Contemporary Management of Infected Mandibular Fractures

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ABSTRACT

The treatment of infected mandibular fractures has advanced rather dramatically over the past 50 years. Immobilization with maxillomandibular fixation and/or splints, removal of diseased teeth in the fracture line, external fixation, use of antibiotics, debridement, and rigid internal fixation has played a role in management. Perhaps the most important advance was the realization that infected fractures also result from moving fragments and nonvital bone, not just bacteria. Controlling movement and eliminating the dead bone allowed body defenses to also eliminate bacteria. The next logical step in the evolution of treatment was primary bone grafting of the resulting defect following application of rigid internal fixation and debridement of the dead bone. We offer our results with this treatment in 21 infected fractures, 20 of which achieved primary union.

KEYWORDS: Fracture, mandible, infected

Infected mandibular fractures are not an uncommon occurrence in busy centers managing large numbers of mandibular fracture patients. At one end of the spectrum are the young, mobile, and aggressive members of our society who sustain these injuries and often delay seeking care until infective symptoms force attention to the matter. At the other end are the elderly and infirm in whom the injury goes unrecognized but for the infection that ensues. It is not unusual for one to appear in the Emergency Department days or weeks after the assault or incident that caused the fracture with a facial abscess or draining fistula.

Some surgeons deem all mandibular fractures more than 48 hours old to be infected.¹ Our criteria are somewhat more basic. To be considered infected, there must be frank purulent drainage from the fracture site, either intraorally or through an extraoral fistula in chronic cases or an associated facial cellulitis in acute presentations. Most infected fractures are open fractures

and usually related to a tooth in the fracture line. Infected closed fractures are rare indeed.

TRADITIONAL MANAGEMENT

Traditional treatment of infected mandibular fractures called for removal of the involved teeth and immobilization of the fracture with maxillomandibular fixation (MMF), splints, external fixators, or a combination of these devices. Drainage was promoted, antibiotics were provided, and one waited for resolution of the cellulitis, if present, and drainage. Antibiotics were initially considered crucial until it was realized that antibiotics did not eliminate the sources of infection (i.e., infected teeth and dead bone). One only debrided the fracture when radiographic evidence indicated sequestrum formation. It was not unusual for an infected fracture so managed to drain for several weeks. The period of MMF predicted to achieve union (6 to 8 weeks) began only after cessation of

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Table 1 Treatment Details and Outcomes of 21 Infected Mandibular Fractures

Patient Initials	ID#	Patient Demographics				Location of Fracture			Drainage Site		Treatment		Approach		Graft Site		Complications			Outcome	
		Age	Gender	Tx Date	Sym-Para	Ant-Body	Postbody/Angle		Intraoral	Extraoral	Tooth Ext		Intraoral	Extraoral	Hip	Tibia	Wound Breakdown	Graft Loss	Loose Hdw	Non-Union	Union
RH	1	33	M	Nov-90	x				x		x		x		x						x
JR	2	32	M	Aug-92	x				x		x		x		x						x
TG	3	33	M	Aug-93		x				x				x							x
JT	4	42	M	Sep-93			x			x	x			x							x
EL	5	37	M	May-94		x			x					x							x
							x		x					x							x
GM	6	38	M	Sep-94	x				x		x		x			x		x			x
						x			x		x		x			x					x
HH	7	39	M	May-96		x					x										x
EL	8	41	M	Oct-98		x			x					x							x
JM	9	54	M	Feb-99		x			x				x								x
LP	10	86	F	Feb-99	x					x				x							x
DS	11	69	F	Dec-99			x		x					x							x
CD	12	31	F	Apr-00			x		x					x				x			x
JB	13	34	M	May-00	x				x					x							x
MB	14	46	F	Jul-01			x				x			x					x		x
DN	15	75	M	Sep-01		x			x					x							x
PV	16	65	M	Jun-02	x				x					x							x
CH	17	55	M	Dec-02			x		x					x				x			x
LH	18	56	M	May-03			x		x		x			x							x
KM	19	29	F	Sep-03			x		x		x		x								x

Tx, treatment; Sym-Para, symphysis-parasymphysis; Ant, anterior; Ext, extraction; Hdw, hardware, retained internal fixation components.

drainage. Usually the fracture healed with 3 to 4 months of MMF and/or other fixation devices, but occasionally a non-union (as evidenced by eburnated bone ends) ensued. This situation required a bone graft and an additional 2 months of MMF. There were further problems if control of the proximal fragment was an issue. To prevent the proximal fragment from riding up, external fixation was necessary. If teeth were inadequate for stable MMF, splints were used with the attendant morbidity of their retaining wires.

