The Role of a Conservative Minimal Interventional Management Protocol in the Fractures of the Dentate Portion of the Adult Mandible

Balasubramanian Krishnan, MDS, DNB, MOMSRCPS(Glasgow), FIBOMS¹

¹Department of Dentistry, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Pondicherry, India

Address for correspondence Balasubramanian Krishnan, MDS, DNB, MOMSRCPS(Glasgow), FIBOMS, 74, 4th Cross, Thanthai Periyar Nagar, Pondicherry 605005, India (e-mail: krishident@yahoo.co.uk).

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Abstract

Mandibular fractures are commonly encountered by the maxillofacial surgeon. Maxillomandibular fixation (MMF) and open reduction and internal fixation (ORIF), or a combination of both, are the accepted standard treatments. This study aims to assess the role of a conservative minimal intervention protocol in the management of undisplaced/minimally displaced fractures of the dentate portion of the adult mandible and the complications associated with such minimalistic intervention. Thirty-four patients with undisplaced/minimally displaced fractures of the dentate portion of the adult mandible were advised to restrict mouth opening and limit themselves to a soft diet for a minimum of 4 weeks. All patients were advised follow-up at regular intervals for at least 3 months. Five patients were lost to follow-up. Symphysis and parasymphysis fractures were the most common fracture locations. Fourteen patients needed tension band stabilization with a mandibular arch bar/bridle wiring and three patients required extraction of luxated teeth. All patients showed satisfactory healing except three in whom additional intervention (ORIF) was performed. The improvement in mouth opening was statistically significant. Complications were seen more frequently among smokers and alcoholics. For patients with minimally displaced mandibular fractures, it is necessary to consider if the perceived benefits of intervention justify the associated added costs and possible complications. Patients have to be fully informed about the possible complications while using this minimal intervention protocol. This study concludes that a conservative minimal intervention management protocol for such fractures of the dentate portion of the mandible can produce satisfactory results.

Keywords

- maxillofacial trauma
- mandibular fractures
- maxillomandibular fixation
- open reduction and internal fixation
- conservative
- dentate

Management of facial trauma forms an integral part of the maxillofacial surgeon's practice. Mandibular fractures are a common form of facial injury in adults and account for nearly two-thirds of all maxillofacial traumas with fractures not involving the condylar process accounting for 65 to 75% of all mandibular fractures.¹ Maxillomandibular fixation (MMF) and open reduction and internal fixation (ORIF), or a combi-

nation of both, are the accepted standard treatments for mandibular fractures. The term maxillomandibular fixation or closed reduction has been described, albeit, erroneously, as a "conservative" management protocol of mandibular fractures.² "Nonintervention" is by definition conservative by nature and commonly employed with fractures involving the ramus, coronoid process, unilateral condylar fractures,

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and in several fractures in edentulous patients. However, a majority of clinicians would be averse to consider nonintervention in fractures of the dentate portion of the mandible owing to a perceived increased infection rate with such compound fractures.³ While this interpretation may be acceptable with severely displaced or contaminated fractures, surgical intervention in minimally displaced fractures with normal/near normal occlusion may expose both surgeon and patient to iatrogenic complications. This study aims to assess the role of a conservative minimal interventional management protocol of undisplaced/minimally displaced fractures of the dentate portion of the adult mandible and the complications associated with such minimalistic intervention.

