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Case Report

Orthodontic extraction of mandibular third molar to avoid nerve injury and promote periodontal healing

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Abstract

Aim: Impacted mandibular third molar extraction is a common procedure in oral surgery, not without risk of nerve injury and periodontal defects on the distal aspect of the adjacent second molar. The ''orthodontic extraction'' is proposed as a method to avoid mandibular nerve injury during the extraction of a deeply embedded third molar and to prevent or limit such periodontal problems.

Material and Methods: A 28-year-old man presented a deeply impacted left mandibular third molar that required extraction. Radiographs revealed a very slight quantity of bone at the distal surface of the adjacent second molar. The third molar was extruded according to the ''orthodontic extraction'' technique. A 3-month retention phase elapsed to ensure adequate bone maturation and the tooth was finally extracted.

Results: No neurological complications occurred. A minimal residual bone defect at the distal surface of the adjacent second molar was detected radiographically both post-operatively and at the 3-year follow-up.

Conclusions: Orthodontic extraction makes third molar removal easier and has no neurological risk. This procedure, followed by a 3-month retention phase, appears to be effective in preventing or limiting the development of periodontal problems on the distal aspect of the adjacent second molar.

Key words: extraction; forced eruption; third molar; tooth impaction

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Several complications may be related to impacted mandibular third molar removal (Bruce et al. 1980, Peterson 1992, Chiapasco et al. 1993). The major one is temporary or permanent neurologic damage to the inferior alveolar nerve, promoted by a close anatomical relationship between the roots of the third molars and the mandibular canal (Kipp et al. 1980, Rud 1983). Furthermore, the extraction may cause loss of bone, development of periodontal pockets and exposure of the cementum on the distal root surface of the adjacent second molar (Kugelberg et al. 1985, Kugelberg 1990, Peng et al. 2001, Kan et al. 2002), all of which may unfavourably affect the long-term prognosis of the tooth. Surgical interventions may be subsequently required to improve or to eliminate such periodontal defects (Pecora et al. 1993, Oxford et al. 1997, Karapataki et al. 2000a, b, Dodson 2004).

''Orthodontic extraction'' (Checchi et al. 1996, Marchetti et al. 2004, Alessandri Bonetti et al. 2007) is a combined orthodontic–surgical approach for extracting impacted mandibular third molars that are in close contact with the mandibular canal. This procedure eliminates the risk of neurological complications (Checchi et al. 1996, Hirsch et al. 2003) and makes extraction easier. A long-term case report of an impacted mandibular third molar extraction is presented, and the results at the 3-year follow-up are evaluated. The ''orthodontic extraction'' technique appears to protect the second molar from periodontal breakdown following the surgical extraction of the third molar.

Conflict of interest and source of funding statement

The authors declare that they have no conflict of interests.
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Case Report