CONCEPTUAL ADVANCES

Over the years, several authors recognized that moving fragments promoted the infection.²⁻⁴ With the advent of rigid internal fixation (RIF) with plates and screws, stable internal fixation of the fragments was possible. A few bold surgeons rigidly fixed these infected fractures and achieved successful outcomes, going against the prevailing principle of never placing hardware in an infected area.⁵⁻⁷ They theorized that RIF would allow resolution of the process by eliminating movement and allowing the body's defenses to eliminate the infection, converting the infected fracture site to a healing one. This treatment proved successful unless there was dead bone or sequestrum in the

fracture site. This had to be resorbed, exfoliated, or surgically removed.

The next advance combined RIF with debridement of the fracture site (creating a defect fracture) and primary bone grafting, an approach noted by several authors.^{3,6,8-12} Benson et al¹³ reported the effectiveness of this approach with outcomes as favorable as those for noninfected mandibular fractures. This shortened the course of treatment and simplified the convalescence by allowing function. Twenty-one infected mandibular fractures in 19 patients (Table 1) were managed with RIF, debridement, and primary bone grafts, with 20 of the 21 achieving union. Both transoral (Fig. 1) and transfacial (Fig. 2) approaches were used in this series. We believe this approach to the management of infected mandibular fractures to be the most effective (and predictable). The course of treatment is dramatically shortened. Convalescent function is allowed, and a favorable outcome is most likely to occur. If it does not work, one has lost only a minor graft, but the RIF device is still in place and the patient is still functional.

TECHNIQUE POINTS

If the infection is acute, an I&D (incision and drainage) is indicated to establish drainage. A stable (although

Figure 1 (A,B) Infected parasymphysis fracture in 42-year-old man sustained 1 month before admission. Note draining fistulas and terminal dentition. (C,D) Treatment with removal of remaining teeth, debridement of fracture, application of reconstruction plate and tibial bone graft. Note chain of tobramycin beads. He healed without incident. This was the first case in which bone grafting in the presence of pus was attempted.

Figure 2 (A,B) A 67-year-old woman with intraorally draining infected fracture resulting from removal of impacted third molar with subsequent "dry socket," chronic infection, and ultimate pathologic fracture sustained 3 weeks prior. (C,D) Application of maxillomandibular fixation (MMF) and transfacial exposure of infected fracture. (E,F) Debridement back to bleeding bone, reduction and application of locking reconstruction plate. (G,H) Defect grafted with particulate marrow harvested from tibia. With MMF released, patient has function through convalescence. (I–K) Final result following removal of both arch bars and locking reconstruction plate.

temporary) MMF is placed and the involved teeth are removed. The fracture is exposed, generally intraorally if in front of the first molar, transfacially if in the posterior body or angle. The fracture is reduced, and a locking reconstruction plate is fixed to the bone with at least three screws on either side of the fracture, well away from the fracture. The fracture site is now debrided and trimmed back to healthy, bleeding bone. Oral wound closure is done if the approach is transfacial. The defect is now grafted with autogenous particulate marrow. Our preferred site is the tibia. Gentamycin powder may be incorporated into the graft or a chain of tobramycin beads placed, although their use is optional as is the use of platelet-rich plasma or fibrin glue. Transfacial wounds are closed over a simple passive rubber drain, which is removed in 24 hours. The MMF is released (and often removed). The patient is allowed convalescent function. Intravenous antibiotics are given intraoperatively and continued postoperatively for 3 days orally.

DISCUSSION

The only patient this treatment was unsuccessful on was immunocompromised. He continued to drain, the graft was lost, the fixation loosened, and had to be replaced. Four patients developed minor wound dehiscence intraorally and lost a few "flakes" of marrow; however, these cases spontaneously granulated over with wound care. A block graft would not incorporate so quickly and would probably be lost. Three patients required removal of the hardware during convalescence due to recurrence of drainage, but, in all cases, the grafts were found to be consolidated with union present.

Modern treatment is designed to simplify convalescence and shorten the course of treatment while providing a favorable outcome. An operative procedure in exchange for convalescent function and a second surgical site to facilitate a shortened course of treatment and more predictable outcome are the potential risks and benefits of this approach. Most patients accept this willingly. Most senior surgeons remember too well the "conservative" alternative treatment with its difficult

convalescence and prolonged course and are happy to recommend what should now be considered contemporary care.

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