Surgical Management of Mandibular Fractures by Different Treatment Modalities

Muhammad Anwar, Zishan Haider

ABSTRACT

Objective — *To evaluate the results of mandibular fractures treated by different techniques.*

Study design — *Cross sectional, observational study.*

Place & Duration of study — *Department of Oral & Maxillofacial Surgery, Nishtar Hospital, Multan and Plastic Surgery Department of Sheikh Zayed Medical College/Hospital Rahim Yar Khan, from July 2007 to June 2010.*

Methodology — *A total 105 cases of mandibular fractures were included in this study. Patients were assigned into three groups according to the type of surgical technique used. Outcome was measured by postoperative variables; duration of intermaxillary fixation (IMF), duration of admission, malunion, nonunion, infection, and facial nerve function.*

Results — *A total of 174 fractures in 105 patients were treated by different surgical techniques. The mean age was 27.3 year with male to female ratio of 6:1. All the three treatment modalities were successful in restoring functional occlusion. Ten patients required readmission and a total of 25 complications were noted. These complications included 05(4.8%) soft tissue infection, 09(8.5%) malocclusion, 04(3.8%) malunion, 05(4.7%) mental nerve dysfunction, and 02(1.9%) cases of facial nerve (mandibular branch) damage. There was no case of non-union or osteomyelitis. Bone healing was satisfactory in 100% of the cases.*

Conclusions — *All the three surgical techniques were successful in restoring functional occlusion. Overall closed reduction plus intermaxillary fixation with 2.7-mm cortical bone screws was the simplest, less invasive, efficient, and cost-effective technique.*

Key words — *Mandible, Fracture, Osteosynthesis, Open Reduction, Internal Fixation.*

INTRODUCTION:

Treatment of mandibular fractures is basic to the treatment of maxillofacial trauma. The mandible is one of the most frequent facial bones to be fractured due to its prominent position and configuration.[1] As mandible plays important role in speech, mastication, and to the form of the lower portion of the face, fractures of this structure must receive careful consideration.[2] Successful treatment of mandibular fractures results in an anatomic bony union with restoration of normal occlusion and function.

In recent years an increased incidence of maxillofacial trauma is observed.[3] The most common causes of mandibular fractures are road traffic accidents, falls, missile injuries, assault and sport accidents.[3-5] A clear understanding of the etiology and extent of all the maxillofacial injuries help in planning how to prevent or to reduce the number and severity of such injuries. This data will also be useful in assessing the current requirements of maxillofacial service in our hospitals and for better future planning to handle the increasing number of patients with maxillofacial trauma.

The fractures of the mandible require early diagnosis, rapid and proper treatment and possible rehabilitation

Correspondence:
Dr. Muhammad Anwar
Burns & Plastic Surgery Department
Sheikh Zayed Medical College/Hospital
Rahim Yar Khan
E-mail: manwarmd@gmail.com

for optimum results.[6] In simplest terms, treatment may be categorized as closed reduction plus intermaxillary fixation (CR + IMF), open reduction with internal fixation (ORIF), or external pin fixation (EPF). ORIF may be accomplished with transosseous wires (TOW) or with bone plates and screws, performed intraorally, extraorally, or percutaneously.[7] In recent years open reduction and internal fixation is the preferred treatment method of mandibular fractures.[8] This prospective study was conducted to analyze the outcome of treatment of mandibular fractures with the aim to restore pre-existing anatomical form, functional occlusion and facial esthetics.

METHODOLOGY:

This cross sectional observational study was conducted at the Oral & Maxillofacial Surgery Department of Nishtar Hospital, Multan and Plastic Surgery Department of Sheikh Zayed Medical College/Hospital, Rahim Yar Khan from July 2007 to June 2010. All the patients with fractures of the mandible treated surgically were included. One hundred and ten patients were managed during the study period of which five had an insufficient postoperative review time (less than 6 weeks) and these were excluded from analysis.

Fractures of the mandible were diagnosed on the basis of history, clinical examination, and radiographs (anteroposterior, lateral, and orthopantogram views). The clinical data of each patient was recorded. Patients were allocated to three groups according to the surgical technique used. Group I (n=35), CR+IMF using 2.7-mm cortical bone crews, arch bars, or Ivy loops. Group II (n=20), Non-rigid osteosynthesis using TOW, K-wire or EPF. Group III (n=50) Rigid/semi-rigid osteosynthesis using bone plates and screws. In postoperative period variables assessed and analyzed were duration of hospital stay and intermaxillary fixation, malunion, infection, nonunion, mental nerve function and facial nerve damage.

