Invasive Management of the Fractured Atrophic Edentulous Mandible

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Atrophic edentulous mandible fractures represent a subset of facial injuries that are more commonly sustained by older victims. Perioperative management of the acutely injured elderly patient is different from the management of younger patients, and is often described as more complex.1,2 Physiologic and anatomic changes attendant to complete edentulism in the mandible, and the metabolic effects of aging are factors that appear to unfavorably influence fracture repair outcome. The triad of high-risk patient, less favorable surgical environment, and compromised treatment outcome has created supporters for minimal surgical intervention when treating atrophic lower jaw fractures.3,4 The purpose of this report is to present an advocacy position for a more invasive surgical repair of these fractures.

Advances in health care, elimination of epidemic-provoking infectious diseases, and the general advantages of living in an affluent modern society have favorably influenced life expectancy in the United States. Census data reported by the US Department of Commerce in 1989 predicted that the elderly population will expand by 50% by the year 2050.5 In the year 2000, people older than 65 years of age will represent 13.6% of the American population and people older than 80 years of age will represent 6.2%.6,7 Life span is a more dramatic method of predicting the upper age limits of patients in the future. When species-specific, idealized, biologic standards describing maximal obtainable age are considered, a maximal attainable age in humans of 110 to 115 years can theoretically be established.

Because fractures of the edentulous mandible are relatively uncommon, individual surgeons or trauma centers are unable to prospectively or retrospectively complete management outcome studies of scientific adequacy. Two multicenter studies of fractures of the edentulous mandible conducted by the Chalmers J. Lyons Academy have provided demographic and outcome information that has influenced treatment approaches4,8 The first study,4 reported that older patients had more systemic health problems at the time of injury (P < .01). They also had thinner mandibles (P < .01) and the fracture fragments were farther apart (P < .05). The fractures were treated longer (P < .01) and the older patients had more systemic complications postoperatively (P < .01). They also found that patients with a history of systemic health problems tended to have thinner mandibles (P < .01). In addition, patients with a previous history of systemic health problems had more postoperative complications (P < .05) and there was a higher degree of postoperative complications (P < .01) in those fractures treated by open reduction. From this study4 it was concluded that atrophic edentulous mandible fractures are a significant problem with a very high risk of nonunion (20% incidence). Open reduction was more likely to cause a nonunion and, therefore, it was recommended that closed methods should be attempted first, if possible.

Fifteen years later, the Chalmers J. Lyons Academy conducted a second study of edentulous mandible fractures,8 acknowledging that the treatment of these fractures still remained controversial. Many similarities were noted between the first and second studies. The age, sex, and systemic health of the patients were not significantly different. However, alterations were a more common cause of jaw injury in the latter study (43% to 33%). More patients were treated with open reduction (81.5% to 66%) in the second study. Although intraosseous wire fixation was the most commonly used method of fixation in the earlier study, bone plates were commonly used by the centers contributing to the second investigation. The differences in treatment were not reflected in the rate of fibrous union (10% in the first study compared with 12.5% in the second study).

The second Chalmers J. Lyons investigation concluded that using an extraoral open reduction with
bone plate fixation may lead to improved results. No attempt was made to study the efficacy of more aggressive treatment with bone grafting as recommended by the first study. Bone grafting in older patients with health problems was considered to carry a high degree of morbidity. The poorly understood and largely unsubstantiated clinical and biologic reasons to perform open reduction with bone grafting were not singularly endorsed.

Advances in the Care of the Trauma Patient

Surgeons are likely to agree that, independent of patient social and systemic factors, anatomically aligning and fixing lower edentulous jaw fracture segments is consistent with the basic principles of facial fracture repair. It would appear that the real controversy in the management of the atrophic mandible fracture is calculating and accepting the risks of more aggressive treatment for the patient. Is the prospect of increased risk justified by the predictability of a more favorable outcome? If the patient’s mandibular injury is complex and requires invasive surgery (grossly displaced bilateral fracture in the body of an atrophic edentulous mandible \(< 10\) mm in height), is an outcome of a nonfunctioning mandible acceptable? Understanding advances in the management of the trauma patient, anesthesia for the elderly, and most importantly, patient wishes are critical elements in the total care of a senior facial trauma victim. The literature indicates that such advances have greatly reduced the risk of surgery in the elderly.

