J Oral Med Oral Surg 2021;27:28
https://doi.org/10.1051/mbcb/2020058

https://www.jomos.org

JOMOS
Journal of Oral Medicine and Oral Surgery

Literature Review

Surgical uprighting of impacted mandibular second molar: a narrative review

Tarnjit Kaur Sangha[1], Sukhneet Kaur Sangha[2], Brandon Hanna[3], Tabassum Tayab[4], Soumya Padala[5,*]

[1] General Dentist, Private Practice, WA, USA
[2] Department of Molecular Bioscience, Bellevue College, WA, USA
[3] First year Orthodontic resident, Georgia School of Orthodontics, Atlanta, Georgia, USA
[4] Ministry of Bahrain, Bahrain
[5] Rush Orthodontics and Craniofacial Center, Rush University Medical Center, IL, USA

(Received: 15 October 2020, accepted: 25 November 2020)

Keywords:
Surgical uprighting / impacted second molar

Abstract – Early diagnosis of impacted mandibular second molar (MM2) is critical since treatment at a later stage can be complicated. It often requires a multidisciplinary approach. Surgical uprighting of impacted MM2 appears to be a safe, effective, and a reliable alternative to conventional orthodontic mechanics with minimal risk of morbidity or pulpo-periodontal problems. Timely diagnosis is critical and factors affecting treatment outcomes must be assessed for a successful outcome. Although surgical uprighting or repositioning is the most commonly prescribed option for MM2 management, there isn't a review of literature that discusses the etiology, assessment, and surgical management of impacted MM2 with an emphasis on surgical uprighting technique and comparing various factors that affect the outcome.

Introduction

Mandibular Second molar (MM2) impactions are relatively rare eruptive disorders and occur in 0.03–0.65% of the population [1–3]. Eruption can be defined as the axial movement of a tooth [4]. Teeth with arrested eruption can be classified under three conditions namely impaction, primary retention and secondary retention. Impaction is defined as a tooth which is completely or partially unerupted and is positioned against another tooth, bone or soft tissue so that its further eruption is unlikely, described according to its anatomic position [4]. Primary retention is defined as impaction without an obstacle in the eruption path or ectopic position of the tooth germ before gingival emergence, and secondary retention is defined as arrested eruption without an obstacle but after gingival emergence [4]. MM2 impactions are more frequently observed unilaterally in the mandible [1,5–7]. A higher number is observed amongst males as compared to females [1,5–7]. It is usually detected at 11–13 years of age [1–3]. It is seldom the primary reason for orthodontic referral and is found as an incidental finding during orthodontic treatment [5,8].

Recently there has been an increased interest in MM2 impactions as they are thought to be caused by iatrogenic means [1,5–7,9,10]. This is due to prevention of the late mesial shift using lower lingual holding arch (LLHA), which decreases the amount of posterior arch length available for the erupting MM2 that is potentially contributing to its impaction [3,4,7,10,11]. MM2 impaction in patients undergoing non-extraction via E-space preservation with a passive LLHA the was 10–20 times more prevalent than that observed in the general population and it has been suggested that any biomechanical approach that prevents mesialization of the first mandibular molar could produce similar results [9,10,12]. Further, delayed eruption of MM2, may cause an otherwise impacted mandibular third molar (MM3) bud to compete for position as well [13]. Treatment plan of impacted MM2 is developed through collaboration among the general dentist, orthodontist, endodontist, periodontist and oral surgeon to offer a plan with the best prognosis [14]. Non-invasive modalities of correction should be considered before an invasive surgical approach is chosen [14].

The goal of this narrative review is to provide an overview of etiology, assessment and surgical management of impacted MM2 with an emphasis on surgical uprighting.