Eighty-nine patients (84.8%) were operated under general anesthesia and 16 patients (15.2%) were treated under local or regional anesthesia. In 98.9% of patients general anesthesia was administered through nasotracheal intubation and a nasogastric feeding tube was routinely passed at induction of anesthesia and secured with a silk suture to the membranous nasal septum along with the nasotracheal tube.

Temporary IMF was applied in ORIF cases for aiding occlusion. The fracture site was exposed by an oral approach in 67.2% of cases, by an extra-oral approach in 15.7%, and a combined approach was used in 17.1% of cases. In combined approach fracture sites were exposed intra-orally and small skin incisions were used for percutaneous placement of screws to facilitate fixation of bone plates. Standard techniques of fixation were used to place hardware in group III patients.[9,10] Inter-maxillary fixation was maintained postoperatively for all the groups for various periods of time (0-6 weeks) dependent on the method of osteosynthesis and presence of concomitant non-fixed fractures. Patients were given dietary and oral hygiene advice postoperatively.

Patients were followed up every 1-2 weeks time for a minimum period of 2 months. The period of follow up was extended if there were complications. Postoperative patient variables were assessed clinically. Anteroposterior or OPG radiographs were used only where deemed necessary. Clinical review continued for at least 2 weeks post removal of IMF, at which time screws, arch bars, or Ivy loops were removed. Soft diet was recommended for 2- 4 additional weeks.

The data was analyzed on SPSS. Variables were analyzed using a Chi-square test. The measurement variables were tested with one-way analysis of variance. A 'p' value <0.05 was considered to be significant.

RESULTS:

The results were reported on a total of 105 patients with 174 mandibular fractures, of which 75 were fixed with bone plates and screws, 29 were treated with non-rigid osteosynthesis techniques, and 54 fractures were treated with CR+IMF. Sixteen (9.2%) concomitant undisplaced fractures in group III were not fixed and managed with IMF. These were mainly subcondylar, ramus, and angle fractures.

The mean age of patients was 27.3 year with an

Table I: Etiology of Injury

Etiology	No. of patients	Percentage
RTA	64	60.9
Fall	15	14.3
FAI	08	7.6
Assault	05	4.8
Industrial	08	4.8
Sports	04	3.8
Others	04	3.8

No = Number, RTA = Road Traffic Accident, FAI = Firearm Injury

age range of 4-75 year. Ninety (85.7%) of the 105 patients were males and 15 (14.7%) females. There was an average of 1.6 fractures per mandible. The etiology of mandibular fractures was divided into seven categories (table I). Regarding fracture location, parasymphyseal fractures were most prevalent (29.3%), followed by body (20.1%), angle (16.1%), condylar (11.5%), symphysis (10.4%), ramus (8.6%), and dentoalveolar (4%) fractures. 43.8% of patients had single mandibular fractures, 47.6% had double fractures and the most common site for these were a parasymphyseal fracture with a contralateral angle fracture (16.2%), and 8.6% of the patients had panfacial fractures. Comminuted fractures were seen in 12% of rigid and 10% of the non-rigid groups.

Regarding treatment modalities, out of 75 fractures in the rigid group that were fixed, 33 reconstruction plates, 12 dynamic compression plates, 10 mini-plates, and 20 lag screws were used. In the non-rigid group, out of 29 fractures, 10 were fixed with K-wires, 17 with TOW, and 2 were managed with EPF. In the CR+IMF group, 20 patients were treated with bicortical intermaxillary fixation screws, 10 patients with arch bars, and 5 patients were treated with Ivy loop indirect interdental wiring. Only 25% of the condylar fractures were treated with open reduction and internal fixation. 9.5% of patients were treated within 24 hours after injury, 52.4% of patients were treated within one weak following trauma. In rest of the patients the treatment delay was more than 1 week.