Methods

This study was approved by the Institute Research Board and Ethics Committee (IEC/2011/2/12). All adult patients who reported to the department of dentistry in a public sector, tertiary care hospital and level 1 trauma center, with fractures of the dentate portion of the mandible over a 3-year period (January 2011–January 2014), were assessed for inclusion in the study. The patients selected were those with (1) minimally displaced/nondisplaced fractures confirmed by clinical examination (minimal segmental mobility on palpation) and radiographic evaluation (orthopantomogram showing no overlap of bone fragments and no vertical discrepancy at inferior border) and (2) unchanged occlusion as compared with pretraumatic occlusion. These patients were then presented with the treatment modalities available for their fractures (MMF/ORIF/conservative or minimal intervention). The pros and cons of each modality were explained to both patient and caregiver and the final interventional method was to be decided by them. Those patients who chose the conservative minimal modality over MMF or ORIF were included in the study. A total of 38 patients fulfilled the inclusion criteria out of which 34 consented to the minimal intervention management protocol. Prophylactic antibiotics were not prescribed and only anti-inflammatory medications and chlorhexidine mouth rinse were given to all patients. Erich arch bar/bridle wire fixation in the form of a tension band stabilization was performed in those cases wherein a mild opening of the fracture at the dental portion was seen during mandibular movements. All patients were then advised to restrict mouth opening and limit themselves to a soft diet for a minimum of 4 weeks. Demographic data, mechanism of injury, delay if any in reporting to the hospital, and habits such as smoking and alcoholism were recorded. Follow-up visits were scheduled every 10th day till the 1st month followed by monthly review till the 3rd month. Possible postoperative complications in the management of mandibular fractures as described by the American Association of Oral and Maxillofacial Surgeons were evaluated in the follow-up visits.⁴ These include (1) mobility at fracture site, (2) malocclusion, (3) restriction in mouth opening, (4) infection, (5) neurosensory disturban-

ces, (6) tooth loss or vitality loss, (7) inability to chew hard food, and (8) need for alternative or additional treatment. Any soft tissue infections were treated on an ambulatory basis with incision and drainage, systemic antibiotics, and extraction of teeth if required. Those not showing satisfactory progress were managed with ORIF/MMF as deemed fit. All patients were requested to be subjected to an orthopantomogram at the 6th month for radiographic confirmation of fracture healing. The results were analyzed using the Statistical Package for the Social Sciences (SPSS, Version 19, IBM Corp., Armonk, NY). A *p* value of ≤ 0.5 was considered significant.

Results

Of the 34 patients (male = 33; female = 1) who enrolled for the study, 5 patients failed to follow up for at least 3 months. The mean age of patients was 34.53 years (95% confidence interval [CI]: 31.29–37.77; range, 20–53 years). Road traffic accidents constituted more than 65% of the study group. Patients reported anytime from 1 day to 11 days after the injury (mean: 3.26 days) (►Table 1). Symphysis and parasymphysis were the most commonly involved fracture location (*n* = 24). Twenty-three patients had fractures of the dentate portion of the mandible limited to a single site. Eleven patients also had an associated undisplaced condylar fracture. Multiple fractures of the dentate mandible were not observed in any patient. Fourteen patients needed tension band stabilization with arch bar/bridle wiring, while extraction of luxated teeth was performed in three patients either on initial presentation or during follow-up (►Table 2). Three patients showed a worsening of symptoms and increased mobility at fracture site and needed additional intervention in the form of ORIF using miniplates under general anesthesia. Postoperative period was uneventful in all three cases. All other 26 patients had a satisfactory fracture healing (►Fig. 1c, ►Fig. 1a, b—Patient No. 31 in ►Table 2). Mean mouth opening at the time of presentation was 2 cm (95% CI: 1.77–2.23; range: 0.9–4 cm), which improved to 3.78 cm (95% CI: 3.55–4.02; range: 2.6–5.3 cm) at 12 to 14 weeks follow-up. This improvement in mouth opening was statistically significant (*p* = 0.00; two tailed) (►Fig. 1d). On comparing mouth opening patients with and without associated condylar fractures, no statistically significant difference was seen either at presentation or at 12 to 14 weeks follow-up. With regard to the effect of substance abuse on complications, a statistically significant association

Table 1 Time of initial presentation

Time elapsed from injury to initial presentation	Number of patients
≤4 d	26
5–8 d	5
≥9 d	3

