

Review

Characteristics of iatrogenic mandibular fractures associated with tooth removal: review and analysis of 189 cases

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Abstract

Fracture of the mandible during exodontia is fortunately rare, but is under-reported. A review identified 189 documented cases of iatrogenic fractures of the mandible (IFM) associated with the removal of teeth. The reasons for its occurrence are thought to be multifactorial and include age, sex, degree of tooth impaction, relative volume of the tooth in the jaw, pre-existing infection or bony lesions, failure to maintain a soft diet in the early postoperative period, and the surgical technique. The clinical experience of the surgeon does not seem to have an important role. We review the aetiology of iatrogenic mandibular fracture and summarise the ways of minimising this complication.

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Introduction

Dental extractions are the most common procedure in oral surgery, and may be associated with several complications, the most common of which are alveolar osteitis, secondary infection, dysaesthesia, and bleeding.^{1–4} The most severe complication after removal of teeth is mandibular fracture (Fig. 1). Iatrogenic fracture of the mandible (IFM) associated with the removal of teeth, which can occur either immediately during the procedure or later, is considered rare with a reported incidence ranging from 0.0034% to 0.0075%.^{5–8} Most published information regarding these fractures is associated with the removal of third molars and is presented in isolated case reports or small series of cases. Several investigators have attempted reviews, but most papers combine information on immediate fractures with that of late ones,

which makes it difficult to draw conclusions regarding aetiology, risk factors, or potential preventive measures.^{7,9,10} The objective of this study was to collect all the available published information regarding IFM associated with tooth removal, either immediate or late, to analyse the data, and to discover some preventive measures that may reduce the risk of this severe complication.

Material and methods

We systematically reviewed articles published between 1953 and 2010 using Medline and the keywords mandible; fracture; and dental extraction; and identified further articles by hand searching of all those selected.

Data were collected on age, sex, extracted tooth, status of dentition (full, partial, edentulous), pathological bone lesion adjacent to the tooth (cyst, periodontitis), position of crown and degree of impaction (using the Pell and Gregory system¹¹), angulation (vertical, mesioangular, horizontal, distoangular), impaction (soft tissue, partial bony, full bony),

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relative volume of mandible occupied by the tooth (%), perception of fracture (crack, pain, swelling), time of fracture (immediate or late), interval from removal of tooth to fracture (weeks), surgeon (GP, specialist, OMF surgeon), and treatment (closed or open reduction, none).

The data were tabulated and analysed. The Student–Neuman–Keuls test was used for statistical analysis and probabilities of 0.05 or less were accepted as significant.

Results

A list of 44 reports on 189 cases of IFM associated with the removal of teeth is shown in Table 1.^{5,7–10,12–50}

Age and sex

Age was documented in 165 cases with the patients in their fifth decade most commonly affected (range 2nd to 8th) ($p=0.05$) (Table 2). Sex was documented in 165 cases, with a male:female ratio of 2.2:1 ($p=0.02$).

Extracted tooth

The extraction of mandibular third molars was more commonly associated with IFM than the extraction of other teeth ($p=0.01$) (Table 3).

Status of dentition

Fifty-five percent of the patients had full dentition, in 32% it was partial, and 13% were edentulous. Fractures were significantly more common in patients who were partially or fully dentate than those who were edentulous ($p=0.04$).

Pathological bone lesion adjacent to the tooth

Preoperative pathological findings at the extraction site such as pericoronitis, periodontal pockets, and cysts, were noted in 50 cases (27%).

Location of crown and degree of impaction

Location of the crown and degree of impaction were mentioned in 52 (28%) cases, mainly in small case series. The mean score for difficulty was 7.1, which indicates that the degree of difficulty ranged from moderate to very difficult.³⁸

Angulation

The spatial relation of the tooth was categorised into four groups according to the angle between the vertical axis of the tooth and the occlusal plane. The categories were mesioangular (10–80°), vertical (80–100°), distoangular (greater than 100°), and horizontal (350–10°). Angulation was reported in 123 cases; 45 (37%) were vertical, 30 (24%) were mesioangular, 16 (13%) were distoangular, and 32 (26%) were horizontal.