A healthy 28-year-old man was referred by his general practitioner to the

Department of Periodontology and Implantology, University of Bologna, Bologna, Italy, for evaluation and treatment of his deeply impacted left mandibular third molar. The patient complained of pain and swelling related to that tooth. The panoramic radiograph (Fig. 1) showed the presence of a fully mesio-angulated impacted left mandibular third molar (tooth #38), with the mesial cusp lying lateral and close to the apical third of the distal root of the second molar (tooth #37). Because the third molar was deeply impacted, a computed tomography (CT) was performed to assess the precise topographic localization of the impacted tooth. Despite the higher radiation dose required as compared with routine radiographical examination (panoramic or periapical radiograph), CT scan still represents the most appropriate diagnostic tool to provide accurate topographic diagnosis in the case of deeply impacted mandibular third molars, thus assessing the exact anatomical relationships between the roots of the third molars and the mandibular canal. A close anatomical relationship between the molar roots and the mandibular canal was confirmed (Fig. 2). Furthermore, evaluation of the periapical radiograph revealed a well-defined radiolucency surrounding the crown of the impacted tooth and involving the distal root of the neighbouring second molar (Fig. 3a). Because of this anatomical situation, a small amount of alveolar bone was present at the distal surface of the second molar, thus jeopardizing the long-term periodontal status of this tooth (Peng et al. 2001). A probing pocket depth (PPD) of 11 mm at the lingual location and of 7 mm at the buccal location of the distal root surface of the second molar was observed. Crestal bone loss at the distal surface of the second molar was also measured on the periapical radiograph, with the distance from the cementoenamel junction (CEJ) to the bottom of the defect being 14 mm. The CT scan also confirmed the severity of the bone defect. It was therefore decided to use the ''orthodontic extraction'' technique to solve the case. Before surgery, the orthodontist applied a lower lingual arch from the first molar to the first molar and adapted a passive, sectional stainless-steel wire to engage the brackets on the buccal surface of the mandibular left molars and pre-molars to provide a stable anchorage for the extrusive movement. Subsequently, the crown of the impacted tooth was surgically exposed under local anaesthesia and an orthodontic wire was bonded directly onto it. At the time of surgical exposure of the third molar crown, root surface debridement was performed at the distal aspect of the adjacent second molar. After 1 week of healing, the orthodontic appliance was activated. A cantilever was applied to the first molar and tied on the occlusal surface of the impacted tooth, thus stimulating tooth eruption. A periodontal re-evaluation and professional oral hygiene on the distal root surface of the second molar was routinely performed every month to ensure complete plaque removal. After 5 months of orthodontic extrusion, the radiograph showed that the third molar roots were further from the mandibular canal (Fig. 3b). The cantilever was passivated. The third molar was extracted after a 3-month retention phase (Fig. 3c). No neurological complications occurred during the extraction. Healing was uneventful and post-operative clinical and radiographic examinations after the extraction revealed good clinical results with a minimal residual bone defect at the distal surface of the second molar. At the 3-year re-evaluation, PPD was 3 mm at the disto-lingual location and 2 mm at the disto-buccal location, and a great amount of crestal bone apposition (crestal bone loss: 2 mm) was observed on the distal surface of the second molar (Fig. 3d).

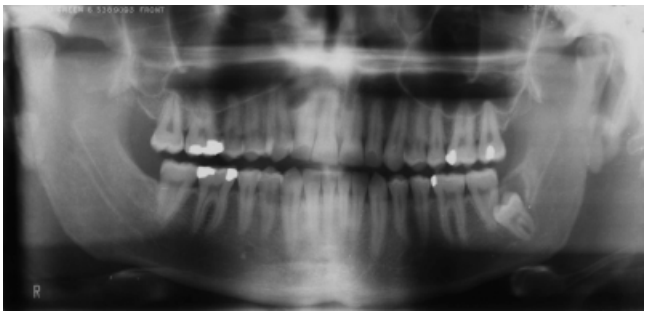

Fig. 1. Initial panoramic radiograph. Note the deep impaction of tooth #38.

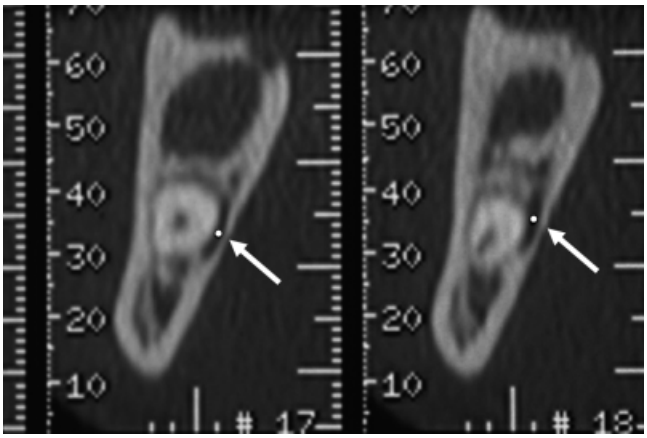

Fig. 2. Computed tomographic scan. Note the close relationship of the mandibular third molar to the inferior alveolar nerve.