Table 2 Data sheet of patients

Patient no.	Age/sex	Mechanism of injury	Site of fracture	Substance abuse		Neurosensory disturbance	Intervention performed	Complications	Additional intervention	Remarks
				Alcohol	Smoking					
1	45/M	RTA	Lt Bd, Lt Con	+	+	–	Arch bar fixation	Deviation of jaw	Training elastics	–
2	52/M	RTA	Rt PS	+	+	–	–	Lost to follow-up	–	–
3	25/M	Fall	Lt PS	–	–	–	Arch bar fixation	–	–	–
4	32/M	RTA	Rt Bd	+	+	–	–	Acute pulpitis of tooth 44, 45	Pulp extirpation	–
5	43/M	RTA	Sy	+	+	–	–	Lost to follow-up	–	–
6	35/M	RTA	Sy	+	+	Rt facial palsy	Steroids	Lingual abscess of tooth 31, 41	I and D; antibiotics	Rt temporal bone fracture
7	20/M	RTA	Sy Rt Con	+	+	–	Arch bar fixation	–	–	–
8	22/M	RTA	Sy	+	–	–	–	–	–	–
9	35/M	RTA	Sy	+	+	–	Arch bar fixation	–	–	–
10	38/M	RTA	Sy	+	–	–	Arch bar fixation	–	–	–
11	29/M	RTA	Lt Bd	+	–	Lt mental nerve	–	–	–	Improving mental nerve paresthesia
12	29/M	Assault	Rt Bd	+	+	–	Arch bar fixation	Acute pulpitis of tooth 45	Pulp extirpation of tooth 45	Tooth 45 extracted 2 wk later
13	43/M	Fall	Lt PS, Rt Con	+	+	Lt mental nerve	Bridle wire fixation	Infection, mobility of fracture site	ORIF	Improving mental nerve paresthesia
14	38/M	RTA	Lt Ag, Lt Con	+	+	Left inferior alveolar nerve	–	–	–	Improving inferior alveolar nerve paresthesia
15	53/M	Assault	Sy	+	+	–	Extraction of mobile tooth 41, 42	–	–	–
16	31/M	RTA	Sy	–	–	–	Bridle wire fixation	–	–	–
17	45/M	RTA	Lt PS, Rt Con	+	–	Lt mental nerve	Bridle wire fixation	–	–	Improving mental nerve paresthesia
18	40/M	RTA	Lt PS	+	+	–	–	Luxated tooth 32, 33	Extraction of tooth 32, 33	–
19	22/M	RTA	Lt PS, Rt/Lt Con	+	+	–	–	Lost to follow-up	–	–
20	30/M	fall	Lt Ag	+	+	Lt inferior alveolar nerve	–	Lost to follow-up	–	–
21	35/F	Bull injury	Sy, Lt Con	–	–	–	–	Deviation of jaw	Training elastics	–
22	40/M	RTA	Rt PS	–	–	–	–	Infection, increased pain and mobility of fracture site	ORIF	–
23	25/M	Fall	Sy	–	–	–	–	Lost to follow-up	–	–

Table 2 (Continued)

Patient no.	Age/sex	Mechanism of injury	Site of fracture	Substance abuse		Neurosensory disturbance	Intervention performed	Complications	Additional intervention	Remarks
				Alcohol	Smoking					
24	34/M	RTA	Lt PS	+	-	-	Bridle wire fixation	-	-	-
25	50/M	RTA	Rt Bd	+	-	-	-	Pus discharge gingival sulcus tooth 43, 44	Antibiotics	-
26	32/M	RTA	Rt PS	+	-	-	Arch bar fixation	-	-	-
27	48/M	RTA	Rt PS, Lt Con, Lt Cor	-	-	-	-	-	-	-
28	25/M	Assault	Lt PS	+	-	-	Arch bar fixation	-	-	-
29	41/M	RTA	Sy	+	-	-	-	Luxated tooth 31, 32	Extraction of tooth 31, 32	-
30	21/M	Fall	Rt PS, Lt Con	+	-	-	Arch bar fixation	-	-	-
31	25/M	Assault	Lt Ag	-	-	-	-	-	-	-
32	32/M	RTA	Sy, Lt Con	-	-	-	-	-	-	-
33	35/M	Fall	Sy, Lt Con	+	+	-	Arch bar fixation	-	-	-
34	24/M	RTA	Rt Bd	+	-	-	-	Infection, increased pain and mobility of fracture site	ORIF	-

Abbreviations: Ag, angle; Bd, body; Con, condyle; Cor, coronoid; Lt, left; PS, parasymphysis; Rt, right; RTA, road traffic accident; Sy, symphysis.

was seen in both smokers ($p = 0.27$) and alcoholics ($p = 0.41$).

