Teeth in the line of mandibular fractures

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D Nickerson, D McPhalen. Teeth in the line of mandibular fractures. Can J Plast Surg 1994;2(3):113-116. This study considers 710 mandibular fractures occurring in 546 patients over a five-year period and notes the fate of 114 teeth involved in the line of 104 of these fractures. Analysis of retention versus removal of teeth in the fracture line and any associated infection was undertaken. Overall, 15.5% of cases that involved retained teeth became infected, as compared with 7.1% of cases in which a tooth was extracted from the fracture site. For third molars, the teeth most commonly involved in mandibular fractures, infection was associated with 20.5% of retained teeth and 10% of cases where teeth were extracted from the fracture site. These data support careful consideration of a tooth's disposition before a decision regarding retention or extraction is made. Furthermore, they suggest that even in the absence of a grossly evident risk factor for infection, such as a fractured tooth, the tooth itself may inherently predispose to infection if retained. Infection rates were higher for retained teeth regardless of whether open reduction with rigid internal fixation or closed reduction with maxillomandibular fixation was used.

Key Words: *Extraction, Infection, Mandibular fractures, Teeth*

Dentition et fracture mandibulaire

RÉSUMÉ : Cette étude se penche sur 710 fractures du mandibule survenues chez 546 patients sur une période de cinq ans et retrace l'évolution de 114 dents atteintes lors de 104 de ces fractures. Une analyse a été effectuée pour étudier la conservation versus l'extraction des dents touchées par ces fractures. De façon globale, dans 15,5 % des cas où les dents avaient été conservées, elles se sont infectées, contre 7,1 % pour les cas dans lesquels l'extraction a été faite à partir du point de fracture. Pour les troisièmes molaires, les dents les plus fréquemment atteintes lors de fractures du mandibule, l'infection a été associée à 20,5 % des dents conservées et à 10 % des cas où les dents ont été extraites. Selon ces données, il faut donc étudier attentivement l'état de la dent avant de décider si elle doit être conservée ou extraite. De plus, même en l'absence d'un facteur de risque d'infection très évident, comme une dent fracturée, la dent elle-même peut prédisposer de façon inhérente à l'infection si elle est conservée. Les taux d'infection ont été élevés lorsque les dents ont été conservées, peu importe qu'il y ait eu réduction ouverte avec fixation interne rigide ou réduction fermée avec fixation maxillomandibulaire.

This study combines a retrospective assessment of a variety of mandibular fractures involving teeth in the fracture line with a review of the literature in an attempt to elucidate whether a general statement regarding the benefit of retention versus extraction of these teeth can be made, especially with regard to infection risk. A considerable amount of controversy exists over the management of mandibular fractures which involve teeth at the fracture site. Prevailing opinion circa 1965 dictated that these teeth be extracted regardless of their status (1,2). Case-specific variables are now more often taken into account when deciding a tooth's fate. The commonly recognized indications for extraction include instability of the tooth, non-viability, exposure of a large portion of a tooth's root, evidence of interference with the repair procedure, and preexisting infection (3,4). Debate over whether (3) or not (5) fracture of the dental pulp constitutes an absolute indication for extraction together with support for the concept of retaining a non-viable tooth under antibiotic coverage as an aid to stabilization during reduction (5,6,7,8) demonstrates that management

principles for teeth in mandibular fractures are far from absolute.

The tooth most commonly involved in a mandibular fracture is the third molar. As such, the fate of third molars involved in fractures of the mandibular angle is of special emphasis in the present study. An unerupted third molar, which is often impacted in the general population (4), weakens the angle and predisposes the angle to fracture (4,9) which often occurs along the socket of the tooth, thus also predisposing the site to infection by exposure to oral flora (3).

METHODS

The health records archives of two Calgary hospitals were chosen as the source of the data. The Calgary General Hospital and Foothills Hospital are both tertiary care trauma centres associated with the University of Calgary and serve the city of Calgary as well as southern Alberta and southeastern British Columbia. All charts containing the international diagnosis codes 802.20-802.29 and 802.30-802.39 were retrieved for the period 1988 to 1992 inclusive. These diagnosis codes are those assigned to the various types of mandibular fractures, as outlined in Table 1.

