

OPTIMAL AND EFFICIENT MANAGEMENT OF MANDIBULAR FRACTURES

¹PAREESA RAHMAN²ADNAN ASLAM³MOHAMMAD YUNUS⁴UZAIR LUQMAN⁵MUHAMMAD MUDASSAR SALEEM⁶JEHANZEB MUGHAL⁷SYED ADNAN ALI SHAH

ABSTRACT

The aim of the study was to find out whether eliminating intraoperative intermaxillary fixation from the management of mandibular fractures has any bearing on treatment outcomes.

A retrospective study was carried out on 53 mandibular fractures treated at Margalla Institute of Health Sciences and its affiliated hospitals from June 2010 to December 2014. Successful bone healing, occlusion and complications were assessed in mandibular fractures treated with open reduction and internal fixation and without the use of intraoperative intermaxillary fixation.

Minor wound dehiscence was seen in 7 patients. 3 patients required hardware removal due to subsequent hardware failure; however no case of nonunion was seen. Clinically significant malocclusion (Moderate: Grade 2) was seen in only one patient after 3 months.

There were negligible and comparable number of postoperative complications. It was concluded 'hand holding' of the mandibular fractures as an alternative to the more traditional IMF/MMF through various means, a reliable and predictable way of fixation of mandibular fractures.

Key Words: *Maxillofacial trauma, mandibular fractures, open reduction, internal fixation, intermaxillary fixation.*

INTRODUCTION

Mandibular fractures are the commonest fractures encountered in maxillofacial trauma after nasal frac-

tures.¹ They may occur as the result of falls, road traffic accidents, interpersonal violence and even due to iatrogenic causes like during or after a tooth extraction.^{2,3}

The history of mandibular fracture management is as old as the history of mankind with writings appearing as early as 1650 BC, when an Egyptian (Edwin Smith) papyrus described the examination, diagnosis, and treatment of mandibular fractures.^{4,5} Hippocrates described bandaging fractures as a means of stabilization. Over the next few centuries, the management of mandibular fractures evolved from a closed approach to a more direct, open approach with experience from orthopedic surgery coming into use relying on direct, anatomical reduction and fixation of these fractures.⁶ It is reported that Guglielimo Salicetti in 1275 managed mandibular fractures by tying the teeth of the uninjured jaw to the teeth of the injured jaw.⁷ Schede in as early as 1888 introduced open reduction and placement of a steel plate with 4 screws as a means of treatment.⁸ In recent times, the most landmark change in management of mandibular fractures was a shift from large, heavy, rigid, compression plates from orthopedic experience to

¹ Pareesa Rahman, BDS, FCPS, FFD RCSI, Assistant Professor & Head, Dept of Oral & Maxillofacial Surgery, Dental Section; Frontier Medical College, Abbottabad

² Adnan, Aslam, BDS, FCPS, FFD RCSI, Assistant Professor & Head, Dept of Oral & Maxillofacial Surgery, Margalla Institute of Health Sciences, Rawalpindi

³ Mohammad Yunus, BDS, MDS. Principal, Margalla Institute of Health Sciences, Rawalpindi

⁴ Uzair Luqman, BDS, FCPS, FFD RCSI. Consultant Oral & Maxillofacial Surgeon, KRL General Hospital, Islamabad,

⁵ Muhammad Mudassar Saleem, BDS, FCPS. Assistant Professor, Dept of OMFS, Islamabad Medical & Dental College, Islamabad

⁶ Jehanzeb Mughal, BDS, AEGD, MFDS, MSc. Consultant Cranio-Maxillofacial Surgeon, Karachi

⁷ Syed Adnan Ali Shah, BDS, MDS, FRACDS, FDS RCS, FFD RCSI, FCPS (Hon). Professor & Chairman; Division of OMFS, Head; Department of Dental Diagnostic & Surgical Sciences, Faculty of Dentistry, University of Manitoba, Winnipeg, Canada

For correspondence: Dr Adnan Aslam, Assistant Professor & Head, Dept of Oral & Maxillofacial Surgery, Margalla Institute of Health Sciences, Quaid-e-Azam Avenue, Rawalpindi
Email: docadnanaslam@hotmail.com

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smaller, softer and hence more malleable, and easier to use plates especially made for use in the maxillofacial skeleton. In the 1970s, Michelet and Champy developed the method of using small, bendable non-compression plates along the support structure of the mandible as a semirigid means of fixation, and together they showed that if these plates were applied correctly utilizing an anatomical concept according to the bands of tension and compression on the mandible, the fixation would be adequate.⁹

