The Association of Third Molars with Mandibular Angle Fractures: A Meta-Analysis

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Abstract

Objective: *To estimate the relative risk of mandibular angle fractures among people with a lower third molar compared with those without a lower third molar.*

Methods: *Data for a case–control meta-analysis were obtained by performing a literature search in MEDLINE and EMBASE to identify suitable observational studies. To be included, studies had to present data on patients with mandibular fractures, incorporate cross-classified information about the presence of a lower third molar and indicate whether the fracture was a mandibular angle fracture on the ipsilateral side.*

Results: *Six studies, involving 3,002 patients with mandibular fractures, met the inclusion criteria. Crude relative risk estimates for an angle fracture, comparing patients with a third molar with those without, ranged from 1.2 to 12.7. There was evidence of heterogeneity across the 6 studies (p = 0.001), but when 2 studies with less methodologic rigour were excluded, a test of homogeneity was no longer statistically significant (p = 0.22). The estimated relative risk across the remaining 4 studies was 2.4 (95% CI 1.9 to 3.0).*

Conclusions: *The presence of a lower third molar may double the risk of an angle fracture of the mandible. This could have a bearing on any clinical decision on whether to extract the molar.*

MeSH Key Words: *mandibular fractures/etiology; meta-analysis; molar, third/physiopathology*

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Mandibular fractures are common; the reported rate of occurrence is 11.5 per 100,000 person-years.[1] People between the ages of 16 and 30 years account for 50.2% of these fractures. Mandibular fractures follow a pattern common to many injuries in that males and young adults are predominantly affected. Fractures of the mandibular angle account for about 40% of mandibular fractures.[2]

Because the lower third molar is located near the angle of the mandible, it has been hypothesized that its presence increases the risk of fracture. It is possible that a mandibular third molar weakens the jaw by decreasing the cross-sectional area of bone. If this is true, extracting the third molar and allowing the tooth socket to fill with bone may reduce the risk of an angle fracture. However, third molars are common, and extraction is costly and controversial in terms of both risks and benefits.[3–9]

Several published studies of patients with mandibular fractures have examined the relation between the presence of a third molar and the risk of fracture. Many are not formal case–control studies, but some can be analyzed as such providing that certain assumptions are met.[10,11] Patients with an angle fracture of the mandible can be considered to be cases. A randomized sample of the population from which the cases arose would constitute ideal controls; few would have a mandibular fracture. Published case series do not have such controls; however, provided that the presence of a third molar is not related to the risk of mandibular fracture in locations other than the angle and the referral or admission of people with mandibular fractures at sites other than the angle is not related to the

Table 1 **Characteristics of included studies**

Authors	Year of publication	Years data collected	Location	No. of cases and controls	Mean age of patients (years)	Data source	Males, %	Injury mechanism (as described in paper)
Tankersly and Abubaker[16]	1995	No information	Virginia, USA	215	No information	Patient case records and panoramic radiograph	No information	No information
Lee and Dodson[13]	2000	January 1993–1998	Atlanta, USA	367	31.7	Patient chart and panoramic radiograph	79	Altercation Motor vehicle crash Fall Gunshot Occupation Other
Ma'aita and Alwrikat[18]	2000	January 1993–July 1997	Amman, Jordan	615	33.2	Patient records and panoramic radiograph	79	Motor vehicle crash Fall Fight Other
Ugboko and others[17]	2000	January 1976–July 1997	Ile-Ilfe, Nigeria	490	30.9	Patient case records and panoramic radiograph	75.3	Motor vehicle crash Fall Sports Gunshot Other
Fuselier and others[19]	2002	1990–2000	Dallas and Atlanta, USA	1,210	30.8	Patient chart and panoramic radiograph	81	No information
Meisami and others[20]	2002	1995–2000	Toronto, Canada	105[a]	No information	Patient chart and panoramic radiograph	83	Assault Fall Sports Motor vehicle crash Other

[a]*Data are for left angle fractures only.*

presence of a third molar, then patients with mandibular fractures at locations other than the angle can be used as controls and should reflect the prevalence of third molars in the general population.

We employed these assumptions to estimate the relative risk of mandibular fracture among people with a third molar compared with those without a third molar, using available data from the published literature.

