Molar Uprighting

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Introduction

Surgical uprighting is a technique commonly used to correct the position of an impacted tooth to bring it into stable occlusion. While the mandibular third molar is the most commonly impacted tooth in the mouth, oral and maxillofacial surgeons routinely evaluate impacted teeth elsewhere in the oral cavity for both extraction and alignment purposes. Impacted second molars are of particular interest, as these teeth often can be brought into alignment by utilizing a number of different treatment modalities, thereby preventing the unnecessary extraction of an otherwise healthy tooth. This chapter explores the etiology of impacted molars, indications and contraindications for uprighting, different uprighting methods including advantages and disadvantages, and potential complications of each technique utilized.

Etiology

While the true incidence of impacted mandibular second molars has not been well studied, estimates of approximately three out of every 1000 patients have been cited [1, 2], and the situation usually occurs unilaterally. There are several proposed etiologies for the impacted second molar, including both systemic and local factors. Systemic factors include endocrine conditions such as hypothyroidism and

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hypopituitarism, febrile diseases, Down syndrome, and irradiation, which may influence permanent teeth impaction. However, these conditions often involve multiple teeth [3, 4]. Local factors include inadequate space for eruption due to arch-length deficiency, excessive distance between the first and second molars resulting in lack of guidance by the distal root of the first molar, prolonged primary tooth retention, lack of mesial movement of the permanent first molar, supernumerary teeth, and tumors, which can obstruct eruption [4–9]. It is essential to determine the cause of impaction in each case that is evaluated in order to properly sequence the treatment, especially if other specialists are involved with the patient's oral care.

Evaluation

Evaluation of impacted molars is done through clinical examination and use of radiographs. When multiple teeth are found to be impacted, the clinician should suspect and evaluate for a systemic cause. The ideal age of uprighting of mandibular second molars varies, but is typically between ages 11 and 14, or before root formation is complete [7]. Radiographic evaluation is essential for determining tooth position and level of impaction, as well as root formation. Common modalities include panoramic and periapical films, though the use of in-office cone beam computed tomography (CT) scans has become commonplace for determining tooth shape, crown-root relationship, and tooth inclination [10]. Conventional radiographs can be used to determine the three-dimensional position of an impacted tooth by utilizing the principle commonly referred to as the SLOB rule, or same-lingual, opposite-buccal. A common method is to use two separate periapical films, and shift the tube horizontally between exposures. The unerupted tooth will appear to move in the same direction as the tube if it is lingually positioned, and will appear to move in the opposite direction as the tube if it is buccally positioned. This is not always required when evaluating an impacted tooth, but becomes useful when the position of the tooth and surgical access are in question. Additionally, a thorough medical history will aid in determining if any systemic causes should be suspected.

Indications for Uprighting

For the majority of non-third molar impactions, the most ideal treatment outcome is aligning the tooth in a functional position. Alignment utilizes both surgical and orthodontic treatment strategies, and it is essential to coordinate between specialists during the surgical planning process. Extraction of the impacted tooth is necessary if there is evidence of root pathology or association with pathologic lesions, based on clinical and radiographic exam. Additionally, if the tooth is tipped lingually or buccally, the tooth should not be surgically uprighted since intact buccal and lingual plates are necessary for stability.

Advantages of molar uprighting include improved function, periodontal health, and decreased caries risk for the impacted molar and adjacent teeth. In addition, the presence of a functional molar prevents the supraeruption of the opposing dentition. Periodontitis is a major concern with partially erupted teeth, as pseudopocket formation

makes teeth exceedingly difficult to cleanse. By uprighting an impacted molar, the pseudopocket is minimized and the crown becomes more easily cleansable, creating an environment for a healthy gingival attachment and better plaque control [11].

Treatment Options

Techniques for uprighting impacted second molars include surgical uprighting and orthodontic repositioning. Some of the major advantages of surgical uprighting are immediate repositioning, low cost, and a relatively high rate of success with proper surgical technique.

Surgical exposure and bonding of an orthodontic appliance allows for active guidance of the impacted tooth into a functional position. The disadvantages of orthodontic repositioning are, the patient must have orthodontic treatment underway in order to deliver an appropriate force system to upright the impacted tooth, sufficient space must be present in the dental arch for the eventual position of the impacted tooth, and the extended treatment time for repositioning. Advantages to orthodontic repositioning include a lower incidence of ankylosis, pulp necrosis, and root resorption when compared to surgical uprighting. The literature for both surgical uprighting and orthodontic repositioning is limited to mostly case reports, though results have demonstrated reliable success with long-term stability for both treatment categories.

