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Research Article

Relevance of Manual Reduction and it's Applicability in Surgical Management of Mandibular Fractures: An Institutional Study

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Abstract

The purpose of this study was to prospectively compare the technique of manual reduction to intermaxillary fixation (IMF) in surgical management of mandibular fractures and to understand its relevance and applicability in the present day and age. The present study was undertaken in 20 patients with mandibular fractures reporting to the department of Oral and Maxillofacial Surgery, Sri Guru Ram Das Institute of Dental Sciences and Research, Sri Amritsar. Patients with unilateral or bilateral mandibular fractures (not involving condyle) requiring open reduction and internal fixation were included in the study. In group A, the average time taken for open reduction and internal fixation was 59.1 ± 16.36 minutes as compared to 83.1 ± 13.54 minutes for IMF group. The mean postoperative radiographic score at 2nd day, 7th day, 6th week and 3rd month in group A (Manual reduction) was 2.6 as compared to 2.5 in IMF group. There was 3 instances of blood after glove perforation in IMF group as compared to none in manual reduction group. Manual reduction during open reduction and internal fixation can be definitely recommended in cases of isolated unilateral or bilateral mandibular fractures provided a skilled and experienced assistant is present during the surgical procedure, providing an excellent and safer alternative to the more invasive IMF.

Keywords: *Mandibular Fracture; Manual Reduction; Inter-Maxillary Fixation; Open Reduction and Internal Fixation*

Introduction

Amongst all the fractures, those of the jaw form the majority of craniofacial trauma recorded, with the incidence of mandibular fractures being twice as common as mid face fractures [1]. Treatment of mandibular fractures in the present era comprises of fracture reduction and restoration of functional dental occlusion followed by placement of internal fixation (most commonly with miniplates) in accordance with the principles described by Michelet., *et al*. and Champy., *et al*. The two most commonly used methods for reduction are [2]:

- Manual reduction, whereby the fractures are reduced by hand and occlusion restored with subsequent placement of internal fixation.
- Intermaxillary fixation (IMF) whereby the dental arches are secured to each other and locked in position, usually with wires, placement of internal fixation on the fracture.

The primary hypothesis of the study was that manual reduction has a shorter operative duration than IMF in case of mandibular fractures. The secondary hypothesis was that manual reduction and IMF provide equivalent outcomes in these patients with regard to complications during surgery, clinical and radiographic outcomes (secondary outcomes), and operator/assistant injury. Thus, the present study was undertaken to understand the relevance and applicability of manual reduction in the surgical management of mandibular fractures.

Material and Methods

The present study was undertaken in 20 patients with mandibular fractures reporting to the Department of Oral and Maxillofacial Surgery, Sri Guru Ram Das Institute of Dental Sciences and Research, Sri Amritsar. Patients were alternatingly allotted to one of the two groups to ensure randomization. Informed consent for the procedure was obtained from all the patients enrolled for the study. The inclusion criteria were as follows:

- Patients with unilateral or bilateral mandibular fractures requiring open reduction and internal fixation were included in the study.
- Patients with adequate number of opposing maxillary and mandibular teeth with normal interproximal contacts to assess occlusion.

The exclusion criteria were as follows:

- Patients with condylar fractures.
- Patients with concomitant midface fractures affecting the occlusion.
- Patients with grossly comminuted mandibular fractures.

The pre-operative assessment for the study included evaluation of the following parameters: Age and gender of the patient, location of the fracture, mechanism of injury, time interval between injury and treatment, occlusion and the degree of displacement of fracture. The degree of displacement for mandibular symphysis, parasymphysis and body fractures was calculated as follows: Orthopantomogram tracing was done and the displacement was calculated by measuring the widest separation at the fracture site. In case of displacement in superior-inferior direction, the distance between the fracture fragments was measured from inferior border. Fractures were graded as follows:

- Minimally displaced fractures (< or = 2 mm).
- Moderately displaced fractures (2 to 4 mm).
- Severely displaced fractures (> 4 mm) [3].

