ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 10, pp.59982-59988, October, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

COMPARATIVE ASSESSMENT OF TWO METHODS OF TEMPORARY INTEMAXILLARY IMMOBILISATION IN THE TREATMENT OF MANDIBULAR FRACTURES-A PROSPECTIVE STUDY

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ARTICLE INFO

Article History:
Received 23rd July, 2017
Received in revised form
27th August, 2017
Accepted 16th September, 2017
Published online 31st October, 2017

Key words:
Fixation screws,
Arch bars,
Intermaxillary fixation,
ORIF (open reduction and Internal fixation),
Mandibular fractures.

ABSTRACT

Background: The management of mandibular fractures has evolved greatly over the years from supportive bandages, splints, circum-mandibular wiring, extra oral pins to rigid fixation and more lately semi rigid fixation. Arch bar fixation has been the popular method for so long. The introduction of intraoral bone plating systems has widened the horizon. This prospective study is aimed at providing the clinician an evidence based recommendation in adopting suitable method.

Objectives: Purpose of this study is to compare two different methods for intermaxillary immobilisation namely intermaxillary fixation screws and Erich arch bars.

Materials and Methods: 24 patients with mandibular parasymphisis fractures with or without sub-condylar fractures, fulfilling the inclusion criteria were selected and grouped into two (group A and group B) with 12 patients in each by random sampling allocation. Group A patients received Intermaxillary fixation screws while in group B Erich arch bar fixation was done. Two groups were evaluated with respect to variables such as reduction of displaced fracture and stability of IMF, possible iatrogenic dental injuries, needle stick injury, time consumed for achieving intermaxillary fixation and evaluation of oral hygiene during the intermaxillary fixation period.

Results: Significant differences were observed between the two groups with clear indication of Intermaxillary fixation screws being more beneficial to the patient and clinician especially in terms of time consumed, avoidance of needle stick injury and oral hygiene maintenance.

Conclusion: Intermaxillary fixation screws are a better alternative to arch bars in achieving intermaxillary fixation in indicated cases.

Citation: Dr. Akhilesh, A.V., Dr. Ravindran, V., Dr. Thomas Joseph, Dr. Manoj Joseph Michael, Dr. Bindu Das. R. and Dr. Fasalulla. O. 2017. "Comparative assessment of two methods of temporary intemaxillary immobilisation in the treatment of mandibular fractures-A prospective study", *International Journal of Current Research*, 9, (10), 59982-59988.

INTRODUCTION

The management of mandibular fractures has evolved greatly over the years from supportive bandages, splints, circum-mandibular wiring, extra oral pins to rigid fixation and more lately semi rigid fixation. The ultimate goal of treatment remains the preservation and restoration of the function and normality of the oro-maxillofacial complex. The introduction of intraoral bone plating systems has meant that prolonged periods of maxillo-mandibular fixation (MMF) are no longer required in the patient with fractures of the mandible or maxilla. However, there is often a need for temporary MMF intraoperatively to assist in the reduction of fractures with the teeth in the correct occlusion. In addition, light elastic traction may be useful postoperatively to correct minor occlusal discrepancies for example, if there is an associated fracture of the condyle (Jones, 1999). Advocates of traditional techniques (MMF, closed reduction) cite high infection rates, more invasive treatment, higher costs, longer hospitalization and need for implant material as reasons to avoid ORIF (open reduction and internal fixation) when possible. Advocates of ORIF techniques describe MMF as less desirable because of patient weight loss, discomfort, prolonged treatment, poor oral hygiene, gingiva injury, increased potential for percutaneous

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injury and inadequate reduction (David, 1998). This study is aimed at reviewing our experience with MMF screws in the treatment of mandibular fractures by evaluating the efficacy and safety of intermaxillary fixation screws with respect to variables such as the following.

- Reduction of displaced fracture and stability of IMF.
- Possible iatrogenic dental injuries.
- Needle stick injury.
- Time consumed for achieving intermaxillary fixation.
- Evaluation of oral hygiene during the intermaxillary fixation period.