Discussion

Bone is one of the few organs that retain the potential for regeneration in adult life with prefracture properties being restored in most cases. Bone fracture healing is a complex process involving the coordinated action of a large number of factors at the molecular level in conjunction with physiological and biomechanical principles. Primary bone healing is rare, with most fractures proceeding to secondary bone healing. The "Diamond Concept" of bone healing has replaced the traditional "Triangular Concept" with the incorporation of the mechanical environment as a vital component in bone regeneration.⁵ Osteogenic cells that produce growth factors are observed in both bone marrow and periosteum with the potential of periosteal cells for proliferation remaining unaffected by aging.⁶ The interfragmentary strain theory of Perren and Rahn proposes that the strain that causes healthy bone to heal is the upper limit that can be tolerated for the regenerating tissue and that the lack of mechanical stimulation results in tissue atrophy, while unphysiological deformation promotes cell dedifferentiation resulting in nonunion.⁷ Furthermore, mechanical stability is essential for the formation and progressive maturation of a callus that bridges the fracture site allowing loads to be transmitted across the fracture line. This callus formation is dependent on the existence of residual cell vitality, adequate blood flow, and interfragmentary movement.⁸ All interventions aim to improve this mechanical stability across the fracture segments for a satisfactory healing. Certain mandibular fractures heal uneventfully by the stabilization achieved with intercuspsation of teeth by MMF. The use of miniplates and monocortical screws introduced by Champy and Michelet has become the most popular method for the rigid internal fixation of most mandibular fractures. Although it does not produce an absolute elimination of interfragmentary motion as seen with compression osteosynthesis, it provides for a functionally stable fixation. The success seen with the monocortical internal fixation can be attributed to two factors: (1) the minimal exposure needed for the fixation of such plates, thereby preserving the soft tissue envelope integrity and vascularity to the maximal extent possible and (2) micro-motion is permitted across the fracture site allowing for a robust callus formation. Nonintervention of mandibular fractures is based on the hypothesis that intact periosteum with its undisturbed vascularity and cellularity may maintain sufficient stability for the interfragmentary motion not to exceed the level tolerated by bone, thereby permitting ossification.

The ability to determine when a fracture is healed can be a clinical challenge. Axelrad and Einhorn opined that factors such as the minimal physical requirement and function desired of the bone, location of the fracture, and method of treatment influence the decision to confirm bony union.⁹ Even the context in which this determination is being made

matters, as the definition of a healed fracture in a clinical setting is evaluated by ability to bear weight fully on the fracture as opposed to a research setting wherein predetermined radiographic and clinical criteria must be met. The clinical and radiographic features that can be observed during fracture healing reveal little about the biology of the healing process. Studies that have assessed the sensitivity of standard radiographs in the healing of fractures found that the optical density of the callus as determined by radiographs did not correlate with either the tensile or compressive failure of the callus.¹⁰ Computed tomography, though good at confirming union, is too sensitive for routine use and is best recommended in a patient whose fracture healing is not progressing as assessed by the simple tools of standard X-rays and physical examination.¹¹

