

Evaluation of Efficacy of Intermaxillary Fixation Screw and Erich Arch Bar for Intermaxillary Fixation in Fracture Mandible: A Prospective Comparative Study

Naqoosh Haidry¹ Nazia Haidry^{2*} Ritesh Raj³ Md. Jawed Iqbal⁴ Pranay Kulkarni⁵ Sheeri Sabir⁶

¹Assistant Professor, Department of Dentistry, All India Institute of Medical Sciences, Patna, Bihar, India.

²Private Practitioner, Patna, Bihar, India.

³Professor, Department of Oral and Maxillofacial Surgery, Patna Dental College & Hospital, Patna, Bihar, India.

⁴Dental Officer, Department of Dentistry, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.

⁵Dental Officer, Health Department, Government of Bihar, Patna, Bihar, India.

⁶Senior Lecturer, Department of Public Health Dentistry, Career Post Graduate Institute of Dental Sciences and Hospital, Lucknow, UP, India.

ABSTRACT

Background: Intermaxillary fixation is regarded as a significant step in the management of maxillofacial trauma since it restores the pre-injury occlusion. Various types of tooth-borne devices like arch bars are used to achieve intermaxillary fixation. To overcome the shortcomings of Erich arch bar, cortical bone screws for IMF were introduced. The present study was designed to compare the efficacy of IMF screw over Erich arch bar in mandibular fracture.

Material and Method: The prospective randomized study was carried out on 60 patients. Patients were randomly divided into 2 groups of 30 patients each. In group A, intermaxillary fixation was achieved by using Erich arch. In group B, IMF was achieved by the use of IMF screws. In this study, patients were evaluated for the following variables- surgical time for achieving IMF in both technique, oral Hygiene, Intraoperative and postoperative complications.

Result: The average surgical time taken for achieving IMF per patient in group A and group B was 85.32 min and 16.75 min respectively. Plaque deposition was more in Erich arch bar group.

Conclusion: IMF screw offers an effective alternative for Erich arch bar in the treatment of the minimally displaced mandibular fracture.

Keywords: Intermaxillary Fixation, IMF screw, Erich arch bar, Mandibulo-maxillary fixation, IMF.

INTRODUCTION

Intermaxillary (mandibulo-maxillary fixation, MMF) fixation is regarded as a significant step in the management of maxillofacial trauma since it restores the pre-injury occlusion. Conventionally intermaxillary fixation is achieved using various types of tooth-borne devices like arch bars, dental and interdental wiring, metallic and nonmetallic splints. However, tooth-borne devices are always

associated with problems like poor oral hygiene, periodontal health, extrusion of teeth, loss of tooth vitality, traumatic ulcer of buccal and labial mucosa, glove perforation and needle stick injury to the operator. Besides this, the procedure is time-consuming. ⁽¹⁾ Because of discomfort, difficulty in wire removal, and maintaining oral hygiene, patients have low acceptability to arch bars. ⁽²⁾ To

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*Correspondence Dr. Nazia Haidry.

Private Practitioner, Patna, Bihar, India.

Email: haidrynazia@gmail.com

overcome these drawbacks, Arthur and Bernado introduced a technique of applying cortical bone screws for IMF, which is indeed a kind of bone borne device. As compared with tooth-borne devices, bone screws have minimal hardware exposure in the oral cavity. ⁽³⁾ The present study was designed to compare the efficacy of IMF screw over Erich arch bar in mandibular fracture.

MATERIAL AND METHODS

The prospective randomized study was carried out on 60 patients who reported to the department of oral & maxillofacial surgery, Patna dental college and hospital, Patna, for treatment of mandibular fracture and required IMF followed by open reduction and internal fixation. The patients with minimally to moderately displaced mandibular fracture affecting occlusion like symphysis, Para symphysis fracture who needed IMF and agreed to participate in the study were included in this study. Informed consent was obtained from all patients who were enrolled in the study.

