Uprighting impacted mandibular second molars using NiTi wire

Drs. Daniel DiBagno, Lauren Sigler Busch, and Daniel J. Rinchuse discuss uprighting impacted mandibular second molars

The prevalence of ectopic eruption and/or impaction of mandibular second molars has been reported to range from 0.3% to 2.3%.\(^1\)\(^2\)\(^3\)\(^4\)\(^5\)\(^6\) Recently, in a Caucasian sample, Cassetta, et al.,\(^\text{,}\) found an incidence of 1.36% of mandibular second molar impaction. There is ambiguity in the prevalence data reporting because second molar impaction rates may be grouped together, maxillary and mandibular, while other sources do not distinguish impactions from ectopic eruption. Moreover, the definition of impaction versus ectopic eruption varies in the orthodontic literature. According to the American Association of Orthodontists (AAO) Glossary of Orthodontic Terms, an impaction is “a condition that describes the total or partial lack of eruption of a tooth well after the normal age for eruption,” whereas ectopic is defined as “located away from normal position” or a “condition in which a tooth develops or erupts in an abnormal position.”\(^\text{,}\)\(^8\) Other researchers use the term ectopic to describe a tooth that could potentially erupt into the arch.\(^\text{,}\)\(^9\) Using this definition, a percentage of ectopically erupting teeth have the ability to self-correct over time into a normal position, whereas impacted teeth remain as such. The definition of ectopic eruption can be made only theoretically or in hindsight and, therefore, is an enigmatic orthodontic definition. Therefore, for the purposes of this paper, we will group the two terms together as impaction. Mandibular molar impaction is more likely to occur unilaterally than bilaterally. The impaction occurs more often on the right side than the left side. Impacted second molars are most often inclined mesially.\(^\text{,}\)\(^10\) There appears to be no gender predisposition to mandibular second molar impaction\(^1\)\(^1\) although some studies report a male predisposition.\(^4\) Eruption problems can be due to genetic or environmental problems, specifically ectopic position or eruption path obstacles.\(^\text{,}\)\(^12\) Genetic causes of eruption disturbances remain elusive. While Parathyroid Hormone Receptor 1 PTH1R has been associated with Primary Failure of Eruption,\(^\text{,}\)\(^13\) specific genetic mutations that are associated with second molar impaction have not yet been identified. However, impaction of the mandibular second molar has been demonstrated to have an autosomal dominant inheritance pattern in Chinese Americans.\(^\text{,}\)\(^6\) Shapira, et al.,\(^4\) found that certain races have higher prevalence of impaction than others; for instance, 2.3% in Chinese American populations versus Israeli populations (1.4%). The same study also found reduced mesial root length of the mandibular second molar to be associated with its impaction.

Environmental factors associated with impaction include crowding,\(^2\) supernumerary teeth, odontomas, cysts, or ectopic positions of the teeth in the deciduous dentition.\(^5\) Lateral reasons for mandibular second molar impaction are use of appliances that maintain arch perimeter, such as the lower lingual holding arch and/or the Schwarz appliance,\(^14\) and incorrectly fitted bands.\(^15\) In a small sample, Evans showed an increase in second molar impaction prevalence from 1976 to 1986.\(^16\) The increased popularity of nonextraction treatment during the time period of the study translated into a decrease in extraction rates. It is postulated that the increase in nonextraction treatment during this time period also led to an increased prevalence of mandibular second molar impaction.\(^7\) Ectopic eruption of the second molars can cause multiple problems, such as resorption, pain, increased orthodontic treatment time, increased caries susceptibility, malocclusion, and periodontal disease.\(^11\)

Mandibular second molars can often times be frustrating for orthodontists. Not only is it difficult for the practitioner to work in the posterior of the mouth while maintaining a dry field to bond brackets, an impacted mandibular second molar may be only partially erupted, so placing a bracket is often problematic or impossible. Many methods and procedures have been reported in the orthodontic literature for uprighting mesioangular impacted mandibular second molars such as surgical methods involving extraction of third molars, extraction of the second molar, and autotransplantation.\(^17\) Other methods involved miniscrews/miniplates.\(^18\)\(^19\) Conservative approaches to correct mandibular second molar impaction include uprighting springs,\(^20\) tip-back cantilevers coupled with buccal exposure,\(^16\) pins,\(^20\) chain-activated auxiliaries,\(^21\) and separating...
wires.23 Many methods require the tooth to have one or more of the cusps exposed or present to place an uprighting appliance.23,24,25,26 Greater success is reported in younger patients, suggesting that the earlier the anomalous eruption is treated, the higher the success rate. The recommended age to treat the mandibular molar impaction is between age 11 and 14.27,28,29 More specifically, it is best to treat the impaction when mandibular second molar root formation is not yet complete.15

Conservative treatments of second mandibular molar impaction are successful in roughly 50% of cases.30 However, this data is skewed as it includes surgical combination treatment as well as maxillary impaction rates. In a retrospective follow-up study of impacted second molars (maxillary and mandibular) Magnusson and Kjellberg31 found the least successful treatment (11%) was extraction of the second molar to permit the third molar to replace it. While the most successful treatment (71%) was surgical exposure of the second molars. Valmaseda-Castellon, et al.,35 found conservative treatments for first and second molar impaction, which included surgical exposure, orthodontic traction, surgical luxation and orthodontic traction, restoration, transplantation, or no treatment, resulted in a 50% success rate in 14- to 20-year-old patients. More studies are needed to evaluate the success rates of orthodontic treatment for mandibular second molar impaction.

