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ORIGINAL ARTICLE

# Incidence of root canal treatment of second molars following adjacent impacted third molar extraction

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**KEYWORDS**
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surgical complication

**Abstract** *Background/purpose:* The aim of this study was to evaluate the incidence of requirement for root canal treatment of adjacent second molars following the surgical extraction of an impacted third molar.
*Materials and methods:* The dental records of 6323 consecutive patients who had impacted third molars removed surgically were evaluated and the incidence of postoperative root canal treatment requirement of adjacent second molars was determined. Patients who required root canal treatment of neighboring second molars were accepted as the study group, while the remaining patients were accepted as a control group. Sex, age at the time of the operation, localization of third molar, the depth of impaction, angulation of the tooth, and the professional experience of the surgeon performing the operation were evaluated from patient records.
*Results:* The incidence of requirement of root canal treatment for second molars following a neighboring impacted third molar extraction was 0.17% (11/6323) and invariably occurred in the mandible. The mean age of the study group was found to be significantly higher than the control group (31 years vs. 23 years). The years of professional experience of the surgeons was significantly lower in the study group than in the control group.
*Conclusion:* Although the incidence is minimal, iatrogenic subluxation injuries occurring during the surgical removal of impacted third molars can lead to pulpal complications and a requirement for root canal treatment of adjacent second molars.


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## Introduction

The surgical removal of third molars is the most frequent operation performed by oral and maxillofacial surgeons. Although it is generally considered a safe procedure, some complications can occur during surgery or in the postoperative period. Common postoperative complications associated with third molar extraction are: alveolitis (0.5—32.5%), infection (0.9—4.2%), postoperative bleeding (0.2—1.5%), transient dysfunction of the inferior alveolar nerve (0.6—5.5%), and permanent dysfunction of the inferior alveolar nerve (0.1—0.9%).[1,2]

Impacted third molars can be classified according to sagittal position as mesioangular, vertical, horizontal, or distoangular, and have been reported in close proximity to the adjacent second molar in 68.5% of cases.[3] In such cases, periodontal defects or distal caries of second molars may be observed.[4] Furthermore, during the extraction of an impacted third molar, varying degrees of dental trauma to the adjacent second molars can occur. The possible pulpal complications of the teeth that are exposed to trauma can be categorized as pulp canal obliteration, pulp necrosis, and internal root resorption.[5] Occasionally patients that have undergone impacted third molar extraction may refer to the clinic with pain or swelling at the extraction site during the late postoperative period, and these symptoms can be related to the adjacent second molars. The traumatic extraction procedure of impacted third molars can lead to pulpal complications at the healthy neighboring second molar.

Although there are several reports in literature regarding complications of impacted third molar extraction procedures,[6—8] there has been no study or clinical report about the incidence of root canal treatment requirement of healthy second molars following the extraction of a neighboring impacted third molar. The purpose of this study was to evaluate the incidence of requirement of root canal treatments of healthy second molars following the surgical extraction of an adjacent impacted third molar.

## Materials and methods

The dental records of patients who underwent impacted upper or lower third molar extraction surgery at Baskent University Department of Oral and Maxillofacial Surgery from March 2008 to September 2013 were reviewed in this study.

Exclusion criteria of the patients are listed as follows:

- Periodontal disease, restoration, caries, craze, root canal treatment, prosthesis, or any other dental treatment of the neighboring second molar teeth prior to the impacted third molar removal procedure
- Patients with traumatic occlusion
- Impacted third molars with pericoronitis, pain, or gingival inflammation
- Impacted third molar removal procedure that exceeded 30 minutes
- Patients experiencing postoperative infection, periodontal lesions and defects, or nonhealing extraction sockets following the third molar removal procedure

The patients who had asymptomatic and healthy impacted third molars and intact neighboring second molars were established and 6323 consecutive patients were finally included in this study.