In case of mandibular angle fractures the alignment of the mandibular canal on either side of fracture line was measured by tracing the canal on orthopantomogram. According to the alignment of the mandibular canal the fractures were graded as:

- Non displaced fracture: Whenever alignment of the mandibular canal was maintained across the fracture line.
- Minimally displaced fracture: Fracture in which malalignment of the canal was less than 50% of height of canal.
- Moderately displaced fracture: Fracture in which malalignment of canal was greater than 50% but less than entire height of canal.
- Severely displaced fracture: Fracture in which malalignment of canal was greater than the height of the canal [4].

Patients were randomly allocated into two equal groups (10 patients each). In group A, reduction was achieved manually during open reduction and internal fixation and group B, reduction was achieved with intermaxillary fixation (IMF). Manual reduction in the first group consisted of visible approximation and hand manipulation of the fracture segments by a skilled assistant/surgeon with the dentition being supported and held into occlusion while internal fixation was applied. In the second group, reduction was achieved by inter-maxillary fixation (IMF) using upper and lower Erich's arch bar placement. Post-operative assessment was carried out both clinically and radiographically on 2nd day, 7th day, 6th week and subsequently at 3rd month. Both groups were assessed for following parameters:

- Operating time: Time from incision to placement of last suture.
- Occlusal outcome: Occlusal outcome was categorized as:
  - Good (equivalent to premorbid occlusion).
  - Fair (Minor discrepancies in occlusion for which either no treatment or occlusal adjustment was required).
  - Poor (Required reoperation to achieve acceptable occlusion).
- Radiographic evaluation: The radiographic evaluation method as used by Dimitraulis G was followed and included assessment of fracture reduction on radiographs and scoring as:
  - Score 3: Radiographic evidence of precise anatomic reduction in the fracture site (Good reduction).
  - Score 2: Minor radiographic spacing of fractures that were slight displaced but had a satisfactory occlusion (Fair reduction).
  - Score 1: Significant discrepancy in the fracture segments that required a second operation to correct the poor alignment and unacceptable occlusion (Poor reduction) [5].
- Injury to the operator/assistant was noted. The latex gloves used were examined by water pressure test involving filling the gloves with 1000 ml water for 2 minutes after each operation by a single observer who was uncommitted to the surgical procedures [6].
- Complications: if any, were documented.

Results

In group A, there were a total of 14 fracture sites in ten patients including 4 bilateral fracture sites. Angle region was the most com-

mon fracture site (n-6, 42.8%), followed by parasymphysis region mandible (n-5, 35.71%) and the body region (n-3, 21.42%). In group B there were a total of 11 fracture sites in ten patients, out of which 5 sites (45.45%) involved parasymphysis region of the mandible followed by three fracture sites (27.27%) each in body and angle region. Among these patients, fifteen patients sustained injury due to road traffic accidents. Two patients sustained fractures due to sports related causes. Assault and interpersonal violence contributed directly to fractures in 3 patients. A total of 14 patients were treated within 5 days of injury. 3 patients were treated between 6 - 10 days and in 3 patients the time interval between injury and treatment was more than 10 days. Out of 14, majority of patients (5) were treated on 3rd day. In group A, 80% patients had disturbed occlusion as compared to 70% patients in group B. Rest of the patients had normal occlusion in both the groups. Operating time in the two groups was compared by independent t-test and P value for equal variances not assumed was used. P value < 0.05 was considered as significant. All tests were two sided. In group A, the average time taken for open reduction and internal fixation was 59.1 ± 16.36 minutes as compared to 83.1 ± 13.54 minutes for IMF group. Statistically highly significant difference was observed in the two groups regarding operating time (P < 0.10) (Table 1). Postoperative occlusion of ten patients each in the IMF group and manual reduction group was checked on 2nd day, 7th day, 6th week and then at 3rd month. At all the postoperative follow up periods, occlusion remained equivalent to premorbid and graded as good in 9 patients each of both the groups. However, 1 patient each in both the groups, required occlusal adjustment postoperatively and thus occlusion was graded as fair. On evaluation, the mean postoperative radiographic score at 2nd day, 7th day, 6th week and 3rd month in group A (Manual reduction) was 2.6 as compared to 2.5 in IMF group. The average radiographic score for group A (Manual reduction) was 2.6 ± 0.49 as compared to 2.5 ± 0.5 in the group B (IMF). No significant difference was observed in the two groups regarding radiographic score (P value < 0.05) (Table 2). Injury to the operator/assistant was evaluated in terms of glove perforation and skin penetrating injury. There was 3 instances of blood after glove perforation in IMF group (n-3) as compared to none in manual reduction group. The incidence of glove perforation was expressed as number per operation. Data was checked for normality by Kolmogorov Smirnov test and independent t-test was applied for comparison of the two groups. The IMF group had significantly more number of perforations than manual reduction group. Significant difference in the incidence was also observed between both the groups regarding unnoticed perforations and perforations on both surgeon and scrub nurse's gloves (p < 0.05). There were five noticed perforations in group A which occurred during wire manipulation as compared to only one noticed perforation in group B which occurred during suturing. Complications occurred in 4 patients (20%) out of 20 patients. These included residual hypoaesthesia in 3 patients of IMF group (30%) and post-operative infection in 1 patient out of 10 patients in manual reduction group (Table 3).