Mandibular fracture management aims to restore aesthetics and function. With occlusion forming one of the most important functional attributes of jaws, intermaxillary/maxillomandibular fixation (IMF/MMF) achieves these goals since it restores facial contouring and masticatory function.¹⁰ IMF/MMF is regarded as a crucial step in the management of maxillofacial trauma since it secures the interrelationship of the occlusal surfaces, banking on the concept that this would automatically align the jaws with each other.¹¹ However, while it is a common finding that patients whose fractures are treated through a closed approach and immobilized with IMF alone have a functional occlusion postoperatively, the same cannot be said about an anatomical reduction of the fractured bony ends. This prolongs bone healing time, and interferes with the ideal of early return to function, in addition to facial contour deformities.¹² Despite the widespread use of internal fixation, most surgeons still rely on IMF to aid in the intraoperative reduction of the fracture site or sites before fixation with bone plate(s) and screws.¹³

IMF is traditionally done with wires and with the rising problems associated with excessive wire use, the question arose that if IMF did not often achieve anatomical reduction, was its intraoperative use necessary at all, because fracture reduction can be achieved by other more accurate means which would also result in restoration of normal occlusion. This is possible through a technique which requires the help from a skilled assistant who 'hand-holds' the jaws into occlusion, while the fractured bones are aligned and plates and screws are applied. Obviating the use of IMF would markedly reduce the operating time, hospital stay, morbidity along with other benefits, with a comparable treatment outcome.¹²

This study was conducted to establish the fact that most linear mandibular fractures with deranged occlusion can be treated by ORIF alone using 'hand held technique' to achieve occlusion, without the need for intraoperative IMF. This has a beneficial impact not only in terms of the operating time of the patient which is significantly reduced by one hour, allowing the patient to be treated as a day care case but also reducing the risk of wire stick injuries to the surgeon and nursing staff. A retrospective audit was done to evaluate whether mandibular fractures treated through

this method had acceptable number of complications with a comparable treatment outcome.

METHODOLOGY

The study was conducted in the Department of Oral and Maxillofacial Surgery, Margalla Institute of Health Sciences and its affiliated hospital, Margalla General Hospital. Margalla Institute of Health Sciences is a dental teaching institution, imparting undergraduate and postgraduate education in Rawalpindi, Pakistan. The Department of Oral & Maxillofacial Surgery practices the full scope of Oral & Maxillofacial Surgery, including maxillofacial trauma, oral pathology/oncology, facial deformity, TMJ disorders and dentoalveolar surgery including implantology. The department treats more than 4000 patients through its outpatient clinic and inpatient services.

A descriptive case series was done on a total of 53 cases of isolated mandibular fractures which underwent open reduction with internal fixation using hand held technique from June 2010 to December 2014 were selected for the study.

In all cases, thorough preoperative evaluation was done and the patients were treated as day care cases or with overall hospital stays less than 24 hours. Orthopantomogram (OPG) and Postero anterior (PA) view of face were the radiographic investigation of choice for all patients.

The successful outcome measures were described as successful bone healing and acceptable occlusion. All patients were assessed postoperatively for minor and major complications like post operative plate infections, wound dehiscence, osteomyelitis, pain, malocclusion, malunion, lingual splaying and the need for second operation.

Malocclusion was assessed using a grading system of mild (requiring no intervention), moderate (requiring a brief period of MMF) and severe (requiring correction surgery). Post operative pain was measured by the visual analog scale of 1-10. Post operative wound infection was observed at 2, 4 and 6 weeks interval. The follow ups of the patient were done for three months to rule out malunion based on combined clinical and radiographical analysis.

The inclusion criteria were:

- All patients in ASA-1 and ASA-2 categories with fractures confined to mandible.
- All mandibular fractures presented to the oral and maxillofacial surgery service within one week of injury.

The exclusion criteria were:

- Fractures involving mandibular condyle

- Concomitant dento alveolar and/or midface fractures.

After an informed consent, preoperative extra oral and intra oral pictures were done with photographic recording of occlusion. The surgical procedure was done under aseptic conditions under general endotracheal anesthesia (GETA) using nasotracheal intubation.

With prophylactic antibiotics and Dexamethasone, after infiltration with 2% lignocaine containing 1:100,000 epinephrine and waiting for an average of ten minutes, the fracture sites were exposed using intra oral transmucosal approach, except in those cases in which a pre existing skin laceration was utilized. In 6 cases, the angle region was exposed through a Risdon incision after a clinical need was felt to have a more wide exposure, with possibility of fixation of more than one plate. Molt No. 9 or Howarth periosteal elevators were used to do a clean periosteal stripping.