Patients with dentoalveolar fracture, comminuted fracture of mandible, edentulous arch, gunshots injuries, pan facial fracture, maxillary fracture, angle and body fracture of mandible, primary & mixed dentition, presence of systemic conditions like rheumatoid arthritis and bronchial asthma, below the age of 18 years were excluded from the study.

Patients were randomly divided into 2 groups of 30 patients each and designated as group A and group B. In group A, intermaxillary fixation was achieved by the conventional method using Erich arch bar fastened with 26 gauge steel wire. In group B, IMF was achieved by the use of stainless steel self-tapping IMF screws of 2mm diameter and 8 or 10 mm length.

After appropriate anesthesia, holes were drilled through mucosa with 1.5 mm drill bits without any gingival incision. A minimum of 1 screw per quadrant was inserted at just above mucogingival junction. The most preferred site is between canine and first premolar. The position and number of screws used varied, dependent on the site of fracture. Attempts were made to orient the long axis of screws at 90 degrees from the roots of the adjacent teeth. After this, the IMF screw was inserted through the predrilled holes, taking care

not to penetrate lingual and palatal mucosa. The screw had pointed tips and its head had a slot where wire or elastic band passed for IMF.

Open reduction and internal fixation with mini-plate performed for fracture based on Champy's principle. MMF was released in all patients immediately after ORIF. Screw and Erich arch bar was left in place to enable postoperative traction to correct the small discrepancy in occlusion. MMF device (screw & arch bar) was removed after 4 weeks in both groups. A clinical follow-up of 1 month following removal of IMF screws & Erich arch bar was done.

In this study, patients were evaluated for the following variables- 1) surgical time taken for achieving IMF in both techniques was evaluated. 2) Oral Hygiene 3) Intraoperative and postoperative complications.

Oral hygiene of the patient was assessed by the modified Turesky-Gilmore plaque index which was taken immediately after placement of IMF screws or Erich arch bar, 2nd, 4th, 6th week. Needlestick injury and incidence of gloves perforation were checked by the water inflation method. Mucosal coverage of IMF screw & Erich arch bar, iatrogenic damage of tooth were also recorded.

The Data collected were analyzed statistically with SPSS version 17.0 software (SPSS, Inc, Chicago, IL) using a chi-square test and 't' test.

RESULT

The average surgical time taken for achieving MMF per patient in group A (Erich arch bar) and group B (IMF Screw) was 85.32 min and 16.75 min respectively (Table-1). 4 screws were applied in 86% of cases and 6 screws were applied in 14 % of cases. The difference in the mean surgical time taken between both groups was statistically highly significant.

Oral hygiene of patients was assessed by using Turskey-Gilmore-Glickman modification of the Quigley Hein Plaque index. The plaque was assessed on lingual, labial and buccal surfaces at the gingival 3rd of all the teeth using a disclosing agent. Mean Value of Turskey-Gilmore-Glickman modification of Quigley-Hein plaque index in Erich arch bar and IMF screw was 2.54 and 1.80 respectively. The

result suggests that plaque deposition was more in the conventional Erich arch bar (Table-2).

Postoperative occlusion in both groups was satisfactory. There was not much difference in the postoperative occlusion status of both groups.

Soft tissue burying or mucosal coverage of 3 IMF screws was observed after 4 weeks at the time of removal. Stab incision under local anesthesia is required for removal of such (buried) screw. No case of full mucosal coverage was reported in the conventional Erich arch bar group. Iatrogenic damage to tooth roots while placing the IMF screw was seen in 5 cases. Loosening of 7 IMF screw was noted after 4 weeks in group B. Perforation of gloves was found in 12 cases in group A whereas group B reported 1 case of glove puncture.

Table 1: Surgical Time (in minutes).

Group	Mean	SD	t value
A	85.32	12.17	
B	16.75	3.62	28.36

Table 2: Mean value of Plaque Index

Group	Mean	SD	t value
A	2.54	0.31	
B	1.80	0.37	7.31



Fig 1: Maxillo-mandibular fixation with IMF screws



Fig 2: Maxillo-mandibular fixation with erich arch bar.