Surgical Uprighting

Surgical uprighting can be safely performed with local anesthesia, with supplementation by intravenous sedation when appropriate. Following adequate anesthesia, a full-thickness mucoperiosteal flap is elevated to expose the site of the impacted molar. There are different opinions regarding extraction of the third molar when uprighting an impacted second molar. Some authors state that it is important to extract the third molar at the time of uprighting a second molar, as the presence of the third molar may limit the movement of the second molar [12–14] (Figs. 13.1a, b and 13.2a, b). However, it has also been advocated to keep

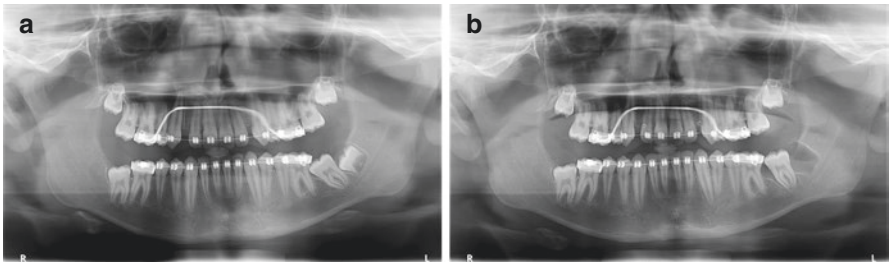

Fig. 13.1 (**a**) Preoperative panoramic imaging of impacted teeth #17 and 18. Note the mesioangular angulation of tooth #18. (**b**) Postoperative panoramic imaging after removal of tooth #18 and surgical uprighting of tooth #17

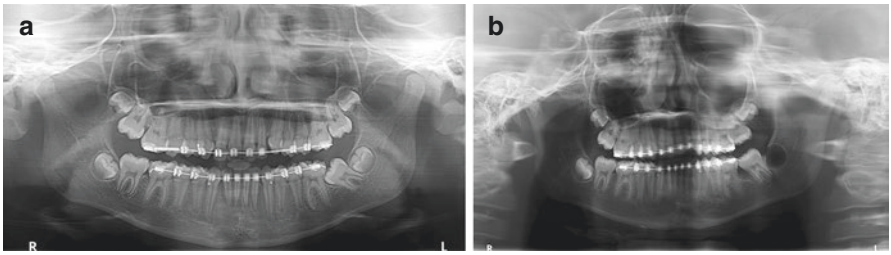

Fig. 13.2 (**a**) Preoperative panoramic imaging of impacted teeth #17 and 18. Note the mesioangular angulation of tooth #18. (**b**) Postoperative panoramic imaging after removal of tooth #18 and surgical uprighting of tooth #17

the third molar, if possible [1]. It is theorized that the third molar may provide some immediate stability to the uprighted second molar, and furthermore, if the second molar eventually needs to be extracted, the third molar can be used to replace it via transplantation or orthodontic repositioning. Either strategy may be employed, though discussion should take place with the patient during the surgical planning process. Alveolar bone is then removed around the crown of the second molar with a bur, allowing for exposure of the height of contour of the crown. A dental elevator is then used to apply distal and occlusal forces in order to position the mesial marginal ridge of the second molar at the same level as the distal marginal ridge of the adjacent first molar. The uprighted molar should not be tipped more than 90° [11]. If the third molar was not previously extracted and limits the elevation of the second molar, the third molar should then be extracted at this time. Once the second molar has been successfully elevated into the desired position, the occlusion is checked to ensure that no occlusal forces are present on the uprighted molar [11]. The surgical site is then irrigated with normal saline and gingiva is closed with 3-0 chromic gut sutures. In order to achieve added stability, in the case of gross mobility on the elevated second molar, orthodontic brackets may be utilized. Attachments can be bonded onto the second molar and the adjacent first molar, if the patient does not already have orthodontic appliances. A 28-gauge ligature wire tied in a figure-eight fashion can be used to splint the first and second molar together. Alternatively, the teeth can be splinted using a wire that is secured to the first and second molars using acid etched composite resin. A postoperative panoramic radiograph should be obtained to provide a baseline for follow-up evaluation. Postoperative instructions for the patient are similar to those of other extractions. Swelling, bleeding, and pain are normal in the immediate postoperative period, and postoperative analgesics may be prescribed. Importantly, it is paramount that the patient avoids bite forces to the uprighted tooth during the initial healing period, or approximately two weeks [1]. The patient should be seen for follow-up in one week to re-evaluate the stability of the uprighted molar, and again in 6 months for repeat panoramic radiograph [6].

Orthodontic Repositioning

In general, orthodontic molar repositioning consists of an attachment that is bonded to the surgically uncovered buccal or distobuccal surface and the subsequent application of an uprighting force along with an appropriate anchorage unit to counteract the uprighting forces. The application of the uprighting force may involve elastics or elastomeric chains, NiTi-coil springs, superelastic NiTi wires, a variety of uprighting springs, or wires. The anchorage for the repositioning forces may involve mini-implants, surgical plates, partial or comprehensive orthodontic appliances. The orthodontic repositioning of a molar is complicated by its distal position in the arch and the difficulty in applying the correct force system for repositioning. The use of mini-implants (MIs) has increased in recent years. The main advantages are their ability to reposition teeth with minimal orthodontic appliances and their ability to limit applying unwanted forces to anchor teeth [15]. MIs may require less intra-oral hardware, which may lead to better patient satisfaction [16].

