Comparison of the Efficiency of Maxillomandibular Fixation Screws over Erich Arch Bars in achieving Intermaxillary Fixation in Maxillofacial Trauma: A Clinical Study

Rahul Jain, Richa Pathak, Shubham Agrawal, Kamini Dadsena, Varun Kumar, Manthru N Ramavath

ABSTRACT

Introduction: Intermaxillary fixation (IMF) is regarded as a significant step in the management of maxillofacial trauma. Various techniques have been mentioned in the literature for achieving maxillomandibular fixation (MMF). Conventional methods like arch bars and eyelet wiring are the most commonly used, but these methods have their own shortcomings. With the introduction of self-tapping MMF screws in 1989, many of the drawbacks with the use of arch bars can be eliminated. Hence, the aim of this study was to compare the efficiency of MMF screws over arch bars in achieving IMF.

Materials and methods: A total of 30 patients who required IMF as a part of their treatment and reported to the Department of Oral and Maxillofacial Surgery, KLE VK Institute of Dental Sciences and KLE Dr Prabhakar Kore Charitable Hospital, Belgaum were included in the study. Patients were divided randomly into two groups: group I: patients treated using MMF screws and group II: patients treated using arch bars. Statistical analysis was performed using the Mann–Whitney U test and unpaired t-test.

Results: There was a significant difference in oral hygiene index between the two groups at the end of 14th postoperative day. The time taken for the placement of MMF screws was significantly less (mean 41.2 minutes) as compared with arch bars (mean 18.7 minutes). Screw loosening was seen in 4 (26%) of 15 patients and 3 screws (4.5%) out of 66 screws used showed partial mucosal coverage at the end of 2 weeks. There were no cases of penetration injury in group I while in group II, penetration injury to the surgeon was noted in 5 (33.3%) cases.

Conclusion: Maxillomandibular fixation screws provided good intraoperative IMF. Placement of screws consumes less time and reduces the intraoperative period and also the risk of penetration injury to the surgeon. We also observed better oral hygiene, better patient compliance, and no major complications with the use of MMF screws. Hence, MMF screws proved to be an efficient alternative to the conventional methods of achieving IMF.

Keywords: Erich arch bars, Intermaxillary fixation, Maxillomandibular fixation screws.

INTRODUCTION

Evolution has made humans quite susceptible to frontal impacts. Trauma to the facial region is common in road traffic accidents, sports-related injuries, and assaults. Maxillofacial trauma represents 42% of all injuries. In these, 70% are mandibular fractures and 30% are maxillary fractures. Since the ancient times, IMF has been used alone to treat fractures of maxilla and mandible as the knowledge of plating systems was rudimentary. This was achieved by attaching a metallic framework to the teeth to provide support to the fractured segments and then IMF was done with elastics or wires. Due to the lack of rigid fixation, the period of IMF was longer which used to cause discomfort to the patient.1

Intermaxillary fixation/MMF is considered one of the most important steps in the management of maxillofacial trauma. It is required to register and secure the correct interarch relationship of the occlusal surfaces and to maintain this relation for the proper reduction and fixation of fracture fragments.

Various methods to achieve IMF have been described in literature, such as Ivy eyelet wiring, Risdon wiring, arch bars, metal splints, acrylic splints, gunning-type splints...
Efficiency of Maxillomandibular Fixation Screws

for edentulous patients, bonded brackets, Dimac wires,
and Leonard button.\(^2\) And, more recently, self-tapping
and self-drilling MMF screws.

Erich arch bars have been considered as the standard for
achieving MMF because of its rigidity, versatility, and popu-
larit.\(^3\) Although they provide superior occlusal control,
reliable fixation, and superior stability during long-term
IMF,\(^2\) they have many disadvantages, including difficulty
in maintaining oral hygiene, trauma to the periodontium,
reduced patient compliance and discomfort, longer time
required for placement, and risk of needle stick injury.
Tooth avulsion during the twisting and tightening of the
wire around the tooth has also been reported in literature.

To overcome these problems, alternate techniques
like self-tapping IMF screws have been introduced.
These screws provide a bone-borne support for the MMF
wires to achieve IMF instead of a tooth-borne support in
the case of arch bars. Due to this, many complications
related to tooth-borne devices like poor oral hygiene
and periodontal health can be avoided.\(^5\) The concept
of direct transosseous wiring for MMF has been previ-
ously communicated in the literature, but is no longer
routinely used. But with the use of cortical bone screws,
these traditional techniques can be implemented more
readily and effectively.

The purpose of this prospective study was to assess
the efficacy of MMF screws in both maxillary and man-
dibular fractures and to compare it with Erich arch bars
as a means of IMF in the treatment of maxillary and
mandibular fractures that were reported to the Depart-
ment of Oral and Maxillofacial Surgery, KLE VK Institute
of Dental Sciences and KLE Dr Prabhakar Kore Charitable
Hospital, Belgaum. The study subjects were selected by
random sampling.