Teeth that were either vertical or horizontal were more commonly associated with IFM ($p=0.04$).

Impaction

The type of impaction was reported in 124 cases of which 64 (52%) were full bony, 38 (31%) were partial bony, and 22 (18%) were soft tissue impaction. Significantly more cases of IFM were associated with full bony impaction ($p=0.04$).



Fig. 1. Intraoperative fracture of the mandible associated with tooth removal. Preoperative (left) and postoperative (right) panoramic radiographs.

Table 1
Reports on iatrogenic fracture of the mandible (IFM) associated with tooth removal ($n = 189$).

| First author and reference | Year | No. of cases |
|------------------------------|------|--------------|
| Ekholm ¹² 1953 | 1953 | 6 |
| Belveze ¹³ 1954 1 | 1954 | 1 |
| Hammer ¹⁴ | 1955 | 3 |
| Nyul ⁵ | 1959 | 5 |
| Ohm ¹⁵ | 1965 | 2 |
| Necek ¹⁶ | 1965 | 4 |
| Lautenbach ¹⁷ | 1966 | 1 |
| Barclay ¹⁸ | 1969 | 1 |
| von Allmen ¹⁹ | 1971 | 1 |
| Harnisch ²⁰ | 1971 | 3 |
| Farish ²¹ | 1972 | 1 |
| Haunfelder ²² | 1972 | 10 |
| Ellis ²³ | 1974 | 1 |
| Berlin ²⁴ | 1977 | 5 |
| de Carvalho ²⁵ | 1977 | 1 |
| Borea ²⁶ | 1977 | 1 |
| Einrauch ²⁷ | 1980 | 1 |
| Barsekow ²⁸ | 1981 | 1 |
| Roth ²⁹ | 1981 | 1 |
| Schroll ³⁰ | 1984 | 1 |
| de Silva ³¹ | 1984 | 1 |
| Paszek-Chromik ³² | 1987 | 1 |
| Litwan ³³ | 1987 | 4 |
| Panos ³⁴ | 1988 | 1 |
| Härterl ³⁵ | 1988 | 4 |
| Guzmán ³⁶ | 1990 | 2 |
| Iizuka ³⁷ | 1997 | 13 |
| Dunstan ³⁸ | 1997 | 2 |
| Becktor ³⁹ | 1998 | 1 |
| Krimmel ⁹ | 2000 | 6 |
| Perry ⁷ | 2000 | 28 |
| Libersa ⁸ | 2002 | 27 |
| Arrigoni ⁴⁰ | 2004 | 7 |
| Kunkel ⁴¹ | 2004 | 2 |
| Kunkel ⁴² | 2007 | 11 |
| Werkmeister ⁴³ | 2005 | 1 |
| Wagner ¹⁰ | 2005 | 17 |
| Komerik ⁴⁴ | 2006 | 1 |
| Wagner ⁴⁵ | 2007 | 1 |
| Woldenberg ⁴⁶ | 2007 | 1 |
| Orihovac ⁴⁷ | 2008 | 1 |
| Khan ⁴⁸ | 2009 | 1 |
| Valiati ⁴⁹ | 2009 | 1 |
| Chrcanovic ⁵⁰ | 2010 | 2 |

Table 2
Age distribution of the reported cases ($n = 165$).

| Age (years) | No. of cases (%) |
|-------------|------------------|
| 10–19 | 3 (2) |
| 20–29 | 25 (15) |
| 30–39 | 34 (21) |
| 40–49 | 49 (30) |
| 50–59 | 28 (17) |
| 60–69 | 22 (13) |
| 70–79 | 4 (2) |

Table 3
Extracted teeth involved ($n = 168$).

| Tooth | No. of cases (%) |
|-----------------|------------------|
| Third molar | 122 (73) |
| Second molar | 14 (8) |
| First molar | 12 (7) |
| Second premolar | 14 (8) |
| Canine | 6 (4) |

Table 4
Time between tooth removal and fracture in the late fracture group ($n = 136$).

| Time (weeks) | No. of cases (%) |
|--------------|------------------|
| 1 | 34 (25) |
| 2 | 40 (30) |
| 3 | 40 (30) |
| 4 | 14 (10) |
| 5 | 5 (4) |
| 6 | 1 (1) |
| 7 | 1 (1) |
| 8 | 1 (1) |

Oral site: right or left side

The side of the mandible was documented in 168 cases. In 81 (48%) it was the right side and in 87 (52%) the left side. The difference was not statistically significant ($p = 0.8$).