A bridle wire was passed around the teeth adjacent to the fracture line but not tightened. Drill holes were drilled using a round bur on a straight hand piece at a suitable distance from the fracture line, and bone reduction clamps were applied to aid reduction, while the jaws were hand held into occlusion by the assisting surgeon, and the bridle wire was tightened. Titanium mini plates and screws in length of 6 and 8 mm were applied across the fracture sites, adhering to Champy's lines. After fixation of the fracture, occlusion was checked again, with gentle closing of the jaws. The wounds were then irrigated with normal saline. The

intraoral incisions were closed with 3-0 Polyglactin 910 sutures and extraoral incisions were closed in layers with 3-0 Polyglactin 910 sutures and 6-0 Polypropylene. None of the patients were placed on postoperative IMF.

All the patients were discharged within 8-12 hours of the procedure, with antibiotics, analgesics and strict instructions on use of fluid diet, till notified further and oral hygiene instructions. Follow up period was for a maximum of 3 months with reviews done at 1 week, 2 weeks, 4 weeks, 8 weeks and 12 weeks. Postoperative radiographs were obtained before discharge.

RESULTS

A total of 53 patients with linear mandibular fractures were treated with ORIF with miniplates, using hand held technique of achieving occlusion. Forty-six of the 53 patients were male. The mean age was 31.73 years (SD +/- 9.67). Average time of operation after injury was 5 days. Patients were examined at follow up visits at 1, 2, 4, 8 and 12 weeks. Malocclusion was classified according to the grades used by Zhang et al. (Zhang J et al. Maxillofacial injury severity score: Proposal of a new scoring system. Int J Oral Maxillofac Surg 2006; 35: 109-14) Mild malocclusion (Grade 1) was seen in 3 patients at one week, and moderate malocclusion (Grade 2) in one patient at one week. Intermaxillary elastics for two weeks were given, which reduced the number of malocclusion (Grade 2) to only one patient at 12 weeks. This patient was referred to the orthodontic department, but did not pursue treatment there.

Wound dehiscence was seen in 07 patients, which was managed conservatively using Chlorhexidine rinses intra orally and anti bacterial cream for skin and daily dressings. Three patients (53) required plate removal due to infection.

None of the patients were seen to have clinically significant malunion requiring surgical correction between the fractured ends and no case of osteomyelitis was seen.

DISCUSSION

Mandible is a unique bone with hinge joints at both ends, elevator muscles of the jaws attached to the ramus and suprahyoid, depressor muscles attached to the body, therefore, attention to detail must be paid to avoid displacement of bone ends and subsequent malocclusion during treatment. The primary goal of fracture management is "healing of the fractured bone resulting in restoration of form and function".¹⁰ Though there is universal agreement as to treatment goals, a plethora of currently accepted treatment modalities indicate a lack of consensus.¹⁴

Maxillo mandibular fixation (MMF) has been used as the most common and useful method used for immobilization of mandibular fractures. Most uncomplicated

TABLE 1: FREQUENCY OF GENDER DISTRIBUTION IN TREATED MANDIBULAR FRACTURES

		Frequency	Percentage
Gender	Male	46	87%
	Female	7	13%

TABLE 2: FREQUENCY OF COMPLICATIONS ENCOUNTERED IN HAND HELD TECHNIQUE USED IN ORIF OF MANDIBULAR FRACTURE

Total No. of patients	Complications	Frequency	Percentage
53	1. Malocclusion	04	7.5%
	2. Wound Dehiscence	07	13%
	3. Plate Infection	03	5.7%
	4. Malunion	0	0
	5. Osteomyelitis	0	0



Fig 1: Case example 1: Pre op PA view face showing displaced fracture of the right sided mandibular body

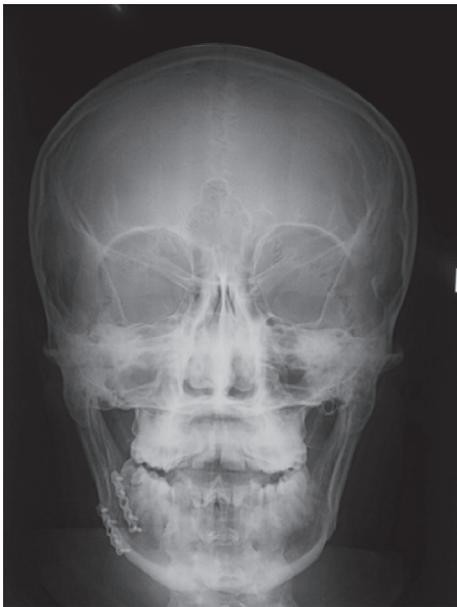


Fig 2: Case example 1: Post op PA view face showing adequate reduction of the fracture through application of two mini plates