Methods

An electronic search was conducted on PUBMED utilizing key terms; Impacted mandibular second molar AND surgical uprighting and Impacted mandibular second molar AND

* Correspondence: soumya_Padala@rush.edu

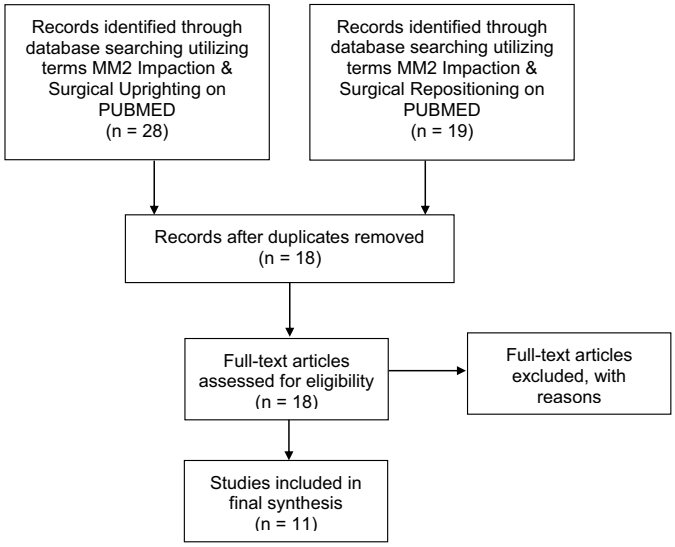

Fig. 1. This flow diagram describes the number of records identified, excluded and included in assessing treatment outcomes for this narrative review.

surgical repositioning. Inclusion criteria included all papers in English that reported case(s) solely treated with surgical uprighting and were part of case reports, studies, series, cohorts, trials. The initial search revealed 47 papers and after removing duplicates, hand searching bibliographies of each paper, records that did not match the above-mentioned selection criteria were removed. 11 were included for the final synthesis (Fig. 1).

Etiology

Various causes have been suggested for the impaction of MM2. Permanent molars erupt distal to the primary molars and may get "locked out" due to inadequate space, into which they erupt due to arch length deficiency (ALD) [6,15]. ALD is a teeth to jaw size discrepancy, which occurs due to disturbance in mandibular growth, tooth development or genetic factors may potentially play a role [15].The space for MM2 is acquired by resorption of the anterior border of the mandibular ramus and mesial migration of the MM1 into the leeway space during transition of the dentition from primary to permanent teeth [15,16]. The tooth bud of MM2 develops with a mesio-axial inclination, and with time it undergoes self-correction due to the process of remodeling [15,16]. Some iatrogenic factors also cause ALD and were attributed to any treatment modality that prevented mesialization of the MM1, such as prevention of mesial shift of MM1 caused by a lip bumper, LLHA or appliances with similar mechanics [15,17]. Additionally, an incorrectly fitted band cemented on MM1 and previous orthodontic sagittal expansion, could also potentially lead to MM2 impaction [18,19].

Arch length excess could also potentially cause impaction due to excess space between the developing MM2 crown and MM1 roots causing MM2 to further incline mesially thus, becoming impacted under MM1's distal height of contour [7,14]. Alling and colleagues postulated that eruption of MM2 requires guidance by the distal root of MM1 similar to the eruption of the maxillary canine, whose eruption depends on the guidance of the lateral incisor [7,14,20].

Some other proposed causes of MM2 impaction are delayed eruption of the second premolars, ankylosis of primary teeth, untimely primary molar extractions, cysts, tumors and third molars occupying a more mesial position [14]. Sometimes MM2 gets impacted spontaneously, which may be related to the MM3's position [15,21].

Classification of MM2 impactions

MM2 impactions are classified as mesial, distal and vertical depending on the position [22]. Authors suggest that lack of space or otherwise known as ALD was the cause of retention of MM2 in the mesio-angular and disto-angular positions, whereas local factors, for example ankylosis, were the reasons for retention in a vertical position [22]. MM2 occasionally undergoes spontaneous uprighting, if the MM3 bud is not developing on top of, or pressing against, the erupting MM2 [10]. Wellfelt and Varpio [6] suggested high success rates in treatment outcomes of mesially inclined MM2 and extraction of MM3 was not always necessary. The treatment of partially retained, distally inclined MM2 appeared to have the least favourable prognosis, with no remarkable change regardless of extraction of MM3 [13].