Perception of fracture

Sixty-three patients (35%) reported a distinct cracking noise that was not always associated with a sudden painful sensation.

Time of fracture

In 35 of 160 patients (22%) fractures occurred intraoperatively, while in the remaining 125 (78%) they were found postoperatively. The time between removal of teeth and diagnosis of fracture was 1–5 weeks. In 86% of the cases the fracture occurred between the first and third week (Table 4) ($p = 0.04$).

Surgeon

The clinical expertise of the operating clinician was reported in 56 cases. Twenty-four (43%) were general practitioners, 12 (21%) were specialists, and 20 (36%) were OMF surgeons. There was no significant difference in the incidence of IFM noted ($p = 0.9$).

Treatment of fracture

Treatment of fractures included closed reduction ($n = 76$, 40%), open reduction ($n = 66$, 35%), and no treatment ($n = 47$, 25%).

Table 5

Preventive measures to reduce the likelihood of iatrogenic fracture of the mandible (IFM).

 Include information on the risk of IFM as part of the consent procedure. Inform patients at risk about the possibility of fracture.

Where the tooth requires surgical extraction, removal of bone should be minimal, and where possible the tooth should be sectioned in preference to removal of bone.

If the impacted tooth is located close to the lower border of the mandible, consider the extraoral approach.

Restrict patients to a soft diet for 4 weeks postoperatively.

Inform patients about the clinical signs and symptoms of a postoperative fracture. A cracking noise should raise the possibility of a fracture, which at first may be difficult to detect radiologically, and serial radiographs may be necessary.

Discussion

Fracture of the mandible associated with the removal of teeth is a rare complication. It may occur either as an immediate complication during operation, or as a late complication, usually within the first 4 weeks after operation. The true incidence of postoperative mandibular fractures as a result of extraction is difficult to establish as some reports on postoperative traumatic mandibular fractures could have happened with an intact mandible, and the occurrence of the two conditions may be just a coincidence.^{31,38}

The reason for this severe complication is thought to be multifactorial and the factors discussed below have been shown to have a significant impact on risk.

Weakening of the mandible as a result of a reduction in bony elasticity during aging may be the cause of the greater incidence of fractures reported at operation among patients in their fifth decade. Ankylosis of the impacted tooth among older patients may also complicate removal and weaken the mandible, as more extensive bone removal may be needed.⁹ Sectioning of the tooth is highly recommended to reduce the amount of bone removed.

Patients with complete dentition are able to produce peak biting forces that are transmitted to the mandible during mastication, and consequently the risk of fracture is high regardless of sex. Men, however, usually have a greater biting force than women,⁵¹ so it could be postulated that they would be more prone to mandibular fractures after surgical extraction. Intuitively, a higher rate of fracture might be expected among older, perhaps osteoporotic women, but the data did not allow multivariate analysis of age and sex, so we cannot comment on this further.

Full bony impacted teeth have a greater incidence of mandibular fracture, presumably because the volume of bone that needs to be removed during the operation weakens the mandible.

The relative portion of the volume of the mandible occupied by the tooth is also an important factor. This ratio of tooth:jawbone (%) can be assessed before the extraction on a dental computed tomogram (CT) with a buccolingual reconstruction program, a technique increasingly used to evaluate the proximity of an impacted tooth to adjacent anatomical structures such as the mandibular canal and maxillary sinus. Wagner et al.¹⁰ reported on 17 cases and found that the mean

ratio was 62%, and Iizuka et al.³⁷ reported on 13 cases and found that the ratio varied from 44% to 84%. Both studies used panoramic radiographs to assess the percentage area of the tooth within the bone for their calculations rather than CT, which enables three-dimensional calculations of tooth volume within the bone.