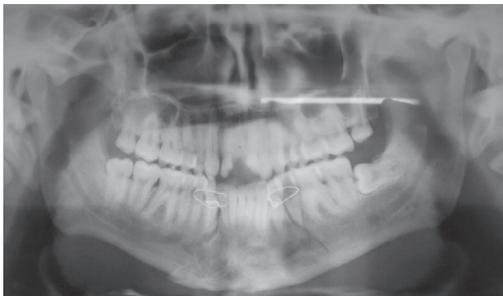


Fig 3: Case example 2: Pre op OPG showing bilateral parasymphiseal fractures of mandible temporarily stabilized with bridle wires



Fig 4: Case example 2: Post op OPG showing adequate reduction of bilateral parasymphiseal fractures with application of upper and lower border mini plates. Bur holes for application of reduction forceps can be noticed



Fig 5: Case example 3: Pre op OPG showing grossly displaced fractures of the left body and right angle regions of the mandible

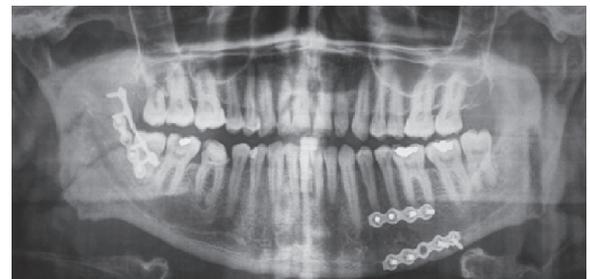


Fig 6: Case example 3: Post op OPG showing adequate reduction and fixation of bilateral mandibular fractures

fractures can be dealt with MMF for a period of 4-6 weeks depending upon each clinical situation. It is the most cost effective of all the treatment modalities but has its limitations and drawbacks as well. Patient's systemic health like epilepsy, psychiatric issues, pulmonary obstructive disease limits the use of MMF. There is also a possibility of failure to control the airway, in case of vomiting, in a patient who is not fully conscious and is in MMF.¹⁵

Pulmonary atelectasis is the most important cause of postoperative fever in the first 24 hours. There is postulated to be an increased risk of atelectasis in MMF patients due to closure of the oral airway and postnasotracheal intubation diminution of the nasal

airway. Obstruction of the airway and accumulation of secretions may facilitate the occurrence of atelectasis; both problems likely to occur in patients treated with MMF. Patients older than 60 years are known to be at a greater risk for developing atelectasis. A study was sought to evaluate the incidence of postoperative atelectasis in which O’Ryan looked at two groups of patients; one group treated with maxillomandibular fixation (MMF) and the other group treated without MMF finding a higher incidence of atelectasis in the former group.^{16,17}

During the 20th century, a number of critical innovations resulted in the improved management of mandibular fractures. The first was the introduction of penicillin during the World War II, which encouraged the open reduction of fractured mandibles and hence improvement in the accuracy of fracture alignment. The second innovation was the introduction of miniaturized bone plates and screws in the 1960s and 1970s, which permitted the rigid internal fixation of fracture sites and hence the abolition of postoperative intermaxillary wire fixation (IMF).¹³ Champy and Lodde in the early 1970s applied this ‘tension band principle’ (also referred to as Champy’s principle) to the mandible.¹⁸ This is accomplished by placement of a plate along the so-called ideal line of osteosynthesis, thereby counteracting distraction forces that occur along the fracture line by the supra hyoid group of muscles during mandibular function.

Beyond a more precise reduction of the fractured bone, the perceived advantages of ORIF organize themselves along two common themes “predictable healing and better patient acceptance”. The early return to function is believed to promote the patient’s oral health and minimizes any masticatory disability resulting from prolonged immobilization of the jaws (Ellis & Carlson, 1992).¹⁵

Most surgeons rely on the use of intraoperative MMF as an adjunct procedure while performing ORIF, to ensure stable occlusion postoperatively. A technique (initially used in pediatric population) of internal fixation after free hand occlusal and bone reduction without MMF, emphasizes on bone reduction under direct vision while eliminating the time and difficulty of applying MMF to an unstable dentition.¹⁹ Fracture reduction by hand without use of MMF has several added benefits.

Cost cutting in terms of reducing operating time by at least an hour and less use of anesthetic agents and operation theatre resources. This allows most patients with mandibular fractures to be treated as day care surgeries. Day care surgery means having less anesthesia complications. The placement of intraoperative MMF and arch bars has a negative impact on operating time, significantly increasing it by about 40 minutes. This has a directly proportional effect on the amount of anesthetic agents used, which in turn doubles the

number of postoperative systemic complications.¹² In all our treated patients, we saved at least one hour, thus allowing us to focus our energies on accurate anatomical and functional reduction of fractured segments as well as cutting back on anesthetic gases. In summation it lead to a substantial cost reduction, thus mutually benefitting the hospital and the patient.