A systematic review done by Magkavali-Trikka et al. discussed the use of MIs with direct and indirect anchorage. Direct anchorage occurs when the application of the uprighting force is on the Mi or surgical plates. When the MIs or surgical plates are used to counteract the forces on the anchorage unit it is called indirect anchorage. The use of MIs with direct anchorage was studied in 15 papers included in this systematic review, and were used in situations that called for correction of molars in the sagittal plane. The MIs were placed in either the retromolar area, vertically in the alveolar ridge of a mesial edentulous site, or mesial to the mandibular molar and between the roots of the adjacent teeth to achieve direct anchorage. Forces were created using either coil springs or by buttons and elastomeric chains. For mesially tilted second molars, buttons were placed on the buccal, lingual, and mesial surfaces, and elastic chains were attached to a MI in the retromolar area, thus creating a distalizing uprighting force. Other treatment options utilizing direct anchorage include using uprighting springs, a cantilever or archwires on the MI or plate delivering the appropriate force on the molar.

A different scenario occurs when there is lingual eruption of the mandibular second molars. This can be caused by an arch-length discrepancy in the posterior segments [17]. While surgical uprighting should not be performed in this situation, orthodontic alignment has been shown to be successful. Two options for correcting this scenario are: interarch cross elastics and MI anchorage. Interarch cross elastics can be used to correct a lingually tipped mandibular second molar and a buccally tipped maxillary second molar simultaneously if both molars need repositioning. However, if the upper second molar is in an ideal position, the lingual and extrusive forces applied to the maxillary second molar are not ideal. In addition, extrusive forces applied to both molars can create occlusal trauma or complicate the buccal lingual correction of the molars. An alternative option is to use MIs placed in the alveolar bone palatal to the maxillary second molar and buccal to the mandibular second molar to generate palatal and intrusive forces on the maxillary molar and buccal and intrusive forces on the mandibular molar. The procedure utilizes MIs

in the maxillary and mandibular alveolar bone, with elastics attached in order to create lateral forces. This treatment method described by Park and colleagues [17] has the benefit of minimal hardware placement and is potentially better tolerated by patients than the interarch cross elastics approach.

Indirect anchorage has also been studied, albeit less extensively. In one case, [18], a MI placed between the second premolar and the first molar was connected to the anchorage unit by a rigid stainless steel wire, helping to counteract the forces felt on the anchor unit. An appropriate repositioning force system is placed on the anchorage unit reinforced by the MI and applied to the molar for uprighting.

Complications

Complications following surgical uprighting of second molars have been well documented and include infection, osteitis, pulp calcification, root resorption, and ankylosis. In a study done by Pogrel and colleagues, an 18-month follow-up period revealed mostly positive results. In a study where 22 second molars were uprighted, one was lost due to infection in the early postoperative period. In this patient, a periodontal infection around the uprighted tooth developed into an osteitis that resulted in bone loss and subsequent gross mobility of the tooth. The molar was extracted, as it appeared non-vital with a radiographic bony defect. The other patients in this case series demonstrated no mobility with stable occlusion, as well as adequate bone formation such that no pocketing depths were greater than 3 mm. Root formation following uprighting has been shown to be variable, with just over half of patients showing continued root formation. However, the root apices appear to be closed in all cases. Likewise, vitality tests using an electronic pulp tester has inconsistent results. Pulp calcification was seen in approximately one-third of cases, though none of these patients were symptomatic. Furthermore, none of the teeth studied required root canal treatment by the 18-month follow-up [19].

The appearance of postoperative radiographs is also a potential concern, due to the potential for root resorption, ankylosis, or pulp calcification. Padwa et al. describes a rate of abnormal postoperative radiographs as 47.3% in a study that examined surgical uprighting results over a 2-year period [1]. However, no pain, swelling, or other symptoms during the follow-up period were seen, nor were any new periodontal defects created. Thus, the radiographic findings of pulpal changes have not been shown to be indicative of clinical failure.

Complications associated with orthodontic repositioning include reduction in amount of keratinized gingiva, gingival recession, gingivitis, ankylosis, devitalization, root resorption, injury to the periodontium, and marginal bone loss [20–23]. While no studies have directly compared surgical uprighting with orthodontic repositioning of impacted molars, careful exposure of the impacted tooth and the appropriate application of external forces will minimize the risk of complications in either treatment option.

Conclusion

Surgical uprighting of molars has been demonstrated to be a safe and reliable means of repositioning teeth into a functional position. Traditional methods of uprighting include immediate surgical repositioning, conventional orthodontic repositioning, or orthodontic repositioning combined with the use of mini-implants or surgical plates. While both options have demonstrated efficacy, the decision-making process should include an informed discussion of the treatment protocols between the patient, surgeon, and orthodontist.

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