MATERIALS AND METHODS

This study was conducted in the department of Oral and Maxillofacial Surgery, Govt. Dental College Calicut, Kerala, India. Permission from the institutional ethical committee was obtained prior to conducting the study. An informed consent was taken from patients who agreed to participate in the study. The study group consisted of twenty four patients with mandibular parasymphisis fractures with or without sub-condylar fractures. They were grouped into 12 each, and named Group-A and Group-B.

The inclusion criteria were

- Non-pathological fracture of mandible.
- Patients in 2nd and 3rd decades.
- The teeth in the area of screw insertion were vital pre-operatively.
- Both favorable and unfavorable fractures were included.
- Both males and females were included.

The exclusion criteria were

- Edentulous patients: as we intended to find incidence of iatrogenic damage to adjacent teeth.
- Patients with underlying systemic disease or condition: as this might compromise/interfere with the healing of fractured site.
- Patients who reported two weeks after initial trauma: as healing would have already started or the sight might be infected which can interfere with the treatment.
- Fracture sites or the whole of mandible associated with pathologies: because these are compromised areas which might require alternative line of management.
- Comminuted fracture of mandible: as these sites will interfere with correct and stable placement of screws.
- Any co-existing fracture of cranio- facial skeleton.

For the sake of standardization, all the patients were treated by same surgeon.

Group-A patients who received inter-maxillary fixation screws. After establishing the pre morbid occlusion open reduction and internal fixation was done in every case. Self-tapping stainless steel screws 8mm long and 2.5 mm in diameter (Figure 1) were inserted, at least one in each quadrant, under local anaesthesia (2% lignocaine with adrenaline 1:200000), into pre-drilled holes.

Figure 1. Self-tapping stainless steel screws

The holes were drilled through the mucosa without a gingival incision. In the maxilla holes were usually placed between the lateral incisor and the canine close to the piriform rim (Figure 2), taking care to pass the drill between/above the apices of the teeth and without penetrating the palatal mucosa.

Figure 2. Intermaxillary fixation screws in maxilla

In the mandible holes were drilled apical to the roots of the teeth. Temporary intermaxillary fixation was achieved using wires or elastic bands (Figures 3 to 5).

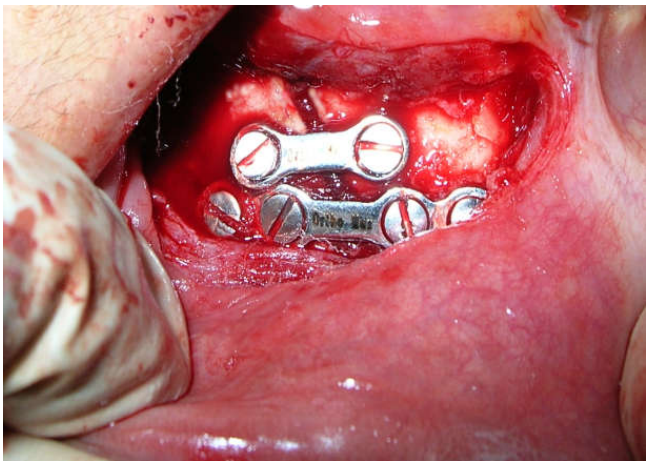


Figure 3. Mandibular fixation

Figure 4. Intermaxillary fixation with IMF screws

Figure 5. Orthopantomograph showing maxillary and mandibular fixation

The screws were left in place for one week to enable postoperative elastic traction to correct small discrepancies in occlusion. When reducing condylar fractures, intermaxillary fixation also helped to achieve closed reduction with stable fixation of the jaws.

Group-B patients received inter-maxillary fixation with Erich arch bars (Figure 6). After infiltrating local anesthetic solution (2% lignocaine with adrenaline 1:200000), Erich arch bars were contoured and adapted to the arches. Arch bars were then fixed to the upper and lower arches by passing stainless steel wires around the cervical regions of the teeth. Maxillomandibular fixation was achieved with 26 gauge stainless steel tie wires (Figure 6).

Figure 6. Inter-maxillary fixation with Erich arch

The same group of surgeons, who had operated, reviewed the patient at the time of splint removal. The findings were recorded as per criteria described below;

Stability of intermaxillary fixation: Adequate/Inadequate

Time consumed for achieving inter-maxillary fixation: This was recorded in minutes from start of the procedure till inter-maxillary fixation was achieved.