	Mean time (minutes)	Number of patients	Std. deviation	Std. error of deviation	t value	P value
Group A	59.1	10	16.36	15.372	0.18	<0.10
Group B	83.1	10	13.54			

Table 1: *Operating time (in minutes).*

	Mean score	Number of patients	Std. deviation	Std. error of deviation	t value	P value
Group A (Manual reduction)	2.6	10	0.49	0.22	0.45	<0.05
Group B (IMF)	2.5	10	0.5			

Table 2: *Radiographic evaluation.*

		Number		Rate per operation (Mean ± SD)		Sig. (2-tailed)
		Group A	Group B	Group A	Group B	
Total Perforations		4	33	0.40 ± 0.51	3.3 ± 2.40	0.002**
Noticed perforations	Yes	1	5	0.10 ± 0.31	0.50 ± 0.52	0.054
	No	3	28	0.30 ± 0.48	2.80 ± 2.48	0.001**
Personnel	Surgeon	3	15	0.30 ± 0.48	1.5 ± 1.26	0.012**
	Assistant	1	10	0.10 ± 0.31	1.00 ± 1.41	0.065
	Scrub nurse	-	8	-	0.8 ± 1.12	0.039**
Consequences	Blood/ Fluid contact	-	3	-	1.00 ± 0	-
	Skin penetration		-		-	-
Total Gloves used		61	65	6.1 ± 0.3	6.5 ± 0.5	0.054

Table 3: *Injury to the operator/assistant.*

Discussion

The primary goal of treatment of mandibular fractures is to reestablish proper occlusal relationship, adequate function and aesthetic harmony. The two most commonly used methods for fracture reduction and restoration of occlusion are: manual reduction, whereby the fractures are reduced by hand and intermaxillary fixation (IMF), whereby the dental arches are secured to each other and locked in position, usually with wires with subsequent placement of internal fixation devices [2]. Statistically highly significant difference was observed between the two groups regarding time taken (P < .001). The mean operating time for the IMF group was 83.1 ± 13.54 minutes whereas for the manual reduction group it

