou P, Roberts GJ. The radiographic localization of impacted maxillary canines: a comparison of methods. Eur J Orthod. 2001;23:25.
12. Kuftinec MM, Shapira Y. The impacted maxillary canine: I. review of concepts. II. Clinical approaches and solution. J Dent Child. 1995;62:317–34.
13. Maverna R, Gracco A. Different diagnostic tools for the localization of impacted maxillary canines: clinical considerations. Prog Orthod. 2007;8(1):28–44.
14. Chaushu S, Chaushu G, Becker A. Reliability of a method for the localization of displaced maxillary canines using a single panoramic radiograph. Clin Orthod Res. 1999;2:194.
15. Alexander Katsnelson A, Flic WG, Susarla S, Tartakovsky JV, Miloro M. Use of panoramic X-ray to determine position of impacted maxillary canines. J Oral Maxillofac Surg. 2010;68:996–1000.
16. Preda L, La Fianza A, Di Maggio EM, Dore R, Schifino MR, Campani R, et al. The use of spiral computed tomography in the localization of impacted maxillary canines. Dentomaxillofac Radiol. 1997;26:236–41.
17. Liu D, Zhang W, Zhang Z, Wu Y, et al. Localization of impacted maxillary canines and observation of adjacent incisor resorption with cone-beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;105:91–8.
18. 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.
19. Vermette ME, Kokich VG, Kennedy DB. Uncovering labially impacted teeth: apically positioned flap and closed-eruption techniques. Angle Orthod. 1995;65(1):23–32.
20. Chaushu S, Becker A, Zeltser R, Branski S, Vasker N, Chaushu G. Patients perception of recovery after exposure of impacted teeth: a comparison of closed-versus open-eruption techniques. J Oral Maxillofac Surg. 2005 Mar;63(3):323–9.
21. 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 Dentofac Orthop. 1994 Jan;105(1):61–72.
22. 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 Apr;149(4):463–472. Review.
23. Schmidt AD, Kokich VG. Periodontal response to early uncovering, autonomous eruption, and orthodontic alignment of palatally impacted maxillary canines. Am J Orthod Dentofac Orthop. 2007;131:449–55.
24. Quirynen M, Op Heij DG, Adriansens A, Opdebeeck HM, van Steenberghe D. Periodontal health of orthodontically extruded impacted teeth. A split-mouth, long-term clinical evaluation. J Periodontol. 2000 Nov;71(11):1708–14.
25. Chapokas AR, Almas K, Schincaglia GP. The impacted maxillary canine: a proposed classification for surgical exposure. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012 Feb;113(2):222–8.
26. Dalessandri D, Parrini S, Rubiano R, Gallone D, Migliorati M. Impacted and transmigrant mandibular canines incidence, aetiology, and treatment: a systematic review. Eur J Orthod 2017 Apr 1;39(2):161–169. Review. (Open Access).