Patients aged 18 years and above and patients with
fractures of maxilla and mandible which require IMF
as a part of their treatment were included in the study.
However, those with dentoalveolar and panfacial frac-
tures, patients having primary and mixed dentition, and
patients having systemic diseases like rheumatoid arthri-
tis and bronchial asthma were excluded from the study.

Parameters taken into consideration were the surgical
time taken for placement and removal of both IMF screws
and Erich arch bar, plaque index scores, and complica-
tions related to both techniques.

During the stipulated timeframe of the trial, patients
were randomly allocated into two groups. Intermaxillary
fixation in both groups was done using 26-gauge wire.
The IMF screws were used in group I, while Erich arch
bar was used in group II. Self-tapping IMF screws with
Capstan Head were 2 mm in diameter, 8 and 10 mm in
length, and its head was 4 mm in length and 4 mm in
diameter.\(^6\) The screw had a pointed tip and its head had
a slot where the wire can be passed for IMF (Figs 1 to 3).

After removal of the screws and arch bars, oral
hygiene status was evaluated using Turesky-Gilmore-
Glickman modification of Quigley-Hein plaque index and also vitality of teeth adjacent to screws was checked with electrical pulp testing.

RESULTS

In group I, all the 15 patients were males (100%). In group II, among the 15 cases, there were 14 males (93.3%) and 1 female (6.7%) (Graph 1). 1 (3.3%) patient was below 20 years, 12 (40%) patients were between 20 and 30 years, 12 (40%) patients were between 30 and 40 years, and 5 (16.6%) patients were between 40 and 50 years of age. In group I, the mean age was found to be 33.53 [standard deviation (SD) 9.43] and in group II, the mean age was 32.6 (SD 9.6) (Graph 2).

Among the 30 patients, 4 (13.3%) had fracture of parasympysis, 6 (20%) had Le Fort II fracture, 6 (20%) patients had angle and parasympysis fracture, 3 patients (10%) had angle fracture, 2 (6.7%) had Le Fort II fracture, 2 (6.7%) patients had symphysis fracture, 2 (6.7%) patients had body of mandible fracture, 1 (3.3%) patient had Le Fort III fracture, 1 (3.3%) patient had body of mandible and angle fracture, 1 (3.3%) patient had angle and zygomaticomaxillary complex (ZMC) fracture, 1 (3.3%) patient had body of mandible and parasymphysis fracture, and 1 (3.3%) patient had parasymphysis and ZMC fracture.

The mean time taken for the placement of MMF screws in group I was 18.73 minutes (SD 3.26) and the mean time taken for the placement of arch bars in group II was 41.27 minutes (SD 5.20). The results were statistically significant using unpaired t-test with p-value 0.00001 (Table 1).

Plaque index score was calculated using Turesky-Gilmore-Glickman modification of Quigley-Hein plaque index. The mean plaque index score in group I was 0.95 (SD 0.26) and in group II the mean plaque index was 3.14 (SD 1.21). The results were statistically significant using Mann–Whitney U test with p-value 0.00001 (Table 2).

There were no cases of penetration injury in group I while in group II, penetration injury to the surgeon was noted in 5 (33.3%) cases. Screw loosening was seen in 4 (26%) out of 15 patients. Out of the total number of screws placed (66) in our study, 7 (10.6%) screws became loose at the end of 2nd week. Three screws (4.5%) out of 66 screws used showed partial mucosal coverage at the end of 2nd week. No case was reported with root damage and screw breakage.

DISCUSSION

Intermaxillary fixation is an essential step to achieve temporary dental occlusion during operative and post-operative phase of treatment. However, in the present

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**Table 1:** Comparison of groups I and II with time taken by unpaired t-test

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
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<td>I</td>
<td>18.73</td>
<td>3.26</td>
<td>18.00</td>
<td>−14.2126</td>
<td>0.00001*</td>
</tr>
<tr>
<td>II</td>
<td>41.27</td>
<td>5.20</td>
<td>41.00</td>
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</tbody>
</table>

*p < 0.05

**Table 2:** Comparison of plaque index in groups I and II with Turesky-Gilmore-Glickman modification of Quigley-Hein plaque index score by Mann–Whitney U test

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Sum of ranks</th>
<th>U-value</th>
<th>Z-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.95</td>
<td>0.26</td>
<td>0.95</td>
<td>120.00</td>
<td>0</td>
<td>−4.6663</td>
<td>0.00001*</td>
</tr>
<tr>
<td>II</td>
<td>3.14</td>
<td>1.21</td>
<td>3.28</td>
<td>345.00</td>
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</table>

*p < 0.05
era of miniplate osteosynthesis, open reduction is preferred to reduce the duration of hospitalization with minimal discomfort to the patient and early return to the work.