The charts retrieved were then reviewed and data pertinent to this present study were entered into a computerized record-

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TABLE 1: Coding scheme of mandibular fractures

Fracture description	Code
Unspecified site, open/closed	802.20 / .30
Condylar process, open/closed	802.21 / .31
Subcondylar, open/closed	802.22 / .32
Coronoid process, open/closed	802.23 / .33
Ramus, open/closed	802.24 / .34
Angle, open/closed	802.25 / .35
Symphysis, open/closed	802.26 / .36
Alveolar border, open/closed	802.27 / .37
Body, open/closed	802.28 / .38
Multiple sites, open/closed	802.29 / .39

oriented data base with user-defined fields (FileMaker Pro 2.0, Claris Corporation). Parameters recorded included the diagnosis code, the patient's age and gender, the date and cause of the injury, the dates of admission to and discharge from hospital, the hospital involved, the date and means of repair if performed, and the course of antibiotics if administered. There were also fields for description of the fracture anatomy, dental involvement in the fracture, and any notes deemed important to the case, especially any associated infection.

In addition, any fractures coded in the patients' charts as 802.20 or 802.30 (unspecified site, open or closed) and 802.29/802.39 (multiple sites, open or closed) were recoded prior to entry in the database, on the basis of the surgeon's written description, in order to provide more specific information for the purpose of this study. For example, if a fracture was coded in the chart as 802.20 but was described as 'a closed fracture of the (left or right) body of the mandible', its code in the database would be 802.28. Similarly, a fracture coded as 802.29 but described as 'a bilateral fractured mandible with left body and angle fractures and a fracture-dislocation of the right condyle' would be entered as 802.28 + 802.25 + 802.21 to ensure each of the three fractures in the case were adequately described and accounted for.

This data was then transferred to a spreadsheet-style data base (Excel 4.0a, Microsoft Corporation), which was employed for further sorting, and computations.

RESULTS

Charts retrieved

A total of 551 charts were retrieved as per the criteria outlined above. Of these, four patients were transfer patients who had received treatment for their mandibular fractures at hospitals other than the Calgary General Hospital or the Foothills Hospital. As such, much of the data regarding cause of the fracture, means of repair, and involvement of teeth in the fracture were incomplete for these patients, and they were excluded from the study. One pediatric patient was assessed at one of the study hospitals but was transferred to the local children's hospital for definitive treatment and was excluded on this basis. This left 546 cases for study. Eight polytrauma patients – six involved in motor vehicle accidents, one who fell from a great height, and one who hit a tree while skiing –

succumbed to other injuries without having their mandibular fractures treated. These were included in the database for the purpose of describing epidemiological factors including patient gender, age, cause of injury and type of fracture, but were excluded from the group assessed to look at the fate of teeth in the fracture line. This left 538 patients for this latter purpose.

Teeth in the fracture line and infection

One hundred and four patients had teeth involved in the fracture line to the extent that the fracture extended at least through the socket if not the tooth. In these 104 patients, a total of 114 teeth were involved (79 third molars, 19 second molars and 16 others) at the fracture site. Fifty-eight of the teeth were retained and of these, 11 were associated with infection (19.0%). There were four infections in the 56 instances where teeth were extracted (7.1%). Infections included both soft tissue infections and osteomyelitis of the mandible. Organisms cultured from the infections included staphylococci, streptococci, *Peplostreptococcus* species, *Eikenella corrodens*, *Klebsiella pneumoniae* and one case of *Actinomyces*, which occurred in the one patient in the study who was known to be seropositive for human immunodeficiency virus (HIV). Cefazolin, which has been shown to reach high levels in bone (1), was the antibiotic most commonly used.

Of the 11 retained teeth associated with infection, three were in one patient at one fracture site, so it is perhaps more accurate to refer to nine of 58 patients (this patient was the only one with multiple tooth involvement and infection) developing infection, for a rate of 15.5%. Two of the retained teeth associated with infection were in two patients who presented after a delay of more than 48 h with an existing infection at the fracture site. In that sense, these patients did not have their teeth retained as part of their management plan but rather because of their failure to seek prompt treatment.

Considering third molars, which made up 69.3% of the teeth involved in fractures, the infection rate when the tooth was retained was eight of 39 (20.5%). Among the 40 extracted third molars, four subsequently developed infection at the site (10%).

Among the 58 teeth that were retained, 33 cases were treated with open reduction and internal fixation (ORIF) and 25 with closed reduction (CR) and maxillomandibular fixation (MMF). The infection rate was 21.2% with ORIF and 16.0% with CR plus MMF. Of the 56 extracted teeth, 38 cases received ORIF and 18 CR plus MMF, with infection rates of 10.5% and 0%, respectively.