Needle stick type injury: The surgeon, first assistant surgeon and scrub nurse used double glove techniques. Incidence of glove puncture was noted either in outer/inner glove. Undiagnosed punctures were identified by water inflation method. A puncture in any of the team members' gloves was taken as a positive finding.

Iatrogenic injury to adjacent teeth: Vitality of all the teeth was checked by heat and cold technique pre-operatively. It was again checked at the time of splint removal, (either Arch bar or Intermaxillary fixation screw). Any positive finding of non-vitality were recorded and noted.

Maintenance of Oral hygiene: Modified gingival index by Lobene *et al* was used at the time of splint retrieval to evaluate the condition of gingiva and scores given according to following criteria.

0-Absence of inflammation
1- Mild inflammation; Slight change in color, little change in texture of any portion of gingiva but not the entire marginal or papillary gingival unit.
2- Mild inflammation; Criteria as above but involving the entire marginal or papillary unit.

Table 1. Evaluation of Group A

Patient	Stability of IMF	Time consumed	Needle stick injury	Iatrogenic damage to adjacent teeth	Evaluation of oral hygiene
1	Adequate	25	Nil	Nil	0
2	Adequate	24	Nil	Nil	0
3	Adequate	21	Nil	Nil	0
4	Adequate	21	Nil	Nil	1
5	Adequate	22	Nil	Nil	0
6	Adequate	21	Nil	Nil	0
7	Adequate	20	Nil	Nil	0
8	Adequate	18	Nil	Nil	0
9	Adequate	20	Nil	Nil	1
10	Adequate	20	Nil	Nil	0
11	Adequate	17	Nil	Nil	0
12	Adequate	18	Nil	Nil	0

All the splints (Arch bars and screws) were retrieved one week post-operatively in the out-patient department and occlusion was rechecked.

3- Moderate inflammation; Glazing, redness, edema and/or hypertrophy of the marginal or papillary gingival units.

4- Severe inflammation; Marked redness, edema and/or hypertrophy of marginal or papillary gingival unit, spontaneous bleeding, congestion or ulceration.

RESULTS

Observations were recorded and data was analysed using suitable computer software statistical tools.

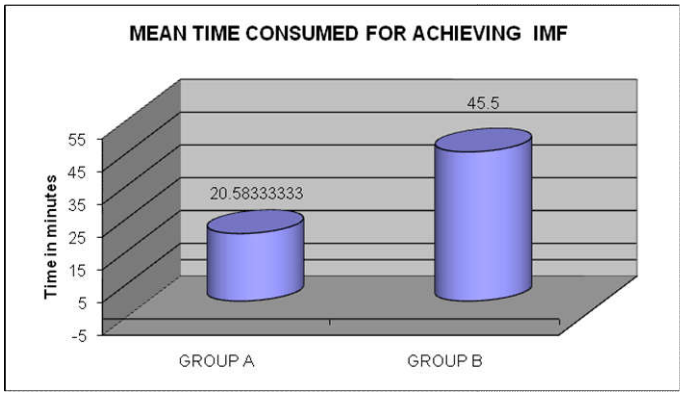
In the parameter of time consumption it is found that there is a high significance difference (p= 0.000) in the mean time consumed by the two groups, also the minimum average time is consumed by GROUP A (mean time = 20.58 min with S. D= 2.353) but in GROUP B it is high (mean time is = 45.5 min with S. D= 4.542).