Methods

Search Strategy

A search of MEDLINE was conducted for articles published from 1966 to July 2000 and of EMBASE for publications from 1980 to July 2000. To identify relevant studies, the MEDLINE search was performed using the keywords "angle fracture" and "third molar." The EMBASE search used the term "third molars." No additional articles were identified in EMBASE that had not been found in the MEDLINE search. The reference lists of the relevant studies were examined and one additional study was identified.

Inclusion Criteria

To be included in this meta-analysis, studies had to meet one of the following criteria:

- A cohort study that reported the number of angle fractures among people with and without third molars.
- A case–control study that provided information about the proportion of those with a third molar among patients with angle fractures compared with those without angle fractures.
- A case series with information about the presence of a third molar in patients with fractures at the angle of the mandible and fractures elsewhere in the mandible.

An angle fracture was defined as a fracture located posterior to the second molar and extending from any point on the curve formed by the junction of the body of the mandible with the posterior border of the ramus.[12]

Study Identification

The search yielded 71 possible articles, all of which were obtained and examined. No cohort or case–control studies were found. Nineteen case series were identified, the original articles were reviewed and 7 were selected. These

Table 2 **Primary statistics from all studies with 95% confidence interval**

Authors	Year of publication	No. patients	Cases (those with angle fracture)		Controls (those with other mandibular fractures)		Odds ratio	95% confidence interval
			No. (%) with third molars	Total	No. (%) with third molars	Total		
Tankersly and Abubaker[16]	1995	215	96 (81)	118	42 (43)	97	5.7	(3.1–10.6)
Lee and Dodson[13]	2000	367	79 (80)	99	170 (63)	268	2.3	(1.3–4.0)
Ma'aita and Alwrikat[18]	2000	615	127 (84)	152	299 (65)	463	2.8	(1.7–4.5)
Ugboko and others[17]	2000	490	65 (86)	76	343 (83)	414	1.2	(0.6–2.4)
Fuselier and others[19]	2002	1,210	269 (82)	326	568 (64)	884	2.6	(1.9–3.6)
Meisami and others[20] [a]	2002	105	50 (78)	64	9 (22)	41	12.7	(4.9–32.8)
Total		3,002	686 (82)	835	1,431 (66)	2,167	2.8	(2.3–3.5)

[a]*Data are for left angle fractures only.*

7 studies contained information about the relation between the mandibular third molar and angle fracture. Subsequently, studies that investigated this relation in exposure or outcome *subgroups* were excluded. One study[12] was excluded because the same patients were also part of a study by Lee and Dodson.[13] Two others were excluded because one was restricted to sports injuries,[14] and the other only included subjects with incompletely erupted third molars.[15] One additional study,[16] published only as an abstract, was found by searching the bibliographies of the 4 studies identified in MEDLINE. Four studies that presented cross-tabulated information about angle fracture and third molars were included.[16–19] In addition, 2 studies published in 2002 and recommended during review of this manuscript were included.[20,21]

Subanalysis of Original Data

Data from the 4 published studies allowed calculation of only crude odds ratios. Because these estimates might be affected by confounding, the authors were contacted and asked to provide their original data. One original data set was received from T.B. Dodson.[13]

Analysis

Information regarding the location of mandibular fracture and the presence of a lower third molar was extracted from each study and used to calculate odds ratios for the association of fracture with the presence of a third molar. Odds ratios were used to approximate relative risks, and 95% confidence intervals (CIs) were calculated. Results were summarized across studies using the Mantel-Haenszel method.[21] This fixed-effect method was considered appropriate, but random-effects estimates were also calculated using the method of DerSimonian and Laird.[22] A formal test of homogeneity was undertaken to establish whether it was reasonable to assume that the estimate of relative risk across studies was consistent.[23,24] All analyses were carried out using the statistical package Stata (v. 6.0, Stata Statistical Software, College Station, Texas, 1997).[25]

Using original data from one study, logistic regression was used to determine whether the crude association between the presence of a third molar and angle fracture might be affected by age, sex or mechanism of injury. Age was categorized as < 29 years, 29–49 or > 49 years. Mechanism of injury was categorized as a fight, motor vehicle crash, gunshot, occupational injury or other.