Diagnosis

Diagnosis of MM2 impaction begins with a clinical examination to evaluate teeth present, stage of development and obvious local conditions that may be interfering with MM2's eruption [5]. Clinically if MM2 has erupted without the contralateral molar beyond 6 months then this would warrant investigation. A routine diagnostic tool such as the Panoramic imaging is sufficient to determine the position of the impacted tooth to adjacent structures. In a preadolescent patient, panoramic evidence of a MM3 follicle positioned on top of the developing MM2 crown may be considered as a risk factor for future impaction [5]. An ankylosed MM2 will be vertically positioned and submerged below the distal prominence of the first molar, with both mesial and distal bone heights lower than normal [5].

In the surgical removal of impacted molars, a risk of 7% chance of nerve injury has been reported. The primary reason for advanced imaging techniques is to reduce this risk [23]. Panoramic imaging creates discrepancies in angular measurements secondary to projection geometry resulting in the presence of distortional inaccuracies [23]. Simply, the panoramic image results in the MM3 appearing less mesially inclined, which can have both treatment planning and surgical implications [23]. CBCT offers significantly greater diagnostic precision over conventional panoramic images for evaluation of root resorption on adjacent teeth [23,24]. More recently 3D

models developed from CBCTS such as ANATOMODELS® have gained widespread acceptance in better visualization of relationships of impacted teeth to adjacent structures. For surgical planning of impacted MM2, accurate assessment of the MM2's angulation and its relationship to the inferior alveolar canal is critical to categorize risk regarding postoperative issues, such as nerve injury and jaw fracture [23]. Furthermore, MRI has been proposed bas an alternative imaging option for impacted teeth because it helps determine volumetric morphology while eliminating ionizing radiation, which is especially important in younger patients [23,25].

Overview of management

Early diagnosis of impacted MM2 is critical, since treatment at a later stage can be complicated [13]. It often requires a multidisciplinary approach and three possibilities can be considered; exclusively surgical techniques, orthodontic techniques or combined surgical and orthodontic techniques [8,26,27]. Although surgical uprighting is a safe and reliable treatment modality for uprighting of MM2 the best treatment option has been contrasted for many years and is case dependent, thus case selection is critical for a reliable outcome [3,15,22,28,29]. It is not in the purview of this paper to discuss other treatment modalities in the management of MM2.

Holland in 1956, was the first to suggest "surgical orthodontics", as a treatment method for the correction of impacted MM2 [5,30]. Surgical orthodontics encompasses procedures such as surgical extraction, surgical uncovering with orthodontic-assisted eruption, surgical uprighting and transplantation of MM3.

Surgical uprighting is a procedure performed by an oral surgeon to reposition the molars into optimal vertical position in the socket, by tipping, so that the root apices preserve apical vessels [5]. It should be considered only after the chance of self-correction and non-invasive methods such as listed below have been ruled out [31–33].

- Brass wire placement/Separating/de-impaction springs [14,26,33–35]
- Orthodontic uprighting [36–38]
- Allowing the third molar to drift after extraction of the impacted MM2. Although success of this treatment is unpredictable as it depends on the eruption path of the third molar.
- The treatment option for the best treatment plan has been contrasted for many years and is case dependant [3,15,22,28,29]

Advantages

In most patients with MM2 impaction, extraction of MM2 is usually not desirable since MM3's eruption path is not predictable [26]. If left untreated, impacted MM2 can cause caries, periodontal issues and root resorption [14]. Despite the success reported by orthodontic uprighting, duration of orthodontic treatment of this condition varies, treatment time may be prolonged, and prognosis is not always positive [26,36]. Orthodontic treatment may not be suitable for severely impacted teeth and non-compliant patients [20]. In the terminal molar area, uprighting may be a tedious procedure utilizing orthodontic appliances due to anatomical variables such as, decreased vestibular depth, soft tissue anatomy and operative variables such as mouth opening, limited accessibility to bond attachments/brackets and patient discomfort [26,36]. Whereas, surgical uprighting is a procedure with minimal morbidity and good long-term prognosis and provides a simpler and quick solution, particularly when orthodontic treatment is contraindicated [13,18]. The overall prognosis is better than what has been reported for transplantation of teeth, since the tooth is not removed from the socket, and in many cases the apical vessels probably remain intact [18].