Table 2. Evaluation of Group B

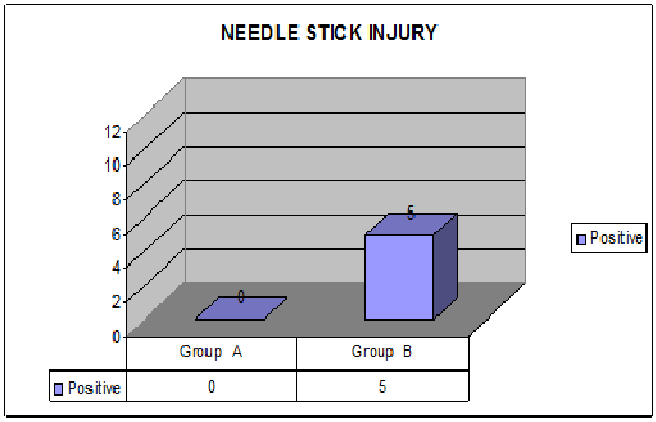
Patient	Stability of IMF	Time consumed	Needle stick injury	Iatrogenic damage to adjacent teeth	Evaluation of oral hygiene
1	Adequate	46	Nil	Nil	3
2	Adequate	50	Present	Nil	4
3	Adequate	48	Present	Nil	3
4	Adequate	55	Present	Nil	4
5	Adequate	44	Nil	Nil	4
6	Adequate	45	Nil	Nil	3
7	Adequate	38	Nil	Nil	3
8	Adequate	40	Nil	Nil	3
9	Adequate	42	Nil	Nil	3
10	Adequate	48	Present	Nil	3
11	Adequate	46	Present	Nil	3
12	Adequate	44	Nil	Nil	3

Table 3. Stability of IMF

		GROUP	
		A	B
ADEQUATE	Count	12	12
	%	100 %	100 %
TOTAL	Count	12	12
	%	100 %	100 %



Graph 1. Time consumed for achieving inter-maxillary fixation



Graph 2. Needle stick type injury

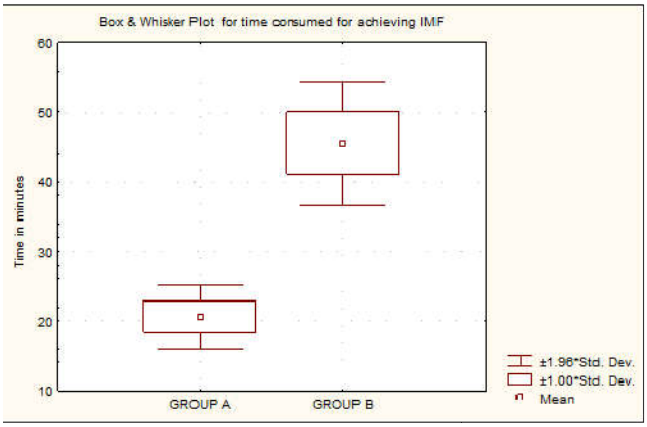


Figure 7. Box And Whisker Plot for time consumed in achieving IMF

Adequate amount of stability was achieved in 100% cases in both GROUP A and GROUP B. So in the measurement of stability there is no performance difference.

When considering the risk of needle stick injury, by the Fisher's exact test it found a significant difference between the two techniques. (p= .0373).Out of 12 cases in Group B, 5 cases had surgical glove perforation.

Table 4. Fisher's exact test

	GROUPA	GROUPB	Row Totals
Frequencies, row 1	0	5	5
Percent of total	0.000%	20.833%	20.833%
Frequencies, row 2	12	7	19
Percent of total	50.000%	29.167%	79.167%
Column totals	12	12	24
Percent of total	50.000%	50.000%	24
Fisher exact p,		p= .0373	24

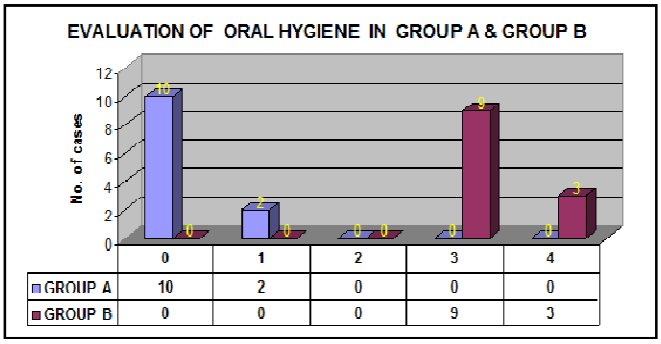
Table 5. Iatrogenic damage to adjacent teeth

		GROUP	
		A	B
IATROGENIC DAMAGE	Count	0	0
%		0.0 %	0.0 %
TOTAL	Count	0	0
%		0.0 %	0.0 %

Coming to the risk of iatrogenic damage to adjacent teeth there was no incidence of any operator induced damage to adjacent teeth in both groups.