This paper demonstrates a simple, cost-effective, pain-free, and conservative method for dealing with ectopic eruption and impaction of mandibular second molars in young patients. This procedure is not appropriate for mandibular second molars that are afflicted with primary failure of eruption or secondary retention.

Appliance design and protocol

In 2011 there were two published22,23 descriptions of a non-surgical technique for uprighting mesially impacted mandibular molars. Each23 used an .014" x .025" Copper NiTi wire, whereas about the same time the author (DD), independently, developed a similar technique using .016" x .016" NiTi wire. The two previous descriptions of the technique did not include a literature review like this current paper and did not discuss a broader utility of the technique.

To initiate uprighting, acid etch the first molar occlusal surface and the occlusal one-third of its distal surface for 30-60 seconds, rinse, dry, and isolate to maintain a dry working field. Cut a 10-12 mm section of .016" x .016" nickel-titanium wire, and hold it at approximately the midpoint of the wire using either a Mathieu ligating plier or Wein-gart utility plier. Topical anesthesia and/or local infiltration of a dental anesthetic can be used when performing this procedure, but it is typically not necessary. The author (DD) has performed this procedure multiple times and has never used anesthetics. Gently pass the wire gingivally between the erupted first and impacted second molars, carefully following the distal contour of the first molar with the leading edge of the wire while sliding the wire in a gingival direction. In most instances, only 3-4 mm of wire will pass gingivally before resistance is felt. When resistance is felt, stop the gingival movement, and bend the occlusal portion of the wire mesially and downward, and hold it (with a ligature director) in the central groove of the first molar while your assistant places a couple small dabs of Band-Lok® (Reliance Orthodontic Products) over the wire, being careful not to get any Band-Lok on the ligature director. Light cure, release your hold with the ligature director, and take a periapical radiograph, if desired, to verify correct wire placement. If the radiograph reveals improper wire placement, remove the Band-Lok from the occlusal surface of the first molar, and repeat the procedure making the necessary directional adjustments. When the radiograph reveals proper wire placement, re-isolate and dry the occlusal surface of the first molar along with the occlusal third of its distal surface, and add sufficient Band-Lok to the occlusal surface to form a posterior bite turbo to disocclude the posterior teeth and protect the working sectional nickel-titanium wire. In addition, also apply a small amount of Band-Lok over the wire as it descends along the occlusal one-third of the distal surface of the first molar. This helps prevent buccal or lingual movement and dislodgement of the working wire as the second molar is uprighting. When performing the procedure unilaterally, a bite turbo of equal size should be added to the first molar on the opposite side of the arch for patient comfort.

The patient should be seen every 2-3 weeks to monitor the second molar uprighting progress. When allowed to go longer than 2-3 week intervals, the author (DD) has sometimes observed the leading edge of the working wire disengage from the second molar and the second molar “relapse” into its original position. At each follow-up appointment, a periapical radiograph should be taken to assess the position of the leading edge of the working wire and the position of the second molar. If the crown of the second molar is not sufficiently exposed in the oral cavity to permit bracket placement, the orthodontist must decide whether to continue the uprighting process with the current wire or to replace it with a wire of longer length to prevent the disengagement of the leading edge of the working wire from the mesial surface of the uprighting molar. In the majority of cases, 2-4 appointments 2-3 weeks apart (4-12 weeks total) are sufficient to upright the second molar enough to place a bracket on the tooth. Case reports

A 12-year 10-month-old male presented with a chief complaint of “I have crooked teeth and don’t like my smile.” Intraoral examination revealed an Angle’s Class I malocclusion with mild maxillary and mandibular anterior crowding, minimal overjet, and a severe (100%) impinging overbite with partially blocked out, but favorably positioned and unerupted, maxillary and mandibular canines. The panoramic radiograph (Figure 1) revealed unerupted and mesially angulated mandibular second molars seemingly}

Figure 1: Panoramic radiograph revealing unerupted mesially angulated mandibular second molars
trapped in the distal crown-root concavity of the erupted first permanent molars on both sides. The developing crowns of both mandibular third molars appeared to overlap the distal surfaces of both unerupted permanent second molars.