Disadvantages

Surgical repositioning is not without risks, some of the complications include, external root resorption, ankylosis, pulpal necrosis [5]. Additionally, periodontal health may get compromised. Usually these complications increase with advancing age and are seen in mature teeth with closed apices or more severe angle of inclination [5,39]. During surgery, buccal bone is removed to improve access. However, this removal of bone causes a rolling up-and out vector of luxation due to reduced resistance from the buccal aspect causing MM2 to be displaced far too buccally [5]. MM2 in its upright position must not be inclined buccally or lingually, therefore the cortical plates on both buccal and lingual aspects must be intact to allow primary stabilization after surgical uprighting. Hence, buccal bone removal for access should be as minimal as possible. Furthermore, correction of this iatrogenic crossbite may need complex orthodontic and surgical mechanics to be employed because enamel cannot resorb surrounding lingual bone and a second uncovering may be required.

A discussion to interpret the significance of clinical factors and their effect on outcomes of surgical uprighting has been categorized in the following sections; clinical factors, management and treatment outcomes.

Clinical factors

Clinical factors to be taken into consideration for surgical uprighting of MM2 are [20,39]:

- Pathological Changes
- Ideal timing and Root formation (Tab. I)
- Arc of rotation and Angle of Inclination
- Third molars
- Space in the arch
- Occlusal factors
- Periodontal factors
- Jaw development
- Infection

Table I. Shows age and root formation stage for surgical up-righting recommended by various authors.

Author (Year)	Age	Stage root formation
Kravitz *et al.* (2016) [5]	11–15	1/2 to 2/3rd
Owen (1998) [34]	10–15	Prior to apex closure
Johnson and Quirk (1987) [27]		
Pogrel and Anthony Pogrel (1995) [18]		
Davis *et al.* (1976) [26]	<13	After apex closure

Pathological changes

Indications for treatment of impacted and retained second molars include the risk of resorption of neighbouring teeth, caries and periodontal problems, follicular cysts, malocclusion, difficulties in treating deep bite, pericoronal inflammation, and pain [14,40].

Ideal timing and root formation

Surgical uprighting prior to root completion of MM2 has been found to improve the long-term prognosis and makes it reliable and simple [2,5]. Ideal timing for surgical uprighting is when MM3 is partially developed and MM2 has one-half to two-thirds root development, which is usually around age 10–15 [5,18,19,27,34,36,41] (Tab. I). Not all patients have chronological age and root development coinciding, due to this variation, radiographic apical closure, which should occur later in teenage years may occur as early as 11 years of age [19,41]. Although in some cases successful uprighting has been achieved after root formation is complete, due to tipping and bodily movement apical vessels get severed, and to enhance revascularization the tooth with incomplete root development and open apex is expected to respond more favorably [14,18,26,27,34]. Because of the potential of immature teeth to revascularize the pulp space, the tooth remains uninfected and inflammatory root resorption will not occur [19].

The most important factor for achieving successful outcomes in transplants is root development. 3–5 mm root development has been determined to be predictive of a successful outcome. Since repositioning is similar to transplantation, this concept is applicable to surgical up-righting as well [34]. However, some authors have reported successful up-righting of mature teeth with closed apices and obtained successful results From this evidence, it seems unclear if these parameters based on age and root maturity are valid predictors [26].

Arc of rotation and angle of inclination

Angle of inclination is measured at the intersection of long axes of impacted MM2 and MM1. Angle of inclination of less than 75° between the MM1 and MM2, is amenable to surgical uprighting [4,5]. Angle greater than 75° often requires a surgical procedure called transalveolar transplantation where the tooth is surgically repositioned in the dentoalveolar segment but away from the socket.

Whereas the arch of rotation is the angular path of MM2 during up-righting. Pogrel and Anthony Pogrel, suggested that uprighting teeth more than 90° could cause them to behave like transplants, thereby diminishing the survival [14,18,42]. Therefore, arc of rotation and angle of inclination for uprighting the MM2 should not exceed 90° and 75°, respectively. In addition, tipping procedures do not cause a significant change in apical position and can be performed successfully even when the root is more developed [18]. Pulp necrosis is reportedly increased with greater distance of root apex movement [18,20]. Previous case reports indicate a high incidence of success with surgical up-righting of MM2 without endodontic treatment therefore indicating good case selection and careful surgical management are the fundamental criteria to prevent pulp necrosis and root resorption [19].