Table 6. Evaluation of oral hygiene

	Evaluation of oral Hygiene	
	Group A	Group B
0	10	0
1	2	0
3	0	9
4	0	3
TOTAL	12	12



Graph 3. Maintenance of Oral Hygiene

Table 7. Logistic regression (logit) test

Model: Logistic regression (logit) N of 0's:2 1's:2		
Dep. var: VAR1 Loss: Max likelihood		
Final loss: .000000000 $Chi^2(1)=5.5452$ p=.01854		
	Const.B0	VAR2
Estimate	-96.8117	13.42412

Logistic regression (logit) test, revealed that there is a significance difference (**p=.018**) in the degree of oral hygiene maintenance in Group A and Group B. Oral hygiene maintenance was very much superior in Group A when compared to Group B.

DISCUSSION

Different methods have been used for intermaxillary fixation in the management of mandibular fractures. The most common technique is to use arch bars or eyelet wires. These techniques take a relatively long time to apply and to remove, can lead to perforation of the surgeon's gloves and consequent ''needle stick'' injury of fingers caused by the sharp-ended wires, with disease transmission risk (Scully and Porter, 1991; Avery and Johnson, 1992; Busch, 1994). Moreover they are not easy to apply when the teeth carry extensive crown and bridgework. Finally, wires tightened during the application of arch bars around the teeth may cause an ischaemic necrosis of the mucosa, and make it difficult to maintain gingival health (Ayoub and Rowson, 2003). To get around these problems, Dal Pont presented a solution for intermaxillary fixation, using S-shaped hooks inserted under general anaesthesia lateral to the pyriform aperture and at the inferior border of the mandible (Dal Pont, 1967). Otten (1981) improved this method using AO miniscrews inserted into the nasal spine and into the symphyseal region of the mandible. These screws were used to attach elastic bands, or wires for intermaxillary fixation (Otten, 1981). The technique adopted for intermaxillary fixation in the present report is that described by Arthur and Berardo (1989) and utilizes at least four self-tapping titanium screws inserted transmucosally, one for each quadrant. The screws, 8mm long and 2.7mm in diameter (Figure 1), are inserted above the root apices in the maxilla near the pyriform rim area or the Zygomatic buttress region (Figure 2). In the mandible, screws are inserted in the region below the root apices between the mental foramina (Figure 3). In our study the area of insertion was same as described by the above author but we used 2.5 mm diameter 8mm length stainless steel screws for achieving intermaxillary fixation. The stability achieved with these screws was found to be at par with the arch bars (Arthur, 1984). There are many advantages to this procedure, with respect to the use of arch bars. First, insertion is easy and takes about 10 min, with significant intraoperative savings in time and cost, and they are equally easy to remove, without anaesthesia (Arthur and Berardo, 1989; Busch, 1994; Karlis and Glickman, 1997; Jones, 1999) (Jones, 1999; Richard, 1994; Arthur, 1989; Vasiliki Karlis, 1991). In our study the mean time consumed for achieving IMF is 20.58 min which is less than half of that is required for arch bar fixation i.e., 45.5 min (Table 1-2, Graph 1, Figure 7). The data from various studies is in agreement with the present study, which suggests that time taken for arch bar fixation is considerably higher than the time taken for self tapping cortical bone screws.