Thirty-eight patients delayed more than 48 h in seeking treatment, and of these, 11 had teeth in the fracture line. Of these 11, three developed subsequent infection and two presented with existing infection as mentioned above.

Table 2 summarizes the data associated with the 13 patients with teeth in the fracture line and associated infection. There were 15 teeth involved in these cases (12 third molars, one second molar, one first molar, and one mandibular cuspid).

A total of 434 patients had fractures that did not involve teeth and of these, 11 developed infection at the operative site or from fractures that were compound intraorally. Of the 11

TABLE 2: Case details of infections associated with teeth in the fracture line

Patient number	Gender	Age (years)	Fracture	Delay (days)	Repair	Tooth involvement	Tooth Fate
076	M	29	L Angle and body	7	ORIF	L mandibular cuspid	Retained *
203	M	27	L Angle	6	CR+MMF	L 3rd molar	Retained
040	F	34	R Angle	8	CR+MMF	R 3rd molar	Retained
347	M	33	L Angle	2	ORIF	L 3rd molar, erupted & impacted	Retained
420	M	26	R Angle	4	ORIF	R 3rd molar	Removed
105	M	29	L Angle	0	ORIF	L 3rd molar	Retained
158	M	30	R Angle	0	ORIF	R 3rd molar	Retained
516	M	33	L Angle	0	ORIF	L 3rd molar, stable	Retained
373	M	34	L Angle	0	CR+MMF	L 3rd molar	Removed
496	M	29	L Angle	0	ORIF	L 3rd molar, impacted	Removed
060	M	31	L Angle	0	ORIF	L 3rd molar, impacted	Removed
055	F	26	L Angle	0	ORIF	L 3rd molar	Removed
381	F	29	L Angle	0	ORIF	L 1st, 2nd & 3rd molars	Retained x 3

* Indicates retention due to delay in presentation; L Left; R Right; CR Closed reduction; MMF Maxillomandibular fixation; ORIF Open reduction and internal fixation

infections that developed independent of any tooth involvement, two had associated delays and nine did not.

DISCUSSION

Mandibular fractures are associated with the same attendant possible complications as other fractures, with malunion, nonunion, and infection being three significant problems. The mandible is further predisposed to infection due to its status as a tooth-bearing structure, which provides the potential of a tooth being at the site of the fracture. If a dentulous mandible is fractured, the fracture tends to extend through the weakest point, the tooth socket, and then from the apex of the socket to the inferior border (9). When this situation arises, the fracture is compounded intraorally, and the potential for infection is increased, by virtue of saliva containing 10^8 to 10^9 bacteria per mL (1). It is largely this issue of infection which has engendered the controversy over whether teeth in the fracture line should be removed or retained.

Some data put extraction in a poor light. In one series of 214 mandibular fractures (8), 13 mandibles developed infection and of these, 12 were fractured in the region of the angle. Second or third molars had been extracted from nine of the 10 dentulous patients. These authors did not cite the open socket as an environment intrinsically favouring infection but rather postulated that the removal of the tooth yielded inadequate stability at the fracture site, consistent with the principle that loose hardware and mobile fracture fragments predispose to infection (10). They state that extracting the tooth before reduction and repair allows greater oral contamination and reduces stability. Citing the role of the tooth in stabilizing the fracture site during repair, they suggest retaining the tooth, and if its removal is indicated, doing so after the repair procedure, a concept echoed by others (7).

Others have advocated retaining the tooth postoperatively under antibiotic coverage (5,6), yet data from the present review would seem to question the wisdom of this approach. All patients in our review who developed an infection following ORIF and tooth retention had been treated with intraopera-

tive and postoperative intravenous antibiotics, yet there was a nearly twofold increase in infection with retention over extraction.

Morgan and colleagues examined the incidence of infection from all causes in two groups of patients, with one group receiving antibiotics and the other receiving none (11). Of 40 patients receiving antibiotics, three patients treated with CR plus MMF developed infection, and no underlying cause was postulated. In a group of 12 patients not receiving antibiotics, two CR plus MMF patients and one ORIF patient developed infection. The ORIF patient who developed infection had a tooth retained in the fracture line, which was mobile and had a fractured root, either one of which is seemingly a clear indication for extraction.