Results

Of the 6 studies[13,16–20] accepted for the main analysis (**Table 1**), 3 were conducted in the United States,[13,16,19] one in Jordan,[18] one in Nigeria[17] and one in Canada.[20] These studies were published between 1995 and 2002. The total number of patients was 3,002: 835 with an angle fracture (cases) and 2,167 with some other fracture of the mandible (controls). The crude relative risk estimates in the 6 studies ranged from 1.2 to 12.7. The summary relative risk ratio across all 6 studies was 2.8 (95% CI 2.3–3.5) (**Table 2**). The random-effects estimate was slightly higher (relative risk ratio 3.1), and the 95% CI was greater (2.0–5.0).

There was evidence of heterogeneity across the 6 studies (p = 0.001). The possible reason for this was explored by

eliminating each study in turn in addition to eliminating the study by Tankersly and Abubaker,[16] because these results were published as an abstract, allowing us only limited ability to assess the methods. Discarding the study by Meisami and others[20] resulted in nonsignificant homogeneity (p = 0.22). Summary relative risk estimates for the remaining 4 studies were 2.4 (95% CI 1.9–3.0) using the Mantel-Haenszel method and 2.3 (95% CI 1.7–3.1) using the random-effects method.

Individual level data from one study[13] showed little confounding by sex (adjusted odds ratio 2.3) or age (adjusted odds ratio 2.4). The risk ratio adjusted for mechanism of injury (2.8 with 95% CI 1.5–5.2) differed slightly from the crude risk ratio.

Discussion

In this meta-analysis, the results from 6 case series were analyzed as if they were case–control studies to estimate that the risk of an angle fracture of the jaw in people with a lower third molar is approximately double that in people without a third molar.

One mechanism by which third molars have been hypothesized to increase the risk of angle fractures is by occupying osseous space and, thereby, weakening the angle region. In support of that hypothesis, mandibular fractures have been reported to occur occasionally (at a very low incidence of 0.0046%) after wisdom tooth removal (when the angle region is weakened further because the tooth is extracted) when usual food is consumed.[26]

The identified studies were case series, not case–control studies. However, assuming that in patients with a mandibular fracture at nonangle locations, the presence of a lower third molar does not influence either the risk of fracture or the likelihood of referral or admission, it is reasonable to analyze these data as if they came from case–control studies. Patients with fractures at nonangle locations should, on average, represent the prevalence of third molars in the population from which the patients with angle fractures arose.[15,17] A similar study design has been used in case–control studies of bicycle helmets and head injuries.[27,28] However, if the presence of a third molar influences the risk of fracture to parts of the jaw other than the angle, the estimates presented here could be biased.

The available published data allowed us to calculate only crude risk estimates. Adjusted relative risk estimates might differ from the crude estimates. When this possibility was examined in one study, adjusting for age and sex revealed no confounding by these variables, whereas adjusting for mechanism of injury resulted in an estimate of 2.9. If the confounding influence of age, sex and mechanism of injury is similar in the other 5 studies, then the true summary relative risk estimate may be slightly greater than our estimate of 2.8 for all studies.

If the association that we found is causal, then this might be taken into account, along with other factors, in any decision regarding the removal of third molars. ◆

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References

1. Azevedo AB, Trent RB, Ellis A. Population-based analysis of 10,766 hospitalizations for mandibular fractures in California, 1991 to 1993. *J Trauma* 1998; 45(6):1084–7.

2. Haug RH, Prather J, Indresano AT. An epidemiologic survey of facial fractures and concomitant injuries. *J Oral Maxillofac Surg* 1990; 48(9):926–32.

3. Meechan JG, Safdar N. Lower third molars and mandibular angle fractures. *Br Dent J* 1996; 180(5):169.

4. Brickley MR, Tanner M, Evans DJ, Edwards MJ, Armstrong RA, Shepherd JP. Prevalence of third molars in dental practice attenders aged over 35 years. *Community Dent Health* 1996; 13(4):223–7.

5. Lysell L, Brehmer B, Knutsson K, Rohlin M. Rating the preventive indication for mandibular third-molar surgery. The appropriateness of the visual analogue scale. *Acta Odontol Scand* 1995; 53(1):60–4.

6. Lysell L, Brehmer B, Knutsson K, Rohlin M. Judgement on removal of asymptomatic mandibular third molars: influence of the perceived likelihood of pathology. *Dentomaxillofac Radiol* 1993; 22(4):173–7.