Sex, age during the operation, localization of the tooth (upper or lower; right or left third molar), the depth of impaction according to Pell and Gregory classification (Class A: the occlusal plane of the impacted tooth is at the same level as the adjacent tooth; Class B: the occlusal plane of the impacted tooth is between the occlusal plane and the cervical line of the adjacent tooth; Class C: the occlusal plane of the impacted tooth is apical to the cervical line of the adjacent tooth), the angulation of the impacted tooth (mesioangular, vertical, horizontal, or distoangular), and the professional experience of the surgeon performing the operation were evaluated from the patient records. Regarding surgical technique, under local anesthesia a buccal sulcular incision was performed from the second molar distally, ending with a mesio-bucally oriented vertical releasing incision. A mucoperiosteal flap was raised. Bone was removed on the buccal and/or distal aspects of the third molar using a surgical bur when the third molar was a fully retained tooth, whereas a mucoperiosteal flap was released but no bone removal was performed during the extraction of a partially retained tooth. The tooth was appropriately split and removed, followed by copious irrigation and suturing with resorbable 3/0 sutures. Postoperative antibiotics, analgesic, and mouth rinse were prescribed to all patients. A follow-up appointment at 1 week was arranged to assess healing, masticatory function, and to remove the sutures.

Of the 6323 patients examined, 11 patients had a postoperative sensitivity on the neighboring second molar teeth, rendering them tender to percussion and mastication. These patients were referred to the endodontic clinic for a detailed examination and management. The teeth responded normally to electric pulp testing (Parkell, Farmingdale, NY, USA) at the time of the first control (1-week period). Radiographic and clinical examinations did not reveal any crack formation, root fracture, and periapical bone destruction of the involved teeth; although an occasional slight widening of the apical periodontal ligament space was observed. The preliminary treatment consisted of relief of occlusal interferences and ordination of a soft diet for approximately 2 weeks. Splinting of the involved teeth was not performed, as fixation does not appear to promote healing in concussion and subluxation injuries.[9] Monitoring and evaluating the condition of the pulp and the supporting structures clinically and radiographically were also recommended after 1 month and 2 months.

Of the 11 patients examined, two patients, four patients, and five patients returned after 2 weeks, 1 month, and 2 months, respectively, with symptoms of acute apical periodontitis including moderate-to-severe intensity in pain, pain in biting, and vertical percussion. Electric pulp testing and cold application using a refrigerant spray (Chloraethyl; IGS Aerosols GmbH, Baden, Germany) was negative after a 1-month period. Of the 11 teeth examined, four teeth had grade-2 mobility. Periodontal probing depths were mostly within normal limits except for five teeth, which indicated a distal probing depth $>$5.5 mm. Radiographic examination revealed a periapical bone destruction of the involved teeth after a 2-month period.

Table 1 summarizes the diagnostic findings that related to the study group. At the same appointment, root canal treatments were initiated on the involved teeth and performed by the same endodontist. The access cavity was prepared, and a rubber dam was applied. The pulp tissue was extirpated, and the working length was estimated as being 1 mm short of the radiographic apex. The root canals were prepared with either a step-back technique using stainless steel files (Maillefer, Ballaigues, Switzerland) or with a crown-down technique using rotary Ni-Ti instruments (ProTaper rotary instruments; Dentsply Maillefer, Ballaigues, Switzerland), and irrigated with 2.5% sodium hypochlorite solution. The root canal treatments were completed in one or two visits. In the two-visit group, the root canals were medicated with a calcium hydroxide paste (Merck, Darmstadt, Germany) for 7 days. A dry sterile cotton pellet was sealed in the pulp chamber with a temporary filling restoration with a minimum thickness of 3 mm. Root canal fillings were performed with AH Plus sealer (Dentsply De Trey GmbH, Konstanz, Germany) and gutta-percha (Diadent, Chongju, Korea) using cold lateral condensation technique.

The patients who underwent root canal treatment of neighboring second molars were accepted as the study group whereas the remaining patients were accepted as the control group. Statistical analysis was performed to determine the ideal sample size of the control group for statistical comparison of the two groups.

### Statistical analysis

Analyses were performed using the Statistical Package for the Social Sciences (SPSS v. 18.0; IBM, Chicago, IL, USA). Prior to statistical comparison of the two groups, the sample size of the control group was determined using a chi-square power analysis test. A sample size of 917 achieves 80% power to detect an effect size of 0.0924 using a 1-degree of freedom chi-square test with a significance level (alpha) of 0.05000. Statistical comparisons between the study ($n = 11$) group and the control ($n = 917$) group were performed using chi-square and Fisher's exact test, and P values $< 0.05$ were considered statistically significant.