Comparison of postoperative variables is given in table II. Analysis of treatment outcome showed that in 90% of patients, functional occlusion was restored. In group III malocclusion was seen in 4 (8%) of the patients in comparison to 2 (10%) in group II, and 3 (8.6%) in the group I. There was no significant difference between the three groups (p = 0.24). Five patients (4.7%) required corrective occlusal adjustments with rubber elastic bands, the remainder resolved at later review.

Infection was seen in 4.8% of patients occurring 1-6 weeks following operation. It was mainly soft tissue infection, manifested by abscess formation or discharging sinus. Only 1 case of infection (2.8%) was recorded in group I, 2 (10%) in the group II, and 2 (4%) in group III. The difference was significant statistically (p=0.012). In group II one patient required removal of wires. Rest of the cases was treated conservatively.

Malunion occurred in 2 patients (5.7%) in group I, 1 (5%) in group II, and 1 (2%) in group III. These 4 patients had multiple fractures and undisplaced fractures were treated conservatively. Only 1 patient in group III was re-operated for malunion. No case of non-union was recorded. There was satisfactory bone healing in 100% of cases. This difference of malunion was not significant statistically (p=0.26).

Mental nerve function was routinely assessed in the follow-up period. Five patients (4.7%) had persistent mental nerve paresthesia, 1 (5%) in group II, 4 (8%) in group III, and none of the patients in group I. A significantly higher incidence (8%) of iatrogenic nerve damage occurred in group III (p = 0.007). Weakness of the marginal mandibular branch of the facial (VII) nerve was significantly higher (4%) in group III (p = 0.0001). It was usually associated with an extra-oral approach.

IMF was used in 58% of patients of group III, and 80% of group II. In group III this was necessary for concomitant non-fixed fractures, or when fracture was treated with semi-rigid fixation technique. 85.7%

Table II: Comparison of Postoperative Variables Among Three Groups

	CR+IMF n = 35	Non-rigid Osteosynthesis n = 20	Rigid Osteosynthesis n = 50	Total (n=105)	%
Infection	1 (2.8%)	2 (10%)	2 (4%)	05	4.8
Malocclusion	3 (8.6%)	2 (10%)	4 (8%)	09	8.6
Malunion	2 (5.7%)	1 (5%)	1 (2%)	04	3.8
Mental Nerve Dysfunction	0	1 (5%)	4 (8%)	05	4.7
VII N Damage	0	0	2 (4%)	02	1.9
IMF>4wks	30 (85.7%)	15 (75%)	20 (40%)	65	61.9
Inpatient >3 days	14 (40%)	18 (90%)	44 (88%)	76	72.4

CR = Closed Reduction, IMF = Intermaxillary Fixation, VII N= Facial Nerve

of patients of group I had 4 weeks or more IMF as compared to group II (75%), and group III (40%). The duration of IMF was significantly shorter for group III (p = 0.002). Hospital stay was over 3 days in 40% of group I, 90% of group II, and 88% in group III. Duration of admission was significantly shorter (p = 0.001) for group I. Ten patients (9.5%) required re-admission, 8 for fixation removal, 1 for malunion, and 1 patient was admitted for soft tissue infection. Overall the complication rate was low in group I.

DISCUSSION:

In the management of facial fractures the aim is to return the patient to his normal function and appearance as early as possible. There are many ways to implement the principles of reduction and fixation.[11] Most of the fractures can be treated adequately by CR + IMF, but in our experience as of others, superior results have been achieved in more serious injuries by open reduction and internal fixation.[12]

IMF utilizing intraoral cortical bone screws is the preferred method over arch bar and Ivy loop techniques.[13,14] Recently the trend is towards open reduction and rigid/semi-rigid internal fixation (RIF).[15] The advantages of the RIF include early mobilization and restoration of jaw function, airway control, improved nutrition and speech, better oral hygiene and an earlier return to the workplace.

The reported rate of infection of mandibular fracture treated with conventional methods is between 4.4 and 17%. We recorded 10% infection rate with wire osteosynthesis compared with 2.8% with IMF and 4% with bone plates. In our study the rate of malocclusion with CR + IMF is 8.6%. This is not significant statistically between the three groups. However, the rate of infection (10%) was significantly higher in the group II. Predisposing factor for infection in this group is the comminuted and contaminated fractures treated with TOW and K-wires with increased mobility at fracture site. Rahim et al reported an infection rate of 5.0%, and malocclusion of 5.0% with IMF.[16] The higher malocclusion rate in our study may be due to the fact that we treated multiple significantly displaced fractures with IMF in patients with poor socioeconomic status.