A study has demonstrated that mandibular fractures that were ‘hand-held’, while bone-plated, had a lower mean number of outer glove perforations than fractures treated with temporary intermaxillary fixation (0.43 compared with 4.62, $P < 0.0001$).²⁰ With the use of MMF, the risk of wire stick injuries and disease transmission is heightened. MMF poses a continuous threat of disease transmission between patient and staff. The incidence of surgical glove perforation during the treatment of some maxillofacial fractures may be as high as 50%, with over 80% going unnoticed at the time of operation. Avery and Taylor carried out an open and randomized study of surgical management of mandibular fractures and 1061 gloves used for 113 patients were examined. The perforation rate varied with the type of fracture and treatment.^{13,20} We observed at least one glove perforation per surgeon in every case where intermaxillary fixation with wiring was done. When using the hand held technique, the rate of glove perforation was significantly reduced to only three times in the 53 patients treated and that too was during the placement of intraoperative bridle wires to stabilize segments.

Pediatric mandibular fractures pose a significant problem to the treating surgeon in placing MMF. These fractures are different from adult fractures as they are complicated by the presence of mixed dentition, loose exfoliating teeth, short roots, and growth concerns. All these issues will create problems while placing the teeth in MMF. Post operatively MMF requires a lot of patient cooperation which in case of pediatric patients is difficult to achieve. In addition, at the time of MMF removal sedation may be required again.¹⁹

Hand held technique accelerates oral hygiene maintenance by at least a period of 2 weeks. Overall patient is more comfortable, with less psychological and social dilemmas with early return to workplace. The use of wire damages the periodontium of the teeth increasing the chances of development of periodontal pocket, increased tooth mobility, extrusion of teeth and creating marginal defects such as external root resorption. However, a study of 392 teeth of 20 consecutive patients treated for jaw fractures with interdental wiring was followed which supports findings that wiring of teeth to splint jaw fractures causes no permanent changes in the tissues surrounding the teeth. The changes seen in the periodontium are temporary and disappear completely once the trauma of the fixation material to the marginal area of the tooth is removed.

Adjacent non-wired teeth were used as controls, and they gave an indication of the general periodontal state of the patient.²¹ It was observed in our study that during the follow-ups, hygiene was maintained by majority of patients. There was very little gingivitis, though wound dehiscence was seen in 07 (13%) patients but they were all in transmucosal incisions and not in gingival incision lines.

However, obviating the use of IMF during fixation of mandibular fractures has its inherent caveats. A skilled assistant (qualified surgeon or senior trainee with prior experience as second assistant) is a definite must, and this saves operating time to a great extent. However, a modified bone reduction clamp customized from towel clips, greatly facilitates application of fixation plates and screws. This also greatly reduces the risk of 'lingual splaying' by aiding in a very precise anatomical reduction, which is a risk with manually holding the jaws into occlusion. 'Hand holding' the aligned jaw also means a firm holding of the fracture, and hence general anaesthesia is a necessity. Another shortcoming of not using IMF/MMF for fixation of mandibular fracture is that 'hand holding' technique cannot be used where there are concomitant condylar or midface fractures with certainty. In cases where the condyles are treated closed, this invariably means a period of intermaxillary guiding elastics, and hence arch bars or a similar mechanism for elastic guidance is needed. We have used the technique in a couple of isolated Le Fort I maxillary fractures with success, but caution must be exercised when using this technique in fractures involving more bones or where there is comminution. Comminuted mandibular fractures where application of a reconstruction plate is warranted, also preferably should receive IMF/MMF to allow a precise adaptation of the bulkier and harder reconstruction plate, so as not to displace fracture segments.

While ideally, the results of such a study can be best validated by enrolling patients in the 'gold standard' of randomized clinical control trial and dividing patients with and without intraoperative intermaxillary fixation in the two groups, the ethical aspect for such a study would be difficult to justify. Since we believe that patients with specific (linear) mandibular fractures without intraoperative IMF tend to fare as well as those who receive intraoperative IMF in our hands, we would not subject a control group of patients to unnecessary use of intraoperative IMF.

CONCLUSION

With a negligible and comparable number of postoperative complications, it was concluded that 'hand holding' of the mandibular fractures as an alternative to the more traditional IMF/MMF through various means, was a reliable and predictable way of fixation of mandibular fractures.

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