Fig 3: Post-operative radiograph showing IMF screws

DISCUSSION

The treatment of mandibular fractures has been in a constant state of evolution over the last few decades. ⁽⁴⁾ The main aim of treating mandibular fractures includes fracture site reduction, stabilization, and achievement of correct dental occlusion. During these processes, it is beneficial to use methods that decrease the risk of percutaneous transmission of blood-borne diseases, reduce operating time and hospital costs. The management of maxillofacial fractures includes different techniques from closed reduction to open reduction and internal fixation (ORIF) and requires control of the dental occlusion with the help of the IMF. ⁽⁵⁾ Erich arch bar is the most common method of achieving IMF but these methods are relatively time-consuming for application and removal of arch bars besides having an inherent risk of perforation of the surgeon's gloves and consequent "needle stick injury" caused by the sharpened wires. ⁽⁴⁾ The other disadvantages of using arch bar include movement of teeth in lateral and extrusive direction, constant traction applied to the wire can distract the fracture parts and possibly cause

additional complications, difficulty to secure arch bar in isolated posterior teeth, and it is not suitable for dentition that carries extensive crown and bridgework.⁽⁶⁾

The introduction of the "bone plating system" has reduced the duration of IMF though there is a requirement of temporary intermaxillary fixation intra-operatively and sometimes postoperatively to correct minor dental occlusal discrepancies by elastic traction.⁽⁵⁾ Some studies noted that IMF screws are "quick and easy" to insert and have fewer risks of needle stick injury than traditional methods. The operating time is also reduced, hence these screws are recommended for temporary intraoperative IMF and postoperative elastic traction.⁽⁴⁾

Steven Key (2000) recommended a thorough clinical and radiographic assessment of the adjacent teeth at the site of screw placement.⁽⁷⁾ The preferred site for screw insertion was the alveolar bone between canine and first premolar but the cases having fracture line in canine and premolar region, the screw position needs to be changed depending on the fracture site and line of incision. The width of the "inter-dental bony septa" converges toward the occlusal surface, while the root circumference of the adjacent teeth enlarges, for that reason the risk of hitting a tooth root increases progressively by placing the screws closer to the coronal third of the root.⁽⁸⁾

Nandini et al reported the maximum time taken for arch bar fixation was 100 min and the average time taken for IMF with the self-tapping IMF screw was 8.5 min.⁽⁵⁾ Vatsa & Siddaraju noted the time taken to perform the procedure ranged from 90 to 110 min with a mean time of 102.8 min for Erich arch bar group and 20 to 30 min with a mean time of 22.5 min for Self-drill screws group which was quite similar with our study.⁽⁹⁾

Qureshi et al noted that Oral hygiene of all the patients was good, and in fact, it had improved postoperatively after meticulous oral hygiene instructions with IMF screws, but the oral hygiene was found very poor in patients with Erich arch bars.⁽⁶⁾ Anshul Rai et al. reported the mean value of Turskey Gilmore Glickman modification of the Quigley-Hein plaque index in IMF screws was 1.88 and in the conventional arch, the bar was 2.69

suggestive that IMF screws have better oral hygiene than the conventional arch bar.^[2] Our study observed that oral hygiene is difficult to maintain when arch bars are used for MMF which is in accordance with several authors in literature.

Qureshi et al reported the incidence of needle stick injuries and perforation of gloves and subsequently the risk of transmission of blood-borne diseases such as hepatitis and acquired immunodeficiency syndrome are much higher in cases of arch bar fixation as compared to IMF screws.⁽⁶⁾ According to Sandhu et al study, the most common complication faced in the conventional arch bar group was glove perforations. Gloves perforation was found in 60% of cases in the arch bar group, while absent in all patients of IMF screw group.⁽¹⁰⁾ The present study noted gloves perforation in 40% cases in the arch bar group and only one glove perforation in the IMF screw group.