7. Knutsson K, Brehmer B, Lysell L, Rohlin M. Mandibular third molars as mediated by three cues. Dentists' treatment decisions on asymptomatic molars compared with molars associated with pathologic conditions. *Acta Odontol Scand* 1997; 55(6):372–7.

8. Tulloch JF, Antczak-Bouckoms AA, Ung N. Evaluation of the costs and relative effectiveness of alternative strategies for the removal of mandibular third molars. *Int J Technol Assess Health Care* 1990; 6(4):505–5.

9. Goldberg MH, Nemarich AN, Marco WP. The impacted third molar: referral patterns, patient compliance, and surgical requirements. *J Am Dent Assoc* 1983; 107(3):439–41.

10. Cummings P, Koepsell T, Weiss NS. Studying injuries with case-control methods in the emergency department. *Ann Emerg Med* 1998; 31(1):99–105.

11. Cummings P, Koepsell T, Roberts I. Case-control studies in injury research. In: Rivara FP, Cummings P, Koepsell T, Grossman D, Maier RV, editors. Injury control: a guide to research and program evaluation. New York, NY: Cambridge University Press; 2000. p. 39–156.

12. Tevepaugh DB, Dodson TB. Are mandibular third molars a risk factor for angle fractures? A retrospective cohort study. *J Oral Maxillofac Surg* 1995; 53(6):646–9.

13. Lee JT, Dodson TB. The effect of mandibular third molar presence and position on the risk of an angle fracture. *J Oral Maxillofac Surg* 2000; 58(4):394–8.

14. Yamada T, Sawaki Y, Tohnai I, Takeuchi M, Ueda M. A study of sports-related mandibular angle fracture: relation to the position of the third molars. *Scand J Med Sci Sports* 1998; 8(2):116–9.

15. Safdar N, Meechan JG. Relationship between fractures of the mandibular angle and the presence and state of eruption of the lower third molar. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1995; 79(6):680–4.

16. Tankersly K, Abubaker AO. The relationship between the presence of mandibular third molars and mandibular angle fractures. *J Dent Res* 1995; 74 AADR (Abstract #550):80.

17. Ugboko VI, Oginni FO, Owotade FJ. An investigation into the relationship between mandibular third molars and angle fractures in Nigerians. *Br J Oral Maxillofac Surg* 2000; 38(5):427–9.

18. Ma'aita J, Alwrikat A. Is the mandibular third molar a risk factor for mandibular angle fracture? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000; 89(2):143–6.

19. Fuselier JC, Ellis EE 3rd, Dodson TB. Do mandibular third molars alter the risk of angle fracture? *J Oral Maxillofac Surg* 2002; 60(5):514–8.

20. Meisami T, Sojat A, Sandor GK, Lawrence HP, Clokie CM. Impacted third molars and risk of angle fracture. *Int J Oral Maxillofac Surg* 2002; 31(2):140–4.

21. Mantel N, Haenszel W. Statistical aspects of the analysis of data from retrospective studies. *J Natl Cancer Inst* 1959; 22(4):719–48.

22. DerSimonian R, Laird N. Meta-analysis in clinical trials. *Control Clin Trials* 1986; 7(3):177–88.

23. Thompson SG. Why sources of heterogeneity in meta-analysis should be investigated. *BMJ* 1994; 309(6965):1351–5.

24. Deeks J, Altman D, Bradburn MJ. Statistical methods for examining heterogeneity and combining results from several studies in meta-analysis. In: Egger M, Smith GD, Altman D, editors. Systematic reviews in health care meta-analysis in context. 2nd edition. London: BMJ Publishing Group; 2001. p. 285–312.

25. Bradburn MJ, Deeks J, Altman D. sbe24:metan an alternative meta-analysis command. *Stat Tech Bull* 1998; 44:15.

26. 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(8): 858–61.

27. Thompson RS, Rivara FP, Thompson DC. A case–control study of the effectiveness of bicycle safety helmets. *N Eng J Med* 1989; 320(21):1361–7.

28. Thompson RS, Rivara FP, Thompson DC. Effectiveness of bicycle helmets in preventing head injuries. A case–control study. *JAMA* 1996; 276(24):1968–73.