Discussion

Mandibular third molar removal is a common procedure in oral and maxillofacial surgery (Bruce et al. 1980, Peterson 1992). Great emphasis is given to the risk of lingual and inferior alveolar nerve injury (Chiapasco et al. 1993), which can be caused by trauma suffered during and after the surgical removal of the third molar. The rate of neurological complications increases when a true anatomical relationship between the roots of the third molar and the mandibular canal exists (Kipp et al. 1980, Rud 1983). The long-term effect on the

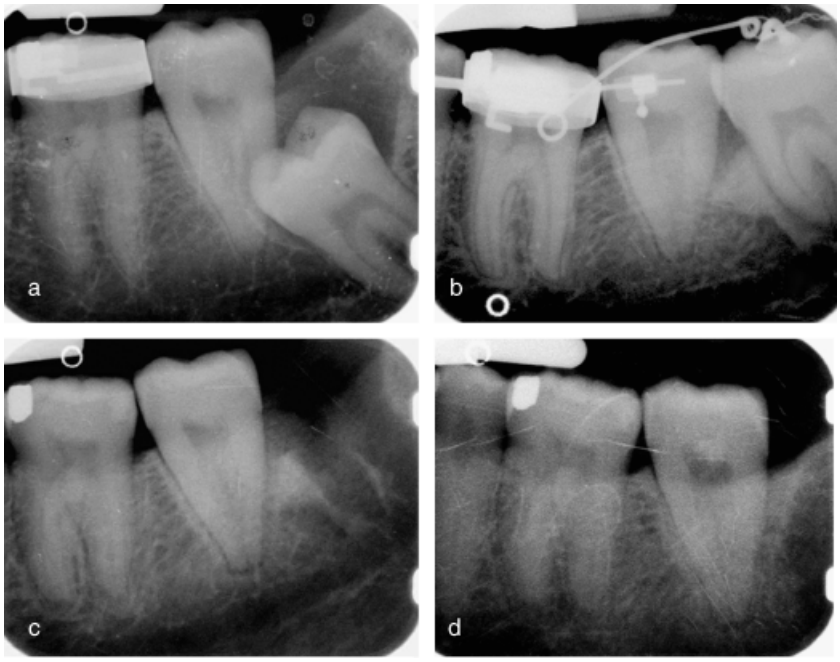

Fig. 3. Periapical intraoral radiographs. (a) Before treatment, (b) at the end of the orthodontic treatment (before tooth extraction), (c) after third molar extraction and (d) 3-year follow-up.

periodontal status of the neighbouring tooth following third molar extraction should also be taken into account. However, there is still no general consensus within the literature regarding such complications. Some studies report an infrabony periodontal defect on the distal surface of the adjacent second molar as a possible adverse effect after third molar removal (Kugelberg et al. 1985, Kugelberg 1990, Peng et al. 2001, Kan et al. 2002). Other studies (Krausz et al. 2005, Richardson & Dodson 2005) have demonstrated that extracting periodontally involved or bony-impacted third molars may result in improved or unchanged alveolar bone height at the distal surface of the adjacent second molar. This is more likely in the case of young ($\leqslant$25 years) and plaque-free people (Kugelberg 1990). However, older patients with high plaque scores and deep pockets have an increased risk of developing deep infrabony defects following third molar surgery, a risk that increases with age (Kugelberg et al. 1985, Kugelberg 1990). It has also been reported that, following impacted third molar surgery, the presence and the severity of an infrabony periodontal defect distal to the adjacent second molar is related to the residual amount of periodontal ligament on this tooth and to the extent of involvement before surgery (Karapataki et al. 2000a). The presence of pre-operative bone defects is a risk factor for persistent post-operative infrabony defects (Kugelberg et al. 1991, Kan et al. 2002).

The use of guided-tissue regeneration (GTR) therapy has been proposed to enhance periodontal healing after third molar removal (Pecora et al. 1993, Karapataki et al. 2000b). But in other studies, GTR therapy (Oxford et al. 1997, Karapataki et al. 2000a, Dodson 2004) as well as the use of bone-grafting materials (Dodson 2004), on the contrary, do not appear to offer predictable benefits when compared with no intervention. Higher costs and risk of post-operative inflammatory complications associated with further surgery should also be taken into account.