In 1990, Scalea et al reported improved survival with early invasive monitoring in the geriatric blunt multiple trauma patient. The authors opined that older trauma patients should be managed differently than younger patients. They concluded that diffuse blunt trauma is a very different disease process in the geriatric patient population. Over a several-year period they sequentially modified their approach for older patients by using invasive monitoring in a selected subset of patients. As a result, a substantial decrease in mortality occurred. The overall survival in 1987 to 1988 was 53\% compared with 7\% in 1986. This difference was significant \(P < .001\) using Chi-square determination. Only 1 of 9 patients without significant injuries who were treated with emergency monitoring died in 1987 to 1988, compared with 4 patients without significant injuries who died in 1986. Hemodynamically, the survivors and nonsurvivors showed no statistical differences in initial wedge pressure, central venous pressure, cardiac output, or systemic vascular resistance. There were highly significant differences \(<.0001\) between optimized cardiac output and systemic vascular resistance in survivors versus nonsurvivors. These findings indicate that, with proper management, elderly patients can withstand surgical operations more complex than the open reduction of a mandible fracture.

Literature Support for Invasive Surgical Management of the Edentulous Mandible

Independent of the physiologic and general health concerns that are attendant to the care of a patient with an atrophic edentulous mandible fracture are the technical and surgical controversies that are associated with the repair of these injuries. An in vitro study of the effect of bony buttressing on fixation strength in an adult bovine rib mandible model concluded that decreased resistance to displacement occurs with decreasing vertical dimension of the rib. Five groups of 6 ribs each were tested based on the vertical-height of the rib and the method of fixation. Vertical dimension of the ribs ranged from \(40\) mm to \(10\) mm. Four groups were treated with \(2.0\) miniplates and one \(10\)-mm group was repaired using a \(2.4\) reconstruction plate. The authors concluded that at higher loads, groups with greater rib height \((30\) mm and \(40\) mm) provided resistance to displacement equivalent to the \(10\)-mm group repaired with a reconstructive plate. The limitations of this study were advanced in the accompanying discussion. The loads applied to the rib model were unidirectional, with forces placed only in a vertical vector. Also, all plates in the mini-group were placed \(5\) mm from the superior border despite the overall height of the rib. A large reconstruction plate requires wider stripping of periosteum for placement and there is less periosteal contact with bone after placement. Large bicortical screws may violate the inferior alveolar nerve or be an instrument for further jaw fracture.

Advocates for more aggressive surgical repair of atrophic mandible fractures preceded the rigid fixation-bone plating techniques in vogue today. In 1973, Obwegeser and Sailer described the use of autogenous or deep-frozen rib grafts to immobilize fractures of the atrophic mandible. They also recommended intraorally repairing these fractures when the segments were displaced. Woods et al successfully treated 9 cases of atrophic edentulous mandibular fractures with autogenous rib grafts.

Newman described the role of autogenous primary rib grafts in treating fractures of the atrophic edentulous mandible. Less than 1\% (35 of over 4,000 facial fractures) of all facial bone fractures seen at the Queen Victoria Hospital, East Grinstead between 1975 and 1994 were recorded as atrophic lower jaw fractures. Of these, 16 were treated with Gunning splints, 15 had rib grafts, 3 were managed conserva-
involve with a soft diet alone, and 1 was treated with miniplate osteosynthesis. All the grafted patients, who averaged 62 years of age, achieved bony union, and were subsequently able to wear dentures. Victims were further described as presenting considerable anesthetic risks, primarily due to ischemic heart disease and chronic airflow limitation resulting in an average preoperative anesthetic grading of American Society of Anesthesiologists III.