Third molars

Many advocate extraction of MM3 at the time of uprighting due to inadequate space in the arch; and avoid two surgical procedures for the patient [34]. Cyst development as a possible complication of this surgical procedure warrants concern and may be a sufficient reason for concurrent removal of MM3 or their removal in 6 months, before a cyst of appreciable size can develop [26]. Since most second molar uprighting are successful it's hard to justify leaving MM3 and later subjecting the patient to another procedure for their removal [27].

However, there are several valid reasons for deferring extraction of MM3 until the survival of the uprighted tooth is assured [34]. As it can be brought into the second molar position at a later date if the repositioned tooth does not survive the surgical procedure. Patients can be informed at the time of the procedure that the MM3 should be evaluated for extraction 6 months postoperatively [26]. In selected cases, Davis and associates reported a favorable experience repositioning 21 MM2 without removal of MM3 [26].

Growth

When the lack of space is due to the MM3 and is the primary reason for MM2 impaction then extraction of MM3 is advocated. In most cases, it is advocated to extract the third molar due to lack of space which is the primary cause of impaction [34]. While pathology in the path of eruption is another likely etiology for some cases [1]. The posterior eruption space

increases with normal growth by 4–5.79 mm from ages 13–18 [1,43,44]. Additionally, this increase in posterior eruption space could also be attributed to remodeling as a consequence to the surgical uprighting procedure, which involves bone removal on the buccal and distal aspect as needed [1]. It is important to be aware that vertical jaw growth may not be complete in all patients, hence orthodontic treatment may be needed to achieve ideal occlusion and correct any tooth submersion that may occur during growth.

Periodontal

The goal of surgical uprighting of MM2 is to optimize occlusal position and establish healthy soft tissue attachment, with adequate access to maintain good oral hygiene [14]. Following luxation, the periodontal ligament undergoes robust changes and new bone forms as a result of the new periodontal attachment [5]. This regeneration occurs predominantly due to coronal growth of periodontal ligament along the mesial root of uprighted MM2 [20]. Thus, surgical luxation of an impacted second molar takes advantage of the excellent wound healing properties of the periodontium [5]. A natural osteogenic response to the defect created by uprighting of the impacted second molars without a bone-grafting procedure is shown with maturation of the crestal bone and a radiographically visible cortex [19]. This emphasizes the importance of an atraumatic surgical approach with primary closure, allowing the tissue in the mesial defect to reorganize against a scaffold of bone [19]. Maintaining viable periodontal ligament cells and minimal cementum damage during surgery is essential for uncomplicated tissue healing [19]. Periodontal regeneration is possible only in the absence of pathogens.

Impacted MM2 is often associated with angled osseous anatomy along its mesial root which is a physiological adaptation of bone due to the tilted or tipped tooth position and has an appearance similar to infrabony defect. This is almost never associated with periodontal pathology and therefore, should not be referred to as a defect or pocket [20]. On occasion, autogenous bone grafting in accessible bone defects may be necessary [14]. In comparison, a fully erupted MM2 that has tipped into an MM1 extraction site will also have an acutely angled osseous topography along its mesial root, but in this case the mesial aspect of the erupted tooth will be associated with a loss of periodontal attachment due to plaque-induced inflammation [5,23,45]. As discussed previously, new periodontal attachment will not occur in the presence of pathogens/periodontitis. In these circumstances, orthodontic uprighting after surgical luxation may actually widen the osseous defect [5].

Occasionally, residual tissue is observed covering distal of MM2 after surgical uprighting is complete. This residual tissue is a sign of ALD and must be removed to prevent periodontal issues in the future [27].

Infection

It has rarely been reported that MM2 developed periodontal infection in the early postoperative period. It should be noted that this periodontal infection has the potential to turn into osteitis resulting in bone loss and tooth loss. Usually, this occurs within a period of 6 weeks when the tooth can become loose in the socket and appear non vital with a bony defect radiographically [18].