There is practically no danger that the procedure will cause injury to the surgeon due to sharp-ended wires, with consequently decreased risk of transmission of blood-borne disease to surgeon and patient alike (Arthur and Berardo, 1989; Avery and Johnson, 1992; Busch, 1994; Gordon *et* al., 1995; Karlis and Glickman, 1997; Jones, 1999). Godin *et al*, reported a 100% glove perforation rate during reconstructive surgery using wires, arch bars and plating techniques. Alveolar wires used for arch bar MMF carried the highest rate of glove perforation. Avery *et* al. have found the incidence of glove perforation in treatment of maxillo-facial fractures is as high as 50%. Even with double gloving, Kelly *et al* (Kelly, 1993), found that 45% of outer and 15% of inner gloves were perforated after placing arch bars. A single arch bar case involves at least 20 stainless steel wires, each with two sharp ends capable of penetrating a gloved hand. In our study (Table 1,2,4, Graph 2) Group B using arch bar MMF, out of 12 cases, surgical glove perforation was detected in 5 of them (41.6%).
The main risk of using screws is the possibility of damaging dental roots while drilling the pilot hole (Key and Gibbons, 2001; Farr and Whear, 2002; Majumdar and Brook, 2002), especially in patients with dental crowding (Key, 2001; Farr, 2002; Arun Majumdar, 2002). In our study we haven't encountered iatrogenic damage to tooth roots (Table 5). This may be due to the fact that we usually drilled the pilot hole near the pyriform rim in maxilla and in the mandible they are placed below the root apices between the mental foramina rather than between the roots (Arthur Bernardo, 1989; Busch, 1991). Mucosal coverage of the screws, because of its placement in the mobile mucosa is less likely, if the screws are to be removed in 1-2 weeks postoperatively. Impingement of tooth roots by osteosynthesis screws during fracture fixation

does not appear to adversely effect the survival of the affected teeth. Mandibular teeth appear to be more "at risk" (3:1) for impingement than maxillary teeth because the thick buccal plate of bone makes identification of root contours difficult. Teeth that are transfixed do not generally become infected and do not appear to require extraction more often than similar, adjacent teeth (Gregory and Duffield, 1996). Despite the number of apparent contacts complications are rare. Radiographic assessment of impingement of teeth by transalveolar screws probably slightly overstate the frequency as parallax error on radiography could produce an apparent contact where there has not been one(false positive) but will not produce an apparent miss (false negative) where there has been a contact (Fabbroni *et* al,2004).

In addition, the risks of damage to the dental papillae and oral mucosa are considerably reduced; the teeth and dental prostheses are not subjected to traction, and it is easier to maintain dental hygiene (Gordon *et al*., 1995; Jones, 1999; Ayoub and Rowson, 2003). The degree of maintenance of oral hygiene (Table 1-2, 6-7, Graph 3)was found to be much better in patients with cortical screws (Group A) than with Erich arch bars (Group B). By logistic regression analysis (Table 7) of the data it was found that there was a significant difference (p=.018) in the degree of oral hygiene maintenance between Group A and Group B. Oral hygiene maintenance is superior in MMF screw fixation patients because the teeth and gingiva are more accessible to brushing and irrigation (Coletti, 2007). Finally, the method is compatible with rigid fixation using any plating system. Our study is consistent with a long list of experimental and clinical studies that proved the efficacy of intermaxillary fixation with MMF screws.

Conclusion

Intermaxillary fixation with intraoral cortical bone screws is a valid alternative to the use of arch bars in the treatment of mandibular fractures. Based on the results of the study we conducted, we conclude by saying:

- Maxillo-mandibular fixation screws are adequate for temporary intraoperative fixation and postoperative elastic traction.
- Maxillo-mandibular fixation screws significantly decreases the operating time and thus saves the operating surgeon's valuable time.
- Maxillo-mandibular fixation screws significantly reduce the risk of inadvertent glove/skin puncture when compared to the application of arch bars.
- Careful attention paid to the three-dimensional relationship of the path of insertion with the surrounding dental structures can avoid iatrogenic dental trauma.
- Patients tolerate the MMF screws extremely well and are able to maintain a higher standard of oral hygiene than with arch bars. From the patient's point of view it also has benefits like more compliance and acceptance as less/no metal is visible. Removal is a less unpleasant experience for both the patient and operator as well as being quicker than arch bar removal.

It is our opinion that a total of four screws (two in each jaw) are enough for a satisfactory inter-maxillary fixation however there is no contraindication to exceed this number when the situation demands.

However, intraoral cortical bone screw technique is not generally indicated for severely comminuted fractures, extensive alveolar bone fractures and in transitional dentition as permanent tooth buds can be damaged. Even though the sample size is too small to arrive at any definitive conclusion, the encouraging results show that intermaxillary fixation screws has a significant role in the treatment of mandibular fractures. A more extensive study involving a larger sample and a longer follow up should be undertaken to evaluate the efficacy of intermaxillary screws over time tested arch bars.

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