Luhr et al.15 treated 84 consecutive atrophic edentulous mandible (20 mm in height or less) fractures (65 patients) by compression plating without using any postoperative maxillomandibular fixation. The 65 patients ranged in age from 38 to 87 years and 50% were older than 70 years of age at the time of treatment. Primary bone grafting was used in 6 cases (7%) because a partial bony defect was present at the fracture site. Eighty-one (96.5%) of the 84 fractures healed uneventfully. Osteomyelitis and nonunion occurred in 1 mandibular body fracture classified as category II (11 to 15 mm in height). Rigid fixation with compression plating and primary cancellous bone and marrow bone grafting were used in the infected fracture site. Two nonunions occurred in a bilateral severely atrophic mandible (<10 mm).

A supraperiosteal paraskeletal clamp-on bone plate (Mennen plate) was used by Maung Aung et al.16 for fixation in 6 cases of atrophic edentulous jaw fractures. The authors reported that the application of the clamp was relatively atraumatic and that it could be placed with little disruption to the local blood supply. One patient died 36 hours postoperatively from a myocardial infarction; the remaining 5 patients progressed to satisfactory union. The recorded height of the “atrophic” mandibles was not stated in the study.

Discussion

Making a case for more aggressive treatment of atrophic edentulous mandible fractures cannot be supported by prospective, statistically validated, long-term outcome studies. Arguably, the current literature suggests that more invasively treated fractures have a greater likelihood of complications and increased general morbidity. Unfortunately, it is impossible to ascertain how patients who were treated more invasively would have done if left untreated or treated to a dysfunctional endpoint.

It is clearly not the intent to assume a cavalier or indifferent attitude toward the very real anesthetic and invasive surgical risks associated with treating the older trauma victim. Rather, it is to advocate a thought process that encourages the following: 1) development of a treatment plan to repair the atrophic edentulous fracture that is idealized for the fracture type, 2) Use of diligent preoperative medical management of preinjury or associated cardiorespiratory and other serious intercurrent illnesses, 3) consideration of the patients’ needs and wishes, and 4) emphasis on clear explanation of the morbidity and mortality consequences of the treatment options available to patients and their families.

Surgical techniques to repair mandibular fractures have improved considerably in the 25 years since the original Chalmers J. Lyons Academy study.1 There is ample evidence to support the utility of open reduction and rigid fixation for edentulous mandible fractures taken as a group independent of mandibular body height. However, fractures of severely atrophic jaws must be viewed separately. They present challenges to surgical management that are not associated with dentate or edentulous body fractures with favorable heights (>20 mm). Time-tested principles of fracture repair need not be abandoned in the face of complex medical conditions. When open reduction is the procedure of choice, rigid fixation devices should be used that will result in immediate function and long-term resistance to hardware fracture. A titanium mesh crib with a simultaneous iliac crest bone graft is one method of treating the atrophic edentulous mandibular body fracture that should be considered.

Several key questions related to the techniques of edentulous mandible fracture repair and the uniqueness of the surgical environment remain unanswered. For example, intraoral open bone plating was associated with a high frequency of complications in the second Chalmers J. Lyons Academy report.8 Horizontally placed bone plates may invite more frequent complications. Miniplates may also be problematic. Does stripping the periosteum off the mandibular body fracture site unfavorably influence treatment outcome? Has Bradley’s work17 describing a potentially adverse healing environment present in the edentulous mandible disproportionately modified surgical approaches?

When presented as isolated injuries, edentulous mandible fractures do not require immediate treatment. Withholding facial fracture repair should be considered in gravely ill patients or in patients with preinjury or postinjury systemic conditions that are treatable. Delaying the management of an edentulous mandible fracture for several weeks may be a very prudent alternative to compromised treatment. Identifying co-morbid conditions and optimizing the trauma victim’s cardiorespiratory and general systemic health are critical initiatives for reducing morbidity and mortality in the high-risk patient.

Invasive surgical management of the atrophic mandible body fracture should be considered when closed techniques have a high likelihood of malunion/nonunion or resulting in continued oral functional impairment for the patient. Open techniques offer the
added advantage of autogenous bone grafting with minimal increased morbidity. Chronologic age should not be a contraindication to a carefully administered general anesthetic. Trauma victims of any age must be managed comprehensively. Dismissing a more involved surgical treatment plan to treat edentulous mandible fractures on the basis of age or increased risks is less arguable in the new millennium.

References
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