Clinical management

Technique of uprighting

Since mesial impaction of MM2 is the most common type of MM2 impaction, the technique described below addresses only surgical technique in relation to mesially impacted MM2. Bone is removed posteriorly to upright MM2 by tipping it superiorly and distally for mesially impacted MM2, until it's level with plane of occlusion [34]. In instances where there is ALD leading to lack of space for MM2 in the posterior alveolus, distal bone may resist this tipping movement and will require more bone removal [27]. To achieve stability, MM2 is uprighted and wedged between the distal bone and the distal surface of the MM1 with no further splinting required [18]. Movement of the apices is kept at minimal to reduce complication of pulpal necrosis [34]. On the mesial side of MM2 bone may need to be removed to accomplish this movement [46]. The surgeon will often feel the tooth "snap" into the osseous trough as the tooth is firmly wedged into its new position [46]. The occlusion is checked and premature contacts on MM2 are eliminated by occlusal equilibration [46]. Elevation of the mesial marginal ridge of the second molar above the distal crest of contour of the first molar is imperative for stability [27]. Some authors use previously freed bone fragments to wedge them in the mesial aspect of the second molar, prior to repositioning the mucoperiosteal flap [26]. While others believe the mesial bone defect tends to fill in without the addition of implant bone or other material [27,34]. The guidance of the socket will sometimes place the tooth buccal or lingual to the normal arch position which may need further orthodontic assistance to idealize the position of the tooth [26]. Rarely, if satisfactory initial positioning is not possible, a partial elevation may be performed and a second procedure in a few months to accomplish the final result [27].

Retention

The uprighted tooth should be relatively stable in its new position if MM2 is wedged between MM3/distal bone and the MM1. Splinting is recommended if mobility is present or if the uprighted tooth is suspected to be relatively unstable in its new position. If the tooth is not stable, splinting is recommended for two weeks with a resin bonded wire [14]. If there is significant mobility and the tooth can be compressed in the socket, the tooth should be rigidly stabilized for no less than four weeks [14]. Some authors recommend using acid etched composite resin to secure a buccal wire of approximately 0.5 mm diameter from the MM1 to MM2 for approximately 4 weeks, prior to initiation of orthodontic tooth movement [18].

Post-operative

The patient may experience minimal discomfort with limited mouth opening for 1–2 weeks after surgery [5]. Mild analgesics and prophylactic antibiotics are usually prescribed [5]. A soft diet should be prescribed for one week to enable reattachment of the periodontal ligaments [5]. The patient is instructed to use warm saline rinses and refrain from chewing on the surgical site [26]. The occlusion must be carefully evaluated after the tooth is uprighted and before the patient is dismissed [27]. An opposing maxillary tooth if supra-erupted with the repositioned tooth must be equilibrated to prevent traumatic occlusion [27]. Ideally, the repositioned tooth should be slightly out of occlusion to avoid occlusal trauma [14].

Follow up

An immediate postoperative panoramic radiograph should be obtained to establish a baseline for evaluation of future healing [14]. Subsequently, follow up radiographs are acquired after 6 months, 1 and 2 years for assessing, crestal bone height, root growth, pulp chambers and presence of root resorption and bone fill [26,27]. Orthodontic treatment can commence after an initial healing period of two to four weeks though some authors recommend that teeth may be banded or bonded in 3 or 4 months for active orthodontic treatment [27].

Treatment outcomes

Literature available on surgical uprighting of MM2s is limited to case reports, case series and retrospective cohort studies. Based on search conducted on PUBMED, only authors listed in Table II provided information relevant to treatment outcomes. Surgical uprighting of MM2 is a procedure with relatively high success rates and minimal complications which can be avoided with good case selection based on various factors discussed throughout this review. Failure rates reported consistently range from 0% to 5%. And several of the complications discussed are asymptomatic in nature which are not indicative of clinical failure. Most authors in their case reports or case series have reported a follow up ranging from immediate postoperative period to up to 15 or more years. Most uprighted teeth maintained good stability and had untoward pulpal or periodontal sequelae with good radiographic bone fill of the defects surrounding the repositioned tooth with no evidence of root resorption.