As IFM is rare, imaging of patients with CT for exodontia could not be justified, but an assessment of factors that could indicate those at high risk might make it sensible in selected cases.

Fifty of the patients (27%) in this review had a history of previous preoperative infections in the extraction site. Pre-existing bony lesions such as periodontal disease, cysts, or recurrent pericoronitis, may also weaken the mandible and further predispose to fracture.^{7,52}

It might be assumed that IFM is associated with incorrect surgical technique, and that the risk would be higher among more inexperienced surgeons, but this is not borne out by the data in this study. There are many confounding variables to take into account including the difficulty of extraction, and the data presented did not allow further analysis of this issue.

Sencimen et al. proposed the use of a sagittal split osteotomy (SSO) to extract deeply impacted lower third molars as it offers good exposure to the operative field and minimises bone loss at the mandibular ramus.⁵³ However, the idea of inducing one type of mandibular fracture (SSO) just to prevent the possibility of another low risk fracture (IFM) seems difficult to justify in most cases. In cases of impaction near the lower border of the mandible, the extraoral approach seems to be a reasonable one.⁵⁴

Most fractures (78%) arose postoperatively and usually occurred during the second or third week. The standard explanation is that they are a result of excessive biting force or minor trauma to a weakened mandible, but Al-Belasy et al.⁵⁵ claimed that mastication does not affect late mandibular fracture after surgical removal of impacted third molars. With higher risk extractions (elderly patients, deep bony impaction, presence of associated pathology) it may be necessary to include specific instruction on diet for at least 4 weeks postoperatively.

Although Wagner et al.¹⁰ found an unbalanced distribution of fractures in the 17 cases they studied, with a prevalence for the left side (70%), there was no side bias in most of the studies reported.

Summary

Before exodontia, the patient and tooth to be removed should be assessed for factors that indicate a high risk of IFM. These include increased age, male sex, bony impaction, large area or volume of tooth within the bone, and associated pathology.

Table 5 shows the preventive measures that can be taken in patients identified as having a high risk of IFM.