Both arches were bonded from first molar to first molar; and after leveling, alignment, and bite opening, space was made for the unerupted maxillary and mandibular canines. The canines were bonded upon eruption, and at that time, the mandibular right second molar was visibly erupting. However, the mandibular left second molar was not visible, and a panoramic radiograph (Figure 2) revealed it to continue to be mesio-angulated and impacted in the distal crown-root concavity of the permanent first molar with the developing crown of the third molar resting against its distal surface. At a subsequent appointment, a 10-12 mm section of .016" x .016" nickel-titanium wire was inserted between the impacted second molar and first molar and bonded to the first molar occlusal surface as described in the previous section (Figures 3 and 4). At the next appointment, 3 weeks later, the crown of the erupting mandibular left second molar was visible in the oral cavity (Figure 5). At this point, a 10-12 mm section of .016" x .016" nickel-titanium wire was inserted subgingivally to upright impacted second molar (Figure 6). At the next appointment, 3 weeks later, the crown of the previously impacted mandibular second molar was uprighted using the NiTi wire technique described (Figures 7 and 8). At this time, the separator was placed to continue uprighting the mandibular left second molar (Figure 9). Figure 2: Panoramic radiograph revealing meso-angulated and impacted left mandibular second molar. Figure 3: Periapical radiograph of .016 x .016 nickel-titanium wire inserted subgingivally to upright impacted second molar. Figure 4: Intraoral photograph of .016 x .016 nickel-titanium wire inserted subgingivally to upright impacted second molar. Figure 5: Intraoral photograph revealing the crown of the previously impacted mandibular second molar. The second molar was uprighted using the NiTi wire technique described. Figure 6: Periapical taken at time of separator placement following use of NiTi wire uprighting technique. Figure 7: Intraoral photograph of separator placement after crown eruption of mandibular left second molar. The separator has been placed to continue uprighting the mandibular left second molar. Figure 8: Periapical radiograph at the end of treatment revealing upright mandibular left second molar. Figure 9: Posttreatment panoramic X-ray revealing upright mandibular left second molar.
point in treatment, the NiTi was removed, and an elastic separator was placed between the mandibular left first and second molars for one visit (3 weeks) to complete the uprighting process (Figures 6 and 7). The mandibular left second molar was now in alignment (Figure 8), and the case was completed in the usual manner. Final radiographs and photos revealed an upright mandibular left second molar with the third molar still present and a total treatment time of 24 months (Figures 9 and 10).

The second patient is a 13-year 1-month-old female who presented with a chief complaint of “My front teeth don’t overlap.” Intraoral examination revealed an Angle’s Class I malocclusion with a mild anterior open bite, mild maxillary and mandibular arch crowding, delayed development of the mandibular right second molar, and a mandibular left second molar with normal development and mesio-angulated impaction. (Figure 11).

Prior to the bonding of fixed appliances, a 10-12 mm section of .016” x .016” nickel-titanium wire was inserted between the impacted second molar and the erupted first molar and bonded to the occlusal surface of the first molar as described in the appliance design and protocol section. However, due to the angulation of the impaction, it was not possible to follow the distal contour of the mandibular first molar with the leading edge of the nickel-titanium section of wire. Therefore, the wire was engaged in the mesial occlusal pit of the impacted second molar (Figure 12). The patient was seen 17 days later to monitor her progress, and another periapical radiograph was taken to assess the uprighting progress (Figure 13). At this appointment a new, slightly longer, section of .016” x .016” nickel-titanium wire was inserted between the molars and secured to the occlusal surface of the first molar with Band-Lok. The patient was seen 25 days later, and the previously impacted second molar was visibly erupting into the oral cavity (Figure 14). Shortly afterward, comprehensive treatment was initiated, and the maxillary and mandibular arches were bonded from first molar to first molar. Four months later, a progress panoramic radiograph was taken.
to assist in bracket repositioning (Figure 15). An occlusal photo taken on the same day shows the previously impacted mandibular left second molar erupting into the oral cavity (Figure 16). An elastic separator was then placed between the mandibular left first and second molars in an attempt to finalize the uprighting process. In the near future, it may also be necessary to bond a bracket to the mandibular left second molar to complete alignment. It may also be necessary to perform the same uprighting procedure on the patient’s slow-developing mandibular right second molar towards the end of active treatment and/or during retention.

Discussion

With the decline in extractions in recent years, and a bias toward nonextraction treatment, impaction of second molars, particularly mandibular second molars may increase. E-space preservation (primary second molar space), as it is often called in the orthodontic literature, in a nonextraction protocol with a passive lingual arch is 10 to 20 times more likely to be associated with impaction of permanent mandibular second molars than in the general population. Likewise, Rubin, et al. showed increased eruption disturbances of the mandibular second molars with orthodontic appliances that maintain arch perimeter in the mixed dentition.

The advantages of the technique for uprighting second molars described in this paper are as follows:

- Relatively painless
- Inexpensive
- Efficient
- Effective
- Places little burden on the patient
- Low-maintenance.

With this technique, it is not necessary, as the case reports demonstrate, to extract the third molars prior to uprighting. A major advantage of this technique is that it can be performed on a bonded or unbonded mandibular arch. Instead of waiting many years and keeping orthodontic appliances on for an extended period of time until mandibular second molars erupt, impacted mandibular second molars can be uprighted before, during, or after active orthodontic treatment. The reciprocating effects on the mandibular first molar are minimal since the opposing occlusion of the maxillary arch prevents supra-eruption. When using this procedure on a bonded mandibular arch, uprighting can be initiated at the initial bonding appointment or at any time during the treatment sequence.

REFERENCES