was 59.1 ± 16.36 minutes in the present study. Our findings are consistent with the observations of Dimitroulis G who reported mean operating time in IMF group and manual reduction groups as: 98.5 minutes and 40.2 minutes respectively [5]. Choi., *et al*. also reported average operating time of 87 minutes in IMF group as compared to 41 minutes while using reduction forceps in mandibular angle fractures [7]. Postoperative occlusion was another parameter evaluated for both the IMF and manual reduction groups on 2nd day, 7th day, 6th week and then at 3rd month. Postoperatively, 90% patients in both the groups presented with good occlusion (equivalent to premorbid occlusion) at all follow up periods (18 out of 20 patients). This was in accordance with the study conducted by Hsu., *et al*. who reported good occlusion in 100% of the patients in manual reduction group and 92.3% patients in the IMF group postoperatively [2]. Laurentjoye M., *et al*. who conducted a study evaluating manual fracture reduction and semirigid osteosynthesis fixation without arch bars reported normal occlusion in 98.6% patients postoperatively [8]. Another parameter evaluated was post-reduction radiographic evaluation in both the groups. Radiographic evaluation was done using a score from 1 to 3 on 2nd day, 7th day, 6th week and 3rd postoperative month. On evaluation, the mean postoperative radiographic score at all postoperative follow up periods in group A (Manual reduction) was 2.6 as compared to 2.5 in IMF group. This is in accordance with the study conducted by Dimitroulis G who reported a mean postoperative radiographic score of 2.45 for both IMF and manual reduction groups [5]. In contrast, the study conducted by Choi., *et al*. comparing use of IMF with manual reduction forceps in mandibular angle fractures reported a lower mean postoperative radiographic score of 2.26 for the IMF group as compared to radiographic score of 2.82 for reduction forceps group [7]. Malhotra K., *et al*. compared 3D plate and conventional miniplate for management of mandibular fractures without postoperative IMF and found mean radiographic score of 2.7 for the miniplate group and 2.9 for the 3D plate group [10]. In this study, the rate per operation for glove perforation was 0.40 ± 0.51 in group A which was quite less than that observed for arch bar wiring (3.3 ± 2.40). This implied that manual reduction led to less number of glove perforations as compared to Erich arch bar and thus decreased the risk of disease transmission and occupational injuries. This is in accordance with the study conducted by Avery CME., *et al*. who investigated double gloving during open reduction and internal fixation of facial fractures and observed a rate per operation for glove perforation of 0.43 for the manual reduction group and 4.62 ± 3.25 for the IMF group [11]. Also, Pieper SP., *et al*. in their study comparing efficacy of three different techniques of triple gloving during application of Erich arch bar observed rate per operation for glove perforation as 5.06 [12]. In contrast Gaujac C., *et al*. who did a comparative analysis of two techniques of double gloving while placing an Erich arch bar for intermaxillary fixation, reported a lower rate per operation of 2.45 in their study [13].

The authors use of conventional arch bar in all the patients served as a limitation of the study as availability of alternate methods such as IMF screws and modified arch bars can modify results. When evaluating IMF screws, Coletti., *et al*. performed a retrospective study on IMF screws and found them to be a time sparing alternative however complications such as screw loosening, root fracture, loosened wires, screw shear, malocclusion and ingested hardware were noted [14]. In a retrospective study by Hashemi., *et al*. involving 373 screws placed in 73 patients, dental complications occurred in 17.8% patients and non dental complications occurred in 54.2% patients equating to a one third of screws resulting in complications with the authors noting that the decision to use IMF screws instead of arch bar was dependent of surgeon's skill and interest [15]. In a prospective study by Rothe., *et al*. comparing conventional arch bar, intermaxillary fixation screws and modified arch bar (modified by making perforations in the spaces between the winglets with 1.1 mm bur and fixed with 1.5 mm screws) for intermaxillary fixation, the authors concluded that IMF screws were the quickest method of the three followed by modified arch bar. However, the authors noted that conventional arch bar was significantly stable when compared to modified arch bar and IMF screws thus serving as a viable option for patients requiring long term intermaxillary fixation [16].

Conclusion

The results of the present study corroborate that the use of IMF not only increases the time taken to reduce and internally fix mandibular fractures, but also increase the cost with regard to both equipment and theatre time. There is also a risk of injury to the surgeon and assistants from wire penetrating their gloves. It offers no benefit in terms of radiographic and clinical outcome. The operating time taken and the risk of complications are less in manual reduction as compared to IMF. Additionally, fracture reduction by manual method is much easier to directly visualize and adjust

compared with when the mandible is in IMF. Thus, when comparing manual reduction vs IMF as two different means of achieving reduction during open reduction and fixation of mandibular fractures, the former can definitely be recommended and is clinically relevant in cases of isolated unilateral or bilateral mandibular fractures provided a skilled and experienced assistant is present along with operating surgeon during the surgical procedure.

