

Outcomes of Patients With Teeth in the Line of Mandibular Angle Fractures Treated With Stable Internal Fixation

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Purpose: This study examines the relationship between postoperative infection and/or need for plate removal with the presence and management of teeth in the line of mandibular angle fractures.

Methods: Data were collected on patients treated by intraoral open reduction and internal fixation for fractures of the mandibular angle during an 8-year period. Outcome variables were postoperative infection and need for removal of the bone plate(s). The relationships of demographic variables, teeth in the line of fracture, and management of teeth in the line of fracture were analyzed using standard statistical methods.

Results: Four hundred two patients had sufficient follow-up for inclusion in the study. A tooth was present in the fracture line 85% of the time. Teeth in the fracture were removed in 75% of the fractures that contained teeth. Postoperative complications occurred in 19% of the sample. Fractures not containing teeth at the time of fracture had a 15.8% rate of postoperative infection compared with 19.1% for patients who had teeth in the fracture ($P = NS$). For angle fractures associated with a tooth, when the tooth was retained, the incidence of infection was 19.5%. When the tooth was removed, the incidence was 19.0% ($P = NS$).

Conclusions: There is an increased risk for postoperative complications when a tooth is present, but the increase is not statistically significant. The incidence of postoperative infection and/or the need for plate removal is not affected by whether the tooth in the fracture is removed.

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Several studies have shown that the mandibular fracture that has the highest incidence of postoperative complications is fracture of the angle.¹⁻⁵ The possible reasons for this are many and include the method of treatment, the time between injury and treatment, the oral health of the patient, and the presence or absence of a tooth in the line of fracture. There has been debate about the most appropriate treatment for those fractures when the teeth are present.⁶ Should they be retained, or should they be removed? There is no consensus on this question, nor any scientifically valid data that would help direct management. The purpose of this study was to determine whether teeth in the line of a mandibular angle fracture increase the incidence of a postoperative infection or the need for

removal of the bone plate(s). A secondary purpose was to determine whether retention or removal of teeth in the line of angle fractures affects the rates of postoperative infection or the need for plate removal.

Patients and Methods

Patients who were treated for mandibular fractures at Parkland Memorial Hospital in Dallas, Texas, from 1990 to the present, have been prospectively included in a database. The database includes demographic information as well as treatment and outcome variables. For the purpose of this study, the following variables were examined: age, gender, side of angle fracture, method of treatment, teeth in the line of fracture, whether the teeth were removed, and whether there was postoperative infection or a need to remove the implanted bone plate(s). Infection was defined as having a purulent discharge from the intraoral incision or through a sinus tract to the skin or having a closed swelling that required incision and drainage of purulent material. Patients from the database who satisfied the following inclusion criteria were analyzed: 1) treatment between the years 1992 and 2000, 2) treatment with a form of fixation that

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allowed active use of the mandible postoperatively (no maxillomandibular fixation), 3) intraoral surgical approach, and, 4) at least 6 weeks of follow-up.

The criteria for whether a tooth in the line of fracture was removed at the time of surgery were the following: fractured teeth, pericoronal/periodontal infection, gross caries, tooth mobility, exposure of the apical half or more of the root (including the apex), and inability to reduce the fracture without tooth removal.

The patient population in this study has been described previously⁷⁻¹⁴ and was largely made up of inner-city indigent patients. None of the patients were placed into postsurgical maxillomandibular fixation. More than half of the patients had at least 1 other fracture of the mandible in addition to the angle. All other fractures of the mandible (with the possible exception of subcondylar) were treated with plate and/or screw fixation, allowing immediate mandibular function. Even those patients who had closed treatment of condylar fractures were allowed immediate mobilization of the mandible but may have had elastics applied to the dentition to "guide" them into proper occlusion. The vast majority of fractures in this patient population were sustained in altercations/assaults (approximately 85%). Antibiotics were administered on admission to the hospital. However, the average time between injury and presentation to the hospital was 1.6 days.

The relationship between demographic data and outcome measures was analyzed using χ^2 bivariate statistics.

Results

Four hundred two patients, (330 males [82%] and 72 females [18%]) met the criteria and were included. The mean age was 28 years (SD, 8.6 years; range, 12 to 56 years). There were almost twice as many angle fractures on the left side (65%). The duration of follow-up was a mean of 17.5 weeks (SD, 20.1 weeks; range, 6 to 208 weeks). A tooth was in the line of the angle fracture 85% of the time ($n = 345$ of 402). The tooth in the line of fracture was removed during the surgery to repair the fracture 75% of the time ($n = 258$ of 345).

The angle fracture was treated by 1 of 6 techniques: a 2.0-mm miniplate ($n = 131$ [32.6%]), a 1.3-mm miniplate ($n = 50$ [12.4%]), a 2.0-mm locking miniplate ($n = 33$ [8.2%]), 2 minidynamic compression plates (DCPs) ($n = 31$ [7.7%]), two 2.0-mm miniplates ($n = 90$ [22.4%]), or two 2.4-mm DCPs ($n = 67$ [16.7%]).