References

- Brauer HU. Unusual complications associated with third molar surgery: a systematic review. *Quintessence Int* 2009;**40**:565–72.
- Renton T, Smeeton N, McGurk M. Factors predictive of difficulty of mandibular third molar surgery. *Br Dent J* 2001;**190**:607–10.
- Christiaens I, Reyckler H. Complications after third molar extractions: retrospective analysis of 1,213 teeth. *Rev Stomatol Chir Maxillofac* 2002;**103**:174–269. In French.
- Benediktsdóttir IS, Wenzel A, Petersen JK, Hintze H. Mandibular third molar removal: risk indicators for extended operation time, postoperative pain, and complications. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004;**97**:438–46.
- Nyul L. Kieferfrakturen bei Zahnextraktionen. *Zahnarztl Welt* 1959;**60**:1–5.
- Alling CC, Alling RD. Indications for management of impacted teeth. In: Alling CC, Helfrick JF, Alling RD, editors. *Impacted teeth*. Philadelphia: WS Saunders; 1993. p. 46–64.
- Perry PA, Goldberg MH. Late mandibular fracture after third molar surgery: a survey of Connecticut oral and maxillofacial surgeons. *J Oral Maxillofac Surg* 2000;**58**:858–61.
- Libersa P, Roze D, Cachart T, Libersa JC. Immediate and late mandibular fractures after third molar removal. *J Oral Maxillofac Surg* 2002;**60**:163–6.
- Krimmel M, Reinert S. Mandibular fracture after third molar removal. *J Oral Maxillofac Surg* 2000;**58**:1110–2.
- Wagner KW, Otten JE, Schoen R, Schmelzeisen R. Pathological mandibular fractures following third molar removal. *Int J Oral Maxillofac Surg* 2005;**34**:722–6.
- Pell GJ, Gregory T. Report on a ten-year study of a tooth division technique for the removal of impacted teeth. *Am J Orthodont Oral Surg* 1942;**28**:660–6.
- Ekholm A. Mandibular fracture in tooth extraction. *Suom Hammaslaak Toim* 1953;**49**:11–4.
- Belveze P. Mandibular fracture after extraction of the lower wisdom tooth. *Montp Med* 1954;**45**:229.
- Hammer H. Forensische fragen in der Zahnextraktionen. *Dtsch Zahnarztl Z* 1955;**23**:1709–27.
- Ohm HJ. Mandibular fracture caused by tooth extraction. Report of 2 cases. *DDZ* 1965;**19**:462–6 [In German].
- Neczek B. Fracture of the mandible at the time of tooth extraction. *Czas Stomatol* 1965;**18**:139–43 [In Polish].
- Lautenbach E. Zwischenfalle und komplikationen in der zan mund und kieferheilkunde. *Med Welt* 1966;**44**:2366–73.
- Barclay JK. Post-operative fracture of the mandible. *N Z Dent J* 1969;**65**:125–7.
- von Allmen G. Mandibular fractures. Statistical studies at the Bern University Oral Surgery Clinic (1963–1968). *SSO Schweiz Monatsschr Zahnheilkd* 1971;**81**:719–31 [In German].
- Harnisch H. Iatrogenic fractures of the jaw. *Quintessence Int (Berl)* 1971;**2**:11–3.
- Farish SE. Iatrogenic fracture of the coronoid process: report of case. *J Oral Surg* 1972;**30**:848–50.
- Haunfelder D, Tetsch P. Mandibular fractures caused by tooth extraction. *Dtsch Zahnarztl Z* 1972;**27**:881–7 [In German].
- Ellis DJ, O'Brien ME. Osteomyelitis iatrogenic osteolysis, pathologic fracture, and bone graft. Report of a case. *Oral Surg Oral Med Oral Pathol* 1974;**37**:364–9.
- Berlin JG. Mandibular fractures caused by tooth extraction. *ZWR* 1977;**86**:8–11.
- de Carvalho AC, Sanches MG, Saad Neto M, de Carvalho PS. Mandibular fracture during tooth extraction. *Rev Assoc Paul Cir Dent* 1977;**31**:91–4 [In Portuguese].
- Borea G, Dallera P, Scotti S. Iatrogenic mandibular fractures. *ZWR* 1977;**86**:467–75 [In German].
- Einrauch HD, Otte H, Selle G. Problems of iatrogenic jaw fractures. *Dtsch Zahnarztl Z* 1980;**35**:209–13 [In German].
- Barsekow F. Iatrogenic mandibular fractures from the medicolegal viewpoint. *Niedersachs Zahnarztbl* 1981;**16**:508–10 [In German].
- Roth H. Complications in wisdom tooth removal. *SSO Schweiz Monatsschr Zahnheilkd* 1981;**91**:440–1 [In German].
- Schroll K. Complications in the removal of mandibular impacted teeth. *ZWR* 1984;**93**:616–21 [In German].
- de Silva BG. Spontaneous fracture of the mandible following third molar removal. *Br Dent J* 1984;**156**:19–20.
- Paszek-Chromik B, Jendroszczyk E. Iatrogenic mandibular fracture. *Czas Stomatol* 1987;**40**:797–802 [In Polish].
- Litwan M, Götzfried HF. Late mandibular angle fracture after operative removal of third molars. *Zahnarztl Prax* 1987;**38**:449–51 [In German].
- Panos G, Bochlogyros PN. Iatrogenic fracture of the mandible. *Hell Period Stomat Gnathopathoprosopike Cheir* 1988;**3**:93–5 [In Greek].
- Härtel J, Flemming G, Groth G. Iatrogenic fracture of the lower jaw. *Stomatol DDR* 1988;**38**:95–8. In German.
- Guzmán AL, Scheinplflug R, Beltrão GC. Iatrogenic mandibular fracture during lower third molar surgery. *Revista Odonto Ciência* 1990;**5**:88–95.
- Iizuka T, Tanner S, Berthold H. Mandibular fractures following third molar extraction. A retrospective clinical and radiological study. *Int J Oral Maxillofac Surg* 1997;**26**:338–43.
- Dunstan SP, Sugar AW. Fractures after removal of wisdom teeth. *Br J Oral Maxillofac Surg* 1997;**35**:396–7.
- Becktor JP, Schou S. Spontan mandibelfraktur efter kirurgisk fjernelse af 3. molar et patient tilfaelde. *Tandlaegebladet* 1998;**102**:10–4.
- Arrigoni J, Lambrecht JT. Complications during and after third molar extraction. *Schweiz Monatsschr Zahnmed* 2004;**114**:1271–86.
- Kunkel M, Morbach T, Wagner W. Wisdom teeth—complications requiring in-patient treatment. A 1-year prospective study. *Mund Kiefer Gesichtschir* 2004;**8**:344–9 [In German].
- Kunkel M, Kleis W, Morbach T, Wagner W. Severe third molar complications including death—lessons from 100 cases requiring hospitalization. *J Oral Maxillofac Surg* 2007;**65**:1700–6.
- Werkmeister R, Fillies T, Joos U, Smolka K. Relationship between lower wisdom tooth position and cyst development, deep abscess formation and mandibular angle fracture. *J Craniomaxillofac Surg* 2005;**33**:164–8.
- Komerik N, Karaduman AI. Mandibular fracture 2 weeks after third molar extraction. *Dent Traumatol* 2006;**22**:53–5.
- Wagner KW, Schoen R, Wongchuensoontorn C, Schmelzeisen R. Complicated late mandibular fracture following third molar removal. *Quintessence Int* 2007;**38**:63–5.
- Woldenberg Y, Gatot I, Bodner L. Iatrogenic mandibular fracture associated with third molar removal. Can it be prevented? *Med Oral Patol Oral Cir Bucal* 2007;**12**:E70–2.
- Orihovac Z, Aljinović-Ratković N, Varga S. Surgical treatment of lower jaw pseudoarthrosis as a result of fracture non-treatment following tooth extraction. *Acta Med Croatica* 2008;**62**:301–3 [In Croatian].
- Khan AA, Banerjee A, Mbamalu D. Mandibular fracture caused by mastication. *Emerg Med J* 2009;**26**:153.
- Valiati R, Ibrahim D, Poli VD, Heitz C, Pagnoncelli RM, Silva DN. Mandibular fracture during mandibular third molar extraction. *Internet J Dent Sci* 2009. Available from URL: <http://www.ispub.com/journal/the->