While satisfactory results have been seen with conservative management of adult condylar, ramus, and coronoid fractures and in a majority of pediatric mandibular fractures, not much scientific literature is available for the conservative management of fractures of dentate portion of the adult mandible.¹² Almost all studies are limited to anecdotal case reports, wherein the conservative protocol was forced upon by either circumstances or patient refusal to undergo treatment.^{13,14} The earliest studies that dealt with conservative management of noncondylar fractures were in the 1960s.^{15,16} In both, MMF was the only other option considered for patients. It is debatable if the same choices would be exercised with the advent of improved hardware and surgical techniques. In a retrospective review of 156 patients with mandibular fractures, conservative intervention in the form of pressure bandage supporting the lower jaw was performed in 77 patients.¹⁷ The author worried that trainee surgeons in their excitement and enthusiasm for a surgical intervention would overlook the limitations of mechanical aids and miss opportunities to assess the place for minimal intervention in the art of fracture management. However, there is no mention of the complications seen with regard to the stability of occlusion, fracture healing, and duration of follow-up. In another study involving 23 patients with mandibular fractures in whom no intervention was performed, spontaneous healing of the fracture was seen in all patients.¹⁸ A critical analysis shows that only seven patients had fractures of the dentate portion of the mandible with a majority having only condylar fractures. Also, some patients had reported 2 to 3 months after injury by which a satisfactory union of fracture had already occurred. Ghazal et al assessed 28 patients with 35 undisplaced fractures of the mandible which were treated by observation and soft diet only and noticed spontaneous healing of all fractures.¹⁹ A closer examination of the earlier-mentioned excellent results reveals that more than 20% of the patients were younger than 16 years and 6 were elderly, patient categories in whom a conservative management protocol is almost always the first line of treatment considered. Back et al observed an uneventful recovery of conservatively managed fractures of the facial skeleton in 230 adult patients.²⁰ However, mandibular fractures constituted only 14% of fractures in their study and included no additional details regarding the site of fracture,

status of dentition, or mouth opening. This study is unique with a prospective analysis of fractures of only the dentate portion of the adult mandible with clearly elicited inclusion criteria and functional outcomes to confirm satisfactory healing and assess complications (►Table 3). Thirteen symphysis/parasymphyseal fractures required intervention in the form of tension band stabilization to counteract the additional torsional forces. All 11 associated condylar fractures were radiographically confirmed as minimally displaced/undisplaced which may explain the absence of a difference in mouth opening either at presentation or at 12 to 14 weeks follow-up. Obviously, the conservative minimal intervention protocol would not be feasible in displaced condylar fractures that may need additional stabilization in the form of MMF or ORIF as indicated.

Clinicians must exercise caution while considering a minimal intervention management protocol for minimally displaced mandibular fractures. The importance of patient compliance in the success of this protocol cannot be overemphasized. Lack of patient compliance has been implicated as one of the most definitive factor predisposing to postsurgical infections following maxillofacial trauma.²¹ A wide range of patient- and clinician-related factors influence the overall compliance. These include the socioeconomic status of the patient, oral hygiene, abusive habits, and forgetfulness. Alcohol consumption is not only important as a contributing etiological factor, but it is also known to be associated with less satisfactory results.²² A similar conclusion can be drawn from this study wherein alcohol was a significant factor in patients with complications even in this specific subset of minimally displaced fractures. Getting contradictory advice from family and friends is another common problem faced in our setting. In this study, 17 patients had reported to this maxillofacial unit after

Fig. 1 (a) Undisplaced fracture of left angle of mandible. (b) Radiographic confirmation of satisfactory union at 6-month follow-up. (c) Flow chart of management protocol and results observed. (d) Mouth opening at initial presentation and at 12–14 weeks follow-up.

Chart 1- Flow chart of management protocol and results obtained

Fig. 1 (Continued)

seeking opinion from other caregivers in a private setting. In almost all instances, these patients had been advised to undergo open reduction and fixation of their fractures under general anesthesia, but could not proceed with the proposed surgery due to economic constraints. Even though these patients appeared relieved to know that no surgery was being considered here, some reported a few days later seeking clarifications to this line of treatment as they had received conflicting information from friends and relatives. To avoid such distress to patients, the informed consent discussion should be conducted with both patient and a family member to allay any apprehensions. In some instances, patients may succumb to misinformation and

decide to seek treatment elsewhere. There is a possibility that the blame for any future complications arising from this intervention sought elsewhere may be laid at the doorstep of the "delay" caused in this unit. Meticulous documentation with clinical and radiographic images will help in rebutting any possible charges of negligence or unsatisfactory treatment. Three of the four patients who did not agree to the treatment protocol of the study felt that no intervention would result in an interpretation of their injuries as "non serious" and would jeopardize their accident insurance claims. They insisted on an intervention despite assurances that any fracture of the facial bone is considered as "grievous" under the law. Clinicians may also