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Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

Ethical Approval

All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from the individuals included in the study.

Bibliography

1. Sakr K, Farag IA, Zeitoun IM. Review of 509 mandibular fractures treated at the University Hospital, Alexandria, Egypt. Br J Oral Maxillofac Surg. 2006;44:107-111.

2. Hsu E, Crombie A, To P, Marquart L and Batstone MD. Manual reduction of mandibular fractures before internal fixation leads to shorter operative duration and equivalent outcomes when compared with reduction with intermaxillary fixation. J Oral Maxillofac Surg. 2012;70:1622-1626.

3. Shetty V, Atchison K, Der-Matirosian C, Wang J, Belin TR. The mandible injury severity score: development and validity. J Oral Maxillofac Surg. 2007;65:663-670.

4. Guimond C, Johnson JV, Marchena JM. Fixation of mandibular angle fractures with a 2.0-mm 3-dimensional curved angle strut plate. J Oral Maxillofac Surg. 2005;63:209-214.

5. Dimitroulis G. Management of fractured mandibles without the use of intermaxillary wire fixation. J Oral Maxillofac Surg. 2002;60:1435-1438.

6. N. Kuroyanagi, T. Nagao, H. Sakuma, H. Miyachi, S. Ochiai, Y. Kimura, H. Fukano, K. Shimozato. Risk of surgical glove perforation in oral and maxillofacial surgery. International Journal of Oral and Maxillofacial Surgery. 2012;41(8):1014-1019.

7. Choi BH, Kim HJ, Kim MK, Han SG, Huh JY, Kim BY, et al. Management of mandibular angle fractures using the mandibular angle reduction forceps. Int J Oral Maxillofac Surg. 2005;34:257-261.

8. Laurentjoye M, Lefebvre CM, Caix P, Siberchicot F and Ricard AS. Treatment of mandibular fractures with michelet technique: manual fracture reduction without arch bars. J Oral Maxillofac Surg. 2009;67:2374-2379.

9. Fordyce AM, Lalani Z, Songra AK, Hildreth AJ, Carton ATM, Hawkesford JE. Intermaxillary fixation is not usually necessary to reduce mandibular fractures. British Journal of Oral and Maxillofacial Surgery. 1999;37:52–57.

10. Malhotra K, Sharma A, Giraddi G and Sahil AK. Versatility of titanium 3D plate in comparison with conventional titanium miniplate fixation for the management of mandibular fracture. J Oral Maxillofac Surg. 2012;11:284-290.

11. Avery CM, Taylor J, Johnson PA. Double gloving and a system for identifying glove perforations in maxillofacial trauma surgery. Br J Oral Maxillofac Surg. 1999;37:316-319.

12. Pieper SP, Schimmele SR, Johnson JA, Harper JL. A prospective study of the efficacy of various gloving techniques in the application of Erich arch bars. J Oral Maxillofac Surg. 1995;53:1174-1176.

13. Gaujac C, Ceccheti MM, Yonezaki F, Garcia IR Jr, Peres MP. Comparative analysis of 2 techniques of double-gloving protection during arch bar placement for intermaxillary fixation. J Oral Maxillofac Surg. 2007;65:1922-1925.

14. Coletti DP, Salama A, Caccamese JF Jr. Application of intermaxillary fixation screws in maxillofacial trauma. J Oral Maxillofac Surg. 2007;65(9):1746-1750.

15. Hashemi HM, Parhiz A. Complications using intermaxillary fixation screws. J Oral Maxillofac Surg. 2011;69(5):1411-1414.

16. Rothe TM, Kumar P, Shah N, Shah R, Mahajan A, Kumar A. Comparative Evaluation of Efficacy of Conventional Arch Bar, Intermaxillary Fixation Screws, and Modified Arch Bar for Intermaxillary Fixation. J Maxillofac Oral Surg. 2019;18(3):412-418.