**Table 1** Diagnostic factors related to teeth that received root canal treatment.

| Diagnostic factors | Study group |
|---|---|
| | *N* |
| Sensitivity to cold testing | 1 |
| Negative response to electric pulp testing | 9 |
| Tenderness to percussion | 11 |
| Tenderness to palpation | 6 |
| Increased mobility (Grade-2) | 4 |
| Distal probing depth > 5.5 mm | 5 |
| Radiographic changes (widened periodontal ligament space or periapical radiolucency) | 8 |
| Sinus | None |
| Swelling | None |

## Results

The study group consisted of 11 patients, five females and six males, while the control group consisted of 917 patients, 602 females, and 315 males (Table 2). There was no statistically significant difference between the sex composition of the study group and the control group ($P > 0.05$).

The mean age of the study group was 31 years (range, 19–63 years) and the mean age of the control group was 23 years (range, 14–85 years). The mean age of the study group was significantly higher than that of the control group (Table 3), and the difference was statistically significant ($P < 0.05$).

The incidence of root canal treatment requirement of a second molar tooth following neighboring impacted third molar extraction was 0.17% (11/6323). The root canal treatments were performed on average 1.5 months (range, 15 days to 2 months) after impacted third molar removal procedures.

None of the extracted third molars in the study group were maxillary teeth; five were lower left and six were lower right molars. Meanwhile, 94 upper right, 99 upper left, 372 lower left, and 352 lower right third molars were extracted in the control group. In the control group, the majority of impacted teeth were localized in the mandible (Table 4). There was no statistically significant difference between the study group and the control group regarding impacted tooth localization ($P > 0.05$).

In the study group, four extracted teeth (27.3%) were Class C according to Pell and Gregory classification; while 218 teeth (23.7%) were Class C in the control group (Table 5). The most common depth of impaction was Class B in the control group. No statistically significant difference was observed between the study group and the control group when the depth of impaction of third molars was considered ($P > 0.05$).

The most common angulations of impacted teeth were mesioangular and vertical angulation both in the study group and the control group. The detailed distribution of the angulations of impacted teeth according to the groups is presented in Table 6. No statistically significant difference was observed between the study group and control group when the angulation of third molars was considered ($P > 0.05$).

The mean years of professional experience of the performing surgeon was 2.4 years in the study group and 9.3 years in the control group. There was a statistically significant difference between the years of professional experience of the clinicians in the two groups ($P < 0.05$). The years of professional experience were significantly lower in the study group (Table 7).

**Table 2** Sex distribution of the two groups.

| | Study group (*n*) | Control group (*n*) | P |
|---|---|---|---|
| Female | 5 | 602 | 0.212 |
| | 45.4% | 65.6% | |
| Male | 6 | 315 | |
| | 54.5% | 34.2% | |
| Total | 11 | 917 | |

**Table 3** Minimum, maximum, and mean age of the two groups.

| Age (y) | Median | Minimum | Maximum | P |
|---|---|---|---|---|
| Study group | 31 | 19 | 63 | 0.005 |
| Control group | 23 | 14 | 85 | |

**Table 4** The disturbance of localization of impacted teeth in the two groups.

| Localization of impacted third molar | Study group | Control group | P |
|---|---|---|---|
| | *N* | *N* | |
| | % | % | |
| Upper right | 0 | 94 | 0.536 |
| | | 10.3% | |
| Upper left | 0 | 99 | |
| | | 10.8% | |
| Lower right | 5 | 372 | |
| | 45.5% | 40.6% | |
| Lower left | 6 | 352 | |
| | 54.5% | 38.4% | |
| Total | 11 | 917 | |

## Discussion

Luxation injuries are the most common group of dental injuries, with reported incidences ranging from 30% to 44%.[10] However, oral surgical complications such as concussion and subluxation injuries to the neighboring second molar during the removal of the impacted third molar are very rare and have never been reported in literature. Thus the goal of the present study was to determine the incidence of root canal treatment of adjacent second molars after surgical removal of impacted third molars and to evaluate the possible reasons for this complication.

The damage caused to the periodontium by concussions and subluxations is generally low, transient, and without serious consequences, although signs of a slight resorption of the root surface may be seen in some cases. Generally, the pulp is also only slightly damaged; the patient may feel some sensitivity while chewing or when touching the tooth.