- internet_of_dental_science/volume_6_number_2_25/article/mandibular_fracture_during_mandibular_third_molar_extraction.html.
50. Chrcanovic BR, Custódio AL. Considerations of mandibular angle fractures during and after surgery for removal of third molars: a review of the literature. *Oral Maxillofac Surg* 2010;**14**:71–80.
 51. Miyaura K, Matsuka Y, Morita M, Yamashita A, Watanabe T. Comparison of biting forces in different age and sex groups: a study of biting efficiency with mobile and non-mobile teeth. *J Oral Rehabil* 1999;**26**:223–7.
 52. Lysell L, Rohlin M. A study of indications used for removal of the mandibular third molar. *Int J Oral Maxillofac Surg* 1988;**17**:161–4.
 53. Sencimen M, Varol A, Gülses A, Altug HA. Extraction of a deeply impacted lower third molar by sagittal split osteotomy. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;**108**:e36–8 [Erratum in: *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2010;109:324].
 54. Abu-El Naaj I, Braun R, Leiser Y, Peled M. Surgical approach to impacted mandibular third molars-operative classification. *J Oral Maxillofac Surg* 2010;**68**:628–33.
 55. Al-Belasy FA, Tozoglu S, Ertas U. Mastication and late mandibular fracture after surgery of impacted third molars associated with no gross pathology. *J Oral Maxillofac Surg* 2009;**67**:856–61.