Postsurgical infections occurred in 75 of 402 angle fractures (19%). The mean time from surgery until an infection developed was 8.1 weeks (SD, 7.3 weeks;

range, 1 to 38 weeks). Removal of internal fixation hardware was required in 75 of 402 cases (19%).

The incidence of infection in patients who had no tooth associated with the angle fracture was 15.8% compared with 19.1% in those who did ($P = NS$). For angle fractures associated with a tooth, when the tooth was retained, the incidence of infection was 19.5%. When it was removed, the incidence was 19.0% ($P = NS$).

The incidence of hardware removal in patients who had no tooth associated with the angle fracture was 17.5% compared with 18.8% in those who did ($P = NS$). For those angle fractures associated with a tooth, when the tooth was retained, the need for hardware removal was 19.5%. When it was removed, the incidence was 18.6% ($P = NS$).

There was a significant difference in the rates of infection with respect to the type of treatment provided ($P < .001$). To further determine whether the relationship between teeth in the line of fracture and the way they were managed affected the rate of infection for the different treatment groups, these relationships were assessed separately for each treatment group. In the 4 treatment groups where there was a sufficient sample size for statistical comparison, no significant relationship was noted for either.

Discussion

There are 2 main questions that this investigation attempted to address. First, does the presence of a tooth in the line of an angle fracture increase the risk of infection and/or the need for hardware removal? The results indicate that the risk of infection and need for hardware increase when there is a tooth present in the fracture line, but the increase in risk is not statistically significant. The risk for infection is approximately 3% higher and the need for hardware removal 1% higher when a tooth is present in the fracture line than when no tooth is present at the time of injury. However, these statistics should be interpreted carefully, because they probably have a direct relationship to the patient sample, the treatment provided, and a host of other variables. The socioeconomic status of the patient, nutritional status, oral hygiene, abusive habits, and other factors may all play a role in the outcomes from treatment. Therefore, the most one can take away from the relationship between the presence or absence of a tooth in the line of an angle fracture is that for this particular patient sample and with the treatment provided, there is no statistically significant relationship. Perhaps with a different patient sample, such as those with excellent oral hygiene and dental care and/or higher socioeconomic status or those treated by other surgical techniques, the relationship between the presence or ab-

sence of teeth and postoperative complication may be different than it was in this sample.

The second question that this investigation attempted to address was the relationship between the management of teeth, when present, in the line of an angle fracture and postoperative complication. In the preantibiotic era, many teeth in the line of fractures were removed to prevent the devastating consequences of osteomyelitis and nonunion. Even today, with antibiotics available, surgeons still differ on whether or which teeth in the line of fracture should be removed. Similar to our findings, others have found no difference in the rate of complications when teeth in the fracture line are removed or retained, although these studies include all fractures of the mandible, not just angle fractures.^{3,15-17} There are few studies that have addressed this debate for fractures of the angle of the mandible. Müller¹⁸ made a distinction between teeth in the anterior and posterior regions of the mandible and recommended that multirooted teeth (ie, molars) be removed when in lines of fracture.

This study shed some light on the question of whether teeth in the line of an angle fracture should be removed but did not completely answer it for all conditions. One must take the finding of the similar rates of complication for those fractures treated with or without extraction in light of the criteria used to determine the fate of the tooth in the line of fracture. Because many noninfected, nonfractured, nonmobile teeth were removed in this study because their apical half of the root and/or apex was exposed to the fracture, more teeth were removed (75%) than would otherwise be if the criteria for extraction/retention were different. For instance, James et al² used the following criteria for tooth removal: 4+ mobility, tooth root fracture, apical pathology, and tooth not necessary for stability of the fracture, and they removed only 39% of teeth present in mandibular fractures. However, most recommendations on tooth removal or retention for mandibular fractures are not region specific. Not surprisingly, recommendations in the postantibiotic era have been on the conservative side, retaining teeth when possible. Because most teeth in the line of an angle fracture are nonfunctional third molars, we did not make an effort to retain such teeth whose apices were exposed to the fracture. Kahnberg and Ridell¹⁹ found that 59% of teeth left in mandibular fractures obtained complete clinical and radiographic recovery. However, that means that 41% did not. They also have shown that teeth whose apices were exposed to the fracture site often resulted in pathologic complications when left in situ. Although such teeth can then be managed with end-

odontic treatment or selective extraction, the patient population in our study does not have ready access to such therapeutic measures. The criteria for extraction that we used are therefore more aggressive for fractures of the angle of the mandible than for other regions of the mandible.

If we used criteria that only mobile, infected, or fractured teeth should be removed, more teeth would have been retained, and perhaps the incidence of complication might be altered. Thus, the difficulty that remains involves determining the appropriate criteria for the removal of teeth in the line of fracture. Until then, the management of teeth in the line of angle fractures, when present, may continue to perplex surgeons.

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