**Table 5** Depth of impaction according to the Pell and Gregory classification in the two groups.

| Depth of impaction | Study group | Control group | P |
|---|---|---|---|
| | *N* | *N* | |
| | % | % | |
| Class A | 3 | 306 | 0.62 |
| | 27.3% | 33.4% | |
| Class B | 4 | 393 | |
| | 36.3% | 42.8% | |
| Class C | 4 | 218 | |
| | 36.3% | 23.7% | |
| Total | 11 | 917 | |

**Table 6** Angulation of impacted tooth in the two groups.

| Angulation | Study group | Control group | P |
|---|---|---|---|
| | *N* | *N* | |
| | % | % | |
| Mesioangular | 4 | 392 | 0.68 |
| | 36.3% | 42% | |
| Horizontal | 3 | 157 | |
| | 27.2% | 17.2% | |
| Vertical | 4 | 304 | |
| | 36.3% | 33.15% | |
| Distoangular | 0 | 64 | |
| | | 6.9% | |
| Total | 11 | 917 | |

Nevertheless, in some cases the injury to the pulp can result in pulpal necrosis or an obliteration of the endodontic system, despite the absence of symptoms immediately after the trauma.[11] According to Andreasen and Pedersen,[12] pulpal necrosis only occurs in 3% of teeth subjected to concussion and subluxations seem to affect the pulp to a higher degree; approximately 6% of the affected pulps do not survive this trauma. This outcome is more significant in teeth with complete root formation when compared with teeth with incomplete root formation. In the present study, root resorption or root canal obliteration was not observed, however, pulp necrosis was the main finding especially after a 1-month period.

The application of excessive and uncontrolled force results in damage to the attachment apparatus (periodontal ligament and cemental layer) of the adjacent tooth. The apical neurovascular supply to the pulp is also affected to varying degrees, resulting in an altered or nonvital tooth and leading to pulpal inflammation.[13] Studies have recorded the force employed by operators during tooth extractions on different jaws and have found that the strength needed to extract lower and higher teeth was not significantly different.[14,15] This result differs from ours because in the present study all of the root canal treatment requirements were on the lower jaw. This could be the result of the density of the lower jaw or the complexity of the root angulations. Cicciù et al[16] also observed the force applied for teeth extraction and concluded that factors such as strange tooth anomalies, large root angles, or strange root forms are the cause of the complications. However, the same authors concluded that bone structure and density do not influence the strength (force applied) values.

Patient age is another factor related to traumatic extraction procedures. The decrease in elasticity of the

**Table 7** Years of professional experience of the surgeon in the two groups.

| Years of professional experience (y) | Median | Minimum | Maximum | P |
|---|---|---|---|---|
| Study group | 2.4 | 1 | 8 | 0.0001 |
| Control group | 9.3 | 1 | 36 | |

bone, narrowing of the periodontal ligament, and increased ankylosis of third molars in older patients offers likely explanations for traumatic extractions.[17–19] Some recent studies have observed increased numbers of intra- and postsurgical complications with the removal of impacted third molars in older patients. Additionally, an analysis dealing with the removal of 354 mandibular third molars reported that increased age is a contributing factor that predicts surgical difficulty of third molar extractions.[20] Surgical removal of impacted mandibular third molars should be carried out well before the age of 24 years, especially for female patients. The highest risk of complication is in persons aged 25 years to 34 years.[21] These findings are in agreement with the present study because we also found a statistically significant difference between the mean age of the study group and the control group. An increase in patient age results in a more traumatic extraction of third molars and the necessity for endodontic treatment of second molars.

The results of the current study showed that the amount of professional experience of the surgeon was another significant factor in the requirement of root canal treatment of adjacent second molars after third molar extraction. The mean age of proficiency was 2.4 years in the study group, which means that most of the complications were encountered by residents. Sisk et al[22] reported that the age and experience of the surgeons were significant factors for complications such as alveolar osteitis and nerve dysesthesia.

Although subluxation injuries are rare, their occurrence can create a prolonged treatment phase, often inducing discomfort in the patient and leading to further problems for the clinician. Prevention is the best way of avoiding future complications. Therefore, the risk and predisposing factors should be analyzed specifically in patients over the age of 30 years regarding the possibility of traumatic injury to the adjacent second molars following the surgical extraction of impacted third molars. The results achieved from this study revealed that the incidence of root canal treatment of adjacent second molars following impacted third molar removal is 0.17%. The results of the present study can be compared to the limited number of previously published articles, and further clinical investigations are needed.

## Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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This study was approved by Baskent University Institutional Review Board and Ethics Committee (Project no: D-KA 13/11).

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