Chart 2- Mouth opening at initial presentation and at 12-14 weeks follow up

Fig. 1 (Continued)

be responsible for poor compliance as a result of communication breakdown, unreasonable management protocols, interpersonal conflict, and an inability to judge individual patient's cooperation level.²³ Marciani et al have opined that the time until initial treatment could be a measure or at least an indication of noncompliance and that a delay in the initial presentation increases the likelihood of poor compliance with the postoperative treatment protocol.²⁴ In this study, out of the eight patients who reported beyond 4 days after injury, four patients failed to follow up and complication was recorded in only one. While complications were seen in 12 patients who reported within 4 days of injury, the association between delay in presentation and complications could not be computed due to loss of follow-up in patients who presented late.

Limitation of resources is a constraint that many trauma units have to keep in consideration during health care decision making. This is all the more important in a publicly funded hospital in a developing country with large case volumes and inadequate manpower that can encourage a surgeon to favor a less resource-intensive intervention. Some workers have shown that no clear overall benefit of ORIF can be demonstrated in the management of displaced mandibular fractures.²⁵ MMF, though least expensive, exposes the surgeon to percutaneous injuries and is not an ideal treatment option in patients in whom compliance is questionable. While MMF for a period of not less than

2 weeks has been recommended for minimally displaced mandibular fractures, it is quite surprising that a non-interventional policy has not been reiterated.²⁶ Furthermore, evidence is available that the severity of the mandibular fracture is a more important factor in the development of complications than the type of treatment used.²⁷ This would mean that minimally displaced fractures are naturally amenable to conservative minimal intervention management and surgical intervention must not be considered as a first option in such fracture patterns.

McKinley opined that a surgical intervention can often hinder or completely disrupt the fracture healing process, and hence, it is the primary responsibility of the surgeon to ascertain whether the potential functional or biological benefits of surgical intervention outweigh the risks of impairing the natural healing process.²⁸ "Primum Non Nocere" should be the guiding principle for patients with minimally displaced mandibular fractures and the surgeon must consider if the perceived benefits of intervention justify the associated added costs and possible complications. A clinical decision to consider a minimal intervention protocol requires sound clinical experience taking into account the nature of the presentation, patient's preferences and choices, and degree of compliance. Patients have to be fully informed about the possible complications before indicating this type of management. This study shows that undisplaced/minimally displaced fractures of the dentate portion of the adult

Table 3 Clinical data of previous studies of conservative management of mandibular fractures

Name of study	Nature	Total number of patients	Total number of adult patients	No. of patients with fractures of dentate portion of mandible	No. of patients with satisfactory healing	Complications
Winstanley ¹⁷	Retrospective	156	156(?) Information not provided	112 (77 patients treated with conservative protocol)	77(?) (Clear information not provided)	a. Permanent paraesthesia of lip—2 (unclear if these patients were managed initially by IMF or conservative protocol) b. Delayed union and infection—5 (unclear if these patients were managed initially by conservative protocol). c. Tooth extraction—15 (unclear if these patients were managed initially by conservative protocol) No clear information provided to ascertain if all complications occurred were limited to fractures of dentate portion of mandible
Guerissi ¹⁸	Prospective/Retrospective	23	23(?) Information not provided	7 (8-pure condyle #; 2-Edentulous #; 5-Ramus #)	22	Malocclusion—3 (treated with mandible exercises and forced intermaxillary occlusion) (unclear if these complications occurred in fractures of dentate portion of mandible)
Chazal et al ¹⁹	Prospective	28	22 (6 Pediatric #)	20 (2 edentulous #)	19	Infection at fracture site—1 (managed with IMF) Minor dental complications—2
Back et al ²⁰	Retrospective	230	230	39. (Information regarding site of mandible fracture and dentate status not provided)	37	Mobility at fracture site—1 (managed with IMF)
Present study	Prospective	34	34	34	26	Infection at fracture site—3 (managed successfully with ORIF) Minor dental complications—6

mandible can be managed satisfactorily with a conservative minimal intervention protocol.

Conflict of Interest

None.

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