The ''orthodontic extrusion'' of a single tooth has also been used as a means of eliminating or reducing bone defects without compromising the periodontal attachment apparatus of the neighbouring teeth, or in other words, as an old method to positively modify osseous contours (Ingber 1974, 1976). It is well known that an eruptive tooth movement produces tensional forces on the periodontal fibers, thus resulting in new bone apposition along the tooth eruption path (Reitan 1967). There is greater bone apposition in impacted teeth that are in a vertical position than there is in those that are in a horizontal position (Alessandri Bonetti et al. 2007) because of the greater shift of the CEJ. After active tooth movement, a retention phase seems to be necessary in order to allow a proper maturation of the newly formed bone. Various studies indicated 3 weeks (Van Venrooy & Raymond 1985), 8 weeks (Ingber 1974, 1976, Berglundh et al. 1991) and 2 months (Felippe et al. 2003) as the ideal retention period. Alveolar distraction osteogenesis and bone tissue formation in the tooth extraction site can be seen as a similar biological model. Histological and histomorphometrical analyses show that distracted bone 70 days after the end of distraction consisted of mature well-organized lamellar bone (Marchetti et al. 2007). Following tooth extraction, it takes several weeks until the newly formed bone (''woven bone'') in the extraction socket is remodelled into lamellar and marrow bone. The portion occupied by bone marrow is 75% from 60 to 90 days and increases to 85% at 180 days (Cardaropoli et al. 2003). In the present case report, a 3-month retention phase elapsed before tooth extraction, which was thought to be clinically sufficient to ensure adequate bone maturation. Root scaling at the distal aspect of the second molar adjacent to the tooth to be extracted was performed at the time of third molar crown exposure in an attempt to remove any plaque deposits or toxins that may interfere with periodontal tissues healing. Specific attention was given to the oral hygiene of the site throughout the duration of therapy. The ''orthodontic extraction'' makes surgery easier and safer (Checchi et al. 1996, Marchetti et al. 2004, Alessandri Bonetti et al. 2007). At the end of the orthodontic extrusion, the tooth to be removed is further from the mandibular canal and has a certain degree of mobility (Checchi et al. 1996), thus reducing the need for surgical instrumentation. Consequently, a greater quantity of bone is saved at the distal surface of the adjacent second molar (Checchi et al. 1996). In this clinical case, there would have been a high risk of residual infrabony defects at the distal surface of the adjacent second molar if surgical extraction had been chosen. The ''orthodontic extraction'' prevented such a problem, giving an excellent long-term result from a periodontal point of view.

This technique is not without some drawbacks (Alessandri Bonetti et al. 2007). It involves two (albeit minor)

surgical operations (exposure of the third molar crown and extraction of the tooth); it is more time-consuming than simple extraction due to numerous appointments and for that reason may be more expensive. Patients' cooperation is necessary throughout the duration of therapy in oral hygiene maintenance and to tolerate some discomfort due to impingement of the orthodontic appliance on the mucosa of the cheek and the gingiva. Limitations of this technique are (a) the presence of tooth ankylosis, which makes it difficult for the tooth to be moved orthodontically and (b) the radiological evidence of third molar roots fused at the apex and the mandibular canal passing between. In this case, the orthodontic extrusion would create a neurological damage to the inferior alveolar nerve.

Conclusion

''Orthodontic extraction'' makes surgery easier and safer for the patient. The risk of neurological complications is greatly reduced as the roots of the impacted molar are pulled away from the mandibular canal due to the orthodontic extrusive movement and a great amount of bone is created distal to the second molar. Notwithstanding the limitations of a single case report, it appears that the orthodontic extraction followed by a 3-month retention phase, which is also indicated for those mandibular third molars that present a high risk of postoperative residual periodontal defects at the distal aspect of the second molar.

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Clinical Relevance

Scientific rationale for the study: The risk of nerve injury and periodontal breakdown of neighbouring mandibular second molars following extraction of deeply impacted third molars is not uncommon.

Principal findings: By ''orthodontic extraction'' of a deeply impacted mandibular third molar (in close relationship with the mandibular canal), no neurological damage occurred and minimal residual bone defect at the distal surface of the adjacent second molar was observed both postoperatively and at 3-year follow up.

Practical implications: ''Orthodontic extraction'' should be considered as alternative method to extract mandibular third molars at high risk of postoperative neurological damage and residual periodontal defect.