The aim of this study was to find an improved technique for achieving IMF. These screws were first introduced in the year to overcome the problems associated with tooth-borne devices. The IMF screws are inserted into the alveolar process of the maxilla and mandible monocortically and act as an anchor point for MMF wires which pass through the holes incorporated in the specialized screw heads known as Capstan heads kept 4 to 5 mm above the alveolar mucosa. Transmucosal IMF screws were first described in a 4-point fixation pattern with at least one screw in each quadrant. The MMF screws with different screw heads can also be used in different patterns like one screw in each quadrant and screws with different screw heads can also be used in with at least one screw in each quadrant.4 The MMF screws have advantage along with a few disadvantages (Table 3).

In the present study, we compared the plaque accumulation in both the groups in order to identify a technique with better ease of maintaining the oral hygiene. The mean plaque index value was found to be higher in group II, i.e., patients treated using Erich arch bars. This implies that with the use of MMF screws, maintenance of oral hygiene is improved, and also the risk of periodontal diseases is significantly reduced. We also noticed better patient compliance with the use of MMF screws than arch bars. Rai et al8 in a comparative study also reported more plaque accumulation in patients treated using Erich arch bars as compared with MMF screws. Similar results were documented by Qureshi et al6 who reported screw loss in 44 (18.3%) screws were completely submucosal coverage of the screws. Out of the 240 screws inserted root fracture during screw placement in 2 (4%) out of 49 patients. Both the teeth were eventually extracted. Similar complications were noted by few researchers as well.6,5,10 In this study, there were no occurrences of root damage associated with IMF screws. Hence, proper planning prior to the insertion of MMF screws is essential. The site for screw placement should be determined after comprehensive radiographic assessment with the use of orthopantomographs (OPG) and intraoral periapical radiographs. The three-dimensional relationship of the path of insertion of the screw with the surrounding dental structures should be carefully assessed to reduce the iatrogenic dental trauma.12

In the present study, the most common complication that occurred with the use of MMF screws was screw loosening. At the 14th postoperative day, screw loosening was seen in 4 (26%) out of 15 patients. Out of the total number of screws placed (66) in our study, 7 (10.6%) screws became loose at the end of 2nd week. This is in accordance with Qureshi et al9 who reported screw loss in 3 of 30 cases. Screw loosening mainly occurs due to the force exerted by the oral musculature while the patient is in IMF. It can also occur when the direction of screw is not perpendicular to the occlusal plane.8

Another complication that occurred with the use of MMF screws was the coverage of the screw head with oral mucosa. Rai et al8 reported a high incidence of mucosal coverage of the screws. Out of the 240 screws used in the study, 44 (18.3%) screws were completely submerged in oral mucosa at the end of 4th week. The author stated that the cause behind the high occurrence of this complication was perhaps the IMF screws were placed high up in the movable alveolar mucosa rather than in the adherent mucosa.

### Table 3: Advantage and disadvantage of IMF screws

<table>
<thead>
<tr>
<th>Merits</th>
<th>Demerits</th>
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<tr>
<td>Much less time for placement hence shortens the operating time</td>
<td>Iatrogenic injury to the roots</td>
</tr>
<tr>
<td>Easy to maintain good oral hygiene</td>
<td>Screw loosening,</td>
</tr>
<tr>
<td>Minimal trauma to the periodontium</td>
<td>Mucosal coverage of screw</td>
</tr>
<tr>
<td>Reduced risk of needlestick injury with the sharp wires</td>
<td>Long-term IMF not possible</td>
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<tr>
<td>Better patient compliance</td>
<td>Expensive</td>
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</table>
In our study, the incidence of needle stick injury was also noted. We found 33% incidence of penetrating injury to the surgeon with the use of Erich arch bars. These results were in close association with results from various other studies.6,9,10 There was no such occurrence with the use of MMF screws.

CONCLUSION

The study was conducted on 30 patients who reported to the Department of Oral and Maxillofacial Surgery that required IMF as a part of their treatment. Based on this study, we can conclude that MMF screws provided good intraoperative IMF. Placement of screws consumes less time and reduces the intraoperative period. The risk of penetration injury to the surgeon with the use of sharp stainless steel wires is also reduced. We also observed better oral hygiene and better patient compliance with the use of MMF screws. Postoperatively, there was no incidence of pain, infection, injury to adjacent tooth root, or nerve damage. The only complication encountered with the use of MMF screws was screw loosening at the end of 2nd week. Hence, if IMF is desired for a longer time period, MMF screws may not be the best choice.

REFERENCES