Some studies report that there is no difference in infection rate between groups of patients where the teeth were retained and those where they were removed (12,13). Where differences have been noted, broad ranges are reported. For infection associated with retained teeth the range is 14 to 38%, and for teeth extracted from the fracture site 3.5 to 11% (6). These figures would certainly support extraction of teeth over their retention, as would the data in this present study. However, it is impossible to say whether there is truly an advantage to extraction or whether all of the infected teeth in these studies were inherently predisposed to infection due to local factors and they (or their sockets, in the case of extraction) would have been infected regardless of whether they were retained or extracted. Rubin et al recently reviewed 105 mandibular fractures associated with incompletely erupted third molars in the fracture line (2). All patients, regardless of whether treatment was by CR or ORIF, also received MMF. The outcome measures used to define 'complication' were either infection or delayed healing, defined as more than six weeks in MMF. These two types of complication were grouped together without any further distinction. The authors were not able to demonstrate statistical significance, but the trend was that the group in which teeth were retained and ORIF was applied had the highest complication rate (44%), followed by retention and CR (20%), extraction and CR (20%), and extrac-

tion with ORIF (19%). This may be a harsh judgement of the protocol of retaining a tooth and treating the fracture with ORIF. Certainly, being in MMF for six weeks or longer is inconvenient and uncomfortable for the patient, but if good union is eventually achieved and infection does not develop it would seem to remain a viable choice.

The data presented herein suggest that there is an increased risk of infection with retained teeth and this can be reduced by extracting teeth when there is question of such risk. In this study, infection rates were roughly comparable for ORIF versus CR plus MMF for extracted teeth, and both of these groups were comparable to the group where ORIF was applied and teeth were removed. The fact that there were no infections in the group where CR plus MMF was applied and teeth were retained suggests that cases in this group were the least likely to become infected from the outset, and that there is no inherent advantage to either means of fixation in terms of infection risk.

Others have reported that 25% of all third molars that are retained at the fracture site become infected (6). In this present study, the overall rate of infection among retained teeth was 19.0% and 7.1 % for the cases where teeth were extracted from the fracture site. In considering third molars specifically, the rates become 20.5% when a third molar was retained and 10.0% when extracted. However, three of the teeth were in one patient and should be perhaps counted as one case, and two of the teeth were in patients whose presentation to hospital was delayed by more than 48 h from the time of the injury; this means that the figure of 19.0% is probably a worst-case scenario. If one considers the infection rate among retained teeth as a percentage of cases, the rate becomes 15.5%.

Two of the patients in the present study who experienced infection associated with a retained third molar at the fracture site presented after delays of seven and four days post-injury with existing infection. In that sense, they were classified as having a retained tooth though the basis for retention was not any medical indication. Disregarding these cases where presentation was delayed would further reduce the rate to 12.5%,

but it seems reasonable to include these delayed cases since the possibility that the development of infection was influenced by the presence of a tooth cannot be ruled out.

CONCLUSIONS

In summary, for both teeth in general and for third molars specifically, retention was associated with roughly twice the risk of infection compared with extraction. This would seem to indicate a benefit in extracting a tooth at the fracture site and carefully flushing and debriding the socket. At the very least, it underscores the necessity of very carefully assessing a tooth's disposition and any risk factors for infection before electing to retain it at a fracture site. Such risk factors include an evident preexisting infection, a fractured tooth, a grossly unstable tooth, a significantly exposed tooth root, and poor oral hygiene.

The data of this study suggest that there is at least an association between retention of teeth in the fracture line and an increased incidence of infection. Infection rates for both teeth in the fracture line in general and specifically for third molars were roughly twice as high when retained as when extracted. The definitive study of this issue would be prospective and would make careful use of a grading scheme for a tooth's disposition. Teeth with any question as to their viability or stability would be extracted; teeth that were judged to be sound could be randomized into 'retained' and 'extracted' groups in an attempt to determine whether the retention of a tooth in the fracture line, in the absence of identifiable risk factors for infection, inherently predisposes that fracture site to infection.

In the absence of such a study, each case must be approached in the context of its unique characteristics and the decision to extract or retain a tooth then made, with the awareness that a retained tooth may present more of an infection risk. Indeed, the data presented herein suggest that the prudent course would be to err on the side of caution and extract a tooth from a mandibular fracture site if there was even the slightest doubt as to its viability or stability.

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