The main purpose of intermaxillary fixation is occlusion stability. The loosening of the screws is another complication associated with the IMF screw method. Anshul et al found that IMF screws are as good as the arch bar for occlusion stability, but the major drawback was difficulty in maintaining it for a longer duration (5–6 weeks) due to the chance of screw loosening.⁽²⁾ Coletti et al. studied retrospectively on 49 patients and indicated that the most common complication was screw loosening (6.5%). The reason for screw loosening was due to the force of the musculature, which was exerted while the patient was in the IMF or in patients where the direction of the screw was not perpendicular to the occlusal plane.⁽¹¹⁾ Busch et al also reported loosening of the screw in his study. He recommended the use of greater diameter screws placed away from root apices.⁽¹²⁾ During transmucosal drilling, we should be very particular about coolant. The soft tissue acts as a cuff around the drill bit, preventing coolant to reach the bone. It causes thermal necrosis and subsequent loosening of the screw.⁽¹⁾ In our cases, loosening of 7 screws may be attributed to thermal necrosis.

Roccia et al. noted that 4.9% of the screws were covered by oral mucosa & none of the conventional arch bars was covered with oral mucosa.⁽¹³⁾ Carl-Peter Cornelius mentioned that soft tissue burying or mucosal overgrowth was only encountered in studies with IMF screws.⁽⁸⁾ The reason behind this

higher percentage of mucosal coverage of the IMF screw might be due to the placement of MMF screws in alveolar mucosa rather than in the attached mucosa. ⁽²⁾ Sandhu et al stated that soft tissue coverage was seen on screws where their angulation or screw site was changed due to resistance felt during insertion or where the site was adjacent to the incision site for ORIF. ⁽¹⁰⁾ Carl Jones designed the screws with capstan shaped head which allowed the wires and elastics to be held "away from the gingival tissue".⁽¹⁴⁾

Iatrogenic damage to roots of adjacent tooth is the most common complication observed with trans alveolar screws in some studies. ⁽¹⁰⁾ Qureshi et al recorded iatrogenic injury to tooth roots in 6 patients, which was due to improper angulations of the drill bit and overcrowding of teeth in the area of screw insertion and the presence of ankylosed teeth. All such teeth were treated by endodontic treatment. ⁽⁶⁾ Piyush & Siddharaju reported an iatrogenic injury to the patients between two study groups- 3 root perforation injury seen in self-drill screws group (15%) and no (0.0%) iatrogenic injury was seen in Erich arch bar group. ⁽⁹⁾ During drilling initial resistance is felt while penetrating the outer cortex followed by minimal resistance in cancellous bone. Drilling may be abandoned in case of continuous resistance and an alternate site may be selected. ⁽¹⁾ If this change in resistance is not felt, the possibility of bur being partly or fully in a tooth root should be considered. If damage of the mandibular or maxillary tooth roots by a central pulp involving lesion is identified on postoperative x-rays after the use of MMF screws a follow-up period of 4 to 6 months is good clinical practice. Endodontic treatment is administered only if vitality testing (repeated at regular intervals) remains negative or if the affected tooth becomes symptomatic, i.e., pulpitis. ⁽⁸⁾

Considering internal rigid fixation can provide stabilization of reduced fractured fragments, 4 screws were applied per case in this study. The mean cost of MMF screws was significantly more than the mean calculated cost for Erich arch bar. Short operatory time with low percutaneous injury risk tend to offset the high cost of screws. ⁽¹⁰⁾ The small sample size and limited follow-up could be considered as limitation of this study. However further clinical studies are required on large sample size along with specificity of technique to extend

their use in management of mandibular fractures to confirm these findings.

CONCLUSION

Although both techniques provide good intraoperative MMF but IMF screws had advantages over erich arch bar as it reduces operating time, reduce the risk of gloves puncture & percutaneous injuries to a surgeon. Oral hygiene maintenance was comparatively better in patients with IMF screws. Hence, we concluded that self-tapping IMF screw offers an simple and quick method of MMF in the treatment of the minimally & moderately displaced mandibular fracture. However, erich arch bars are the preferred choice for patients who require long-term intermaxillary fixation.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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