Complications reported, included development of periapical pathology requiring root canal treatment or leading to tooth loss, supraeruption, arrested root formation, pulpal obliteration, pulpal calcifications follicular cysts and root resorption [4,18,19,26]. Davis *et al.*, reported development of follicular cyst as a consequence of this procedure and recommended third molar extraction at the time of the procedure or within 6 months to prevent development of cysts [26]. Periodontal infection around a uprighted tooth has been reported that developed into osteitis resulting in boneless and loosening of the tooth by 6 weeks. The tooth appeared nonvital

Table II. Summary of factors and outcomes available presented by various authors in the literature.

Author/Year	No. of impacted MM2	Age range	MM2 root apices open/closed	Inclination average deg.	Third molars (extracted/ present)	Success	Failure	Complications
Owen (1998) [34]	4	6–12	Open	26–44	Extracted	4	0	None
Shipper and Thomadakis (2003) [19]	2	11	Open and Closed	65	Extracted	1	1	Necrosis, root resorption, tooth loss, root canal therapy, infection
Mcaboy *et al.* (2003) [14]	1	14	Open	65	Extracted	1	0	None
Padwa *et al.* (2017) [1]	19	11–15.2		122.6 ± 34.9	50% extracted	17	2	2 periapical radiolucency, 6 pulpal obliterations,1 root resorption
Pogrel and Anthony Pogrel (1995) [18]	22	11.7–17.9	Open		81.8% extracted	21	1	Tooth loss, periodontal infection and 10 teeth has arrested root formation.
Davis *et al.* (1976) [26]	22	10–17	Open and Closed	22.5–54	32% extracted	20	2	2 Follicular cysts supraeruption
Terry *et al.* (1993) [46]	16		Open			16	No	No

with a bony defect radiographically and increased mobility which required removal.

The relationship of predictive factors (listed in Tab. II) to the success rate cannot be established because of a deficiency in the nature of data, type and number of studies available. This is also consistent with Padwa *et al.*'s conclusion, that no statistically relevant associations between the predictor variables and the primary outcome can be drawn [1].

Conclusion

Premature MM3 eruption, delayed MM2 eruption, unusual angulation of MM2, MM1 bands, or excessive dental crowding may block the eruption of MM2 [46]. If simple orthodontic measures, such as removal of MM1 band, placement of an orthodontic separator, use of a coil spring, *etc*. do not correct the malposition, a surgical procedure should be considered [46]. Surgical uprighting of impacted MM2 appears to be a safe and reliable alternative to conventional orthodontic mechanics for uprighting of the impacted MM2. It is an effective procedure with minimal risk of morbidity or periodontal problems [5]. MM2 extractions extend treatment, because MM3 eruption is unacceptable in at least three-quarters of these cases [34]. This surgical uprighting procedure has made orthodontic therapy less demanding on the patient and more efficient for the practice [34]. For the best results with repositioning of the impacted MM2 recognition and treatment must begin in early adolescence [27]. This takes advantage of incomplete root formation and a more vascular and resilient bony bed [27]. After closure of the apex, the technical difficulty, particularly with repositioning, increases as well as the incidence of complications and failure [27]. With proper interception and treatment, the prognosis is excellent [27]. This surgical approach provides a useful alternative when traditional, noninvasive techniques are contraindicated or ineffective [14]. Long-term follow-up reveals filling of the osseous defects adjacent to the MM2 with new bone with no adverse pulpal-periodontal sequelae [46].

Future studies

It seems that with our present knowledge of facial growth, inherent patterns of space problems could be populated by a system of criteria to alert the clinician to an apparently developing impaction problem [27]. This would more accurately dictate the proper time to initiate corrective measures [27]. Skeletal jaw types and molar relationships should be analyzed to determine in which groups this is most prevalent [27]. With a more precise system of early diagnosis, perhaps surgical uprighting could be avoided [27].

Conflicts of interests: The authors declare that they have no conflicts of interest in relation to this article.

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