In our study the rate of infection, and of other complications of RIF, are comparable with other national and international studies except numbness of the inferior alveolar nerve, which is higher (8%) than other studies.

CONCLUSIONS:

All the three surgical techniques were successful in restoring functional occlusion. Rigid internal fixation with lag screws was reliable, efficient, and cost-effective technique for anterior mandibular fractures. Overall CR+IMF with 2.7-mm cortical bone screws was the simplest, less invasive, efficient and cost-effective technique in treating most of the mandibular fractures.

REFERENCES:

1. Adeyemo WL, Iwegbu IO, Bello SA, Okoturo E, Olaitan AA, Ladeinde AL, et al. Management of mandibular fractures in a developing country: a review of 314 cases from two urban centers in Nigeria. World J Surg. 2008;32:2631-5.
2. Khan SU, Khan M, Khan AA, Murtaza B, Maqsood A, Ibrahim W, et al. Etiology and pattern of maxillofacial injuries in the Armed Forces of Pakistan. J Coll Physicians Surg Pak. 2007;17:94-7.
3. Cheema SA, Amin F. Incidence and causes of maxillofacial skeletal injuries at Mayo Hospital in Lahore, Pakistan. Br J Oral Maxillofac Surg.2006;44:232-4.
4. Muñante-Cárdenas JL, Olate S, Asprino L, de Albergaria Barbosa JR, de Moraes M, Moreira RW. Pattern and treatment of facial trauma in pediatric and adolescent patients. J Craniofac Surg. 2011;22:1251-5.
5. Gandhi S, Ranganathan LK, Solanki M, Mathew GC, Singh I, Bither S. Pattern of maxillofacial fractures at a tertiary hospital in northern India: a 4-year retrospective study of 718 patients. Dent Traumatol. 2011;27:257-62.
6. Saluja H, Kini Y, Mahindra U, Kharkar V, Rudagi BM, Dehane V. A comparative evaluation of different treatment modalities for parasymphysis fractures: a pilot study. Int J Oral Maxillofac Surg. 2012;41:906-11.
7. Ellis E 3rd. A prospective study of 3 treatment methods for isolated fractures of the mandibular angle. J Oral Maxillofac Surg. 2010;68:2743-54.
8. Andreasen JO, Storgård Jensen S, Kofod T Schwartz O, Hillerup S. Open or closed

repositioning of mandibular fractures: is there a difference in healing outcome? A systematic review. Dent Traumatol. 2008;24:17-21.

9. Spiessl B. New concepts in maxillofacial bone surgery. Berlin, Germany: Springer-Verlag 1976.

10. Spiessl B. Internal fixation of the mandible: A manual of AO/ASIF principles. Berlin, Germany: Springer-Verlag 1989.

11. Kumar S, Prabhakar V, Rao K, Brar R. A comparative review of treatment of 80 mandibular angle fracture fixation with miniplates using three different techniques. Indian J Otolaryngol Head Neck Surg. 2011; 63:190-2.

12. Parmar BS, Shailesh M, Raghani, Manish, Toral K. Three dimensional miniplate rigid fixation in fracture mandible. J Maxillofac Oral Surg. 2007;6:14-6.

13. Karlis V, Glickman R. An alternative to Arch-bar maxillomandibular fixation. Plast Reconstr Surg. 1996;99:1758-9.

14. Ghazali N, Benlidayi ME, Abizadeh N, Bentley RP. Leonard buttons: a reliable method of intraoperative intermaxillary fixation in bilateral mandibular fractures. J Oral Maxillofac Surg. 2012;70:1131-8.

15. Kalfarentzos EF, Desponia D, Georgios M, Tyllianakis M. Biomechanical evaluation of plating technique for fixing mandibular angle fracture: The introduction of a new 3 D plate approach. J Oral Maxillofac Surg. 2009;13:139-44.

16. Rahim A, Warraich RA. Mandibular fracture osteosynthesis: A comparison of three techniques. Pakistan Oral Dent J. 2009;29:201-6.