

## Comparison of Self-Tapping Screws Versus Erich's Arch Bar Wiring for Occlusion Maintenance in the Surgical Management of Mandibular Fracture: A Randomized Control Trial

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### Abstract

**Background:** Conventional methods like Erich's arch bars and eyelet wires are currently most common methods for achieving temporary inter-maxillary fixation (IMF). **Objectives:** The purpose of the present study was to compare the efficacy of Self-tapping screws over Erich's arch bar wiring for inter maxillary fixation in the treatment of mandibular fractures. **Methodology:** This was a randomized control trial study. Study duration was one year from October 2014 to September 2015. This study involved patients with mandibular fractures aged 22 to 65 years who visited Department of Oral & Maxillofacial Surgery at Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. After random sampling according to inclusion and exclusion criteria surgical treatment was done by miniplate osteosynthesis. Study population were divided into two groups. In group A, temporary MMF was done with Erich's arch bar and in group B treatment was given with self-tapping screws. The study outcomes were total time required for achieving temporary MMF, number of wire stick injury, stability of occlusion and oral hygiene index. All the parameters were measured preoperatively and postoperatively for 14 days up to removal of screws or arch bars. **Results:** The mean time taken for temporary MMF was  $11.31 \pm 2.46$  min with screws as compared to  $84.72 \pm 14.30$  min with Erich's arch bar. Mean number of perforations were significantly more in group A. Occlusion stability was 69.2% in group A and 84.6% in group B. The mean value of plaque index in group A was  $2.85 \pm 0.25$  and in group B was  $1.15 \pm 0.16$ . **Conclusion:** In conclusion, plaque deposition was more in group A. [Journal of National Institute of Neurosciences Bangladesh, July 2022;8(2):175-180]

**Keywords:** Fractures; mandible; maxillofacial fractures; maxillo-mandibular fixation; treatment; facial injuries; trauma

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### Introduction

Successful treatment of mandibular fractures depends on

reduction, restoration of normal occlusion and fixation to restore the mandibular form and function to its previous

condition. Before fracture reduction, temporary Maxillo-mandibular fixation (MMF) with correct registration of occlusion is required. MMF is regarded as the crucial step in the management of maxillofacial trauma, since it secures the inter-relationship of the occlusal surfaces, which is the absolute essential step in reduction of fragments in both jaws. There is a need for temporary MMF intra-operatively to assist in reduction of fractures with the teeth in correct occlusion and post operatively to correct minor occlusal discrepancies. Intra-operative application of tooth borne inter-maxillary fixation devices are time consuming and increases the duration of anesthesia.

Stable MMF can be achieved by various techniques like Eyelets, Arch bars, Bonded brackets, Cast metal splints, Vacuum formed splints, Pearl steel wires, Self-tapping MMF screws and Self drilling IMF screws, the standard being the use of arch bars applied to both dental arches<sup>1</sup>. However, these are time-consuming methods, with a constant danger of trauma to the surgeon's fingers by the sharp wire ends. Twisting a wire around a tooth conveys little feel as to its tightness and there is a danger of avulsion if force is too great. Wires tightened during the application of arch bars around the teeth may cause ischemic necrosis of the mucosa and the periodontal membrane and if damage is extensive, tooth loss may result<sup>2</sup>. Currently, self-tapping MMF screws have been advocated for MMF<sup>3</sup>. MMF screws are inserted into the bony base of both jaws in the process of fracture realignment and immobilization. IMF screws were initiated as a means of achieving temporary jaw fixation, as the only therapeutic method, or prior to internal fixation of certain types of mandibular fractures. MMF is predominantly used as only an intra-operative technique to aid reduction in miniplate osteo-synthesis.

Despite the fact that the method is easy to apply, it carries the risk of damage to the roots of the teeth. Self tapping MMF screws are quick and easy to use and greatly shorten the operating time to achieve temporary MMF. They are relatively inexpensive and reduce the risk of needle stick type injuries associated with wires<sup>4</sup>. There is also no trauma to gingival margins and gingival health is easier to maintain as compared to arch bars or eyelets. The purpose of the present study was to compare the efficacy of Self-tapping screws over Erich's arch bar wiring for inter maxillary fixation in the treatment of mandibular fractures.

## Methodology

**Study Settings and Population:** This randomized clinical trial was done in the Department of Oral and

Maxillofacial Surgery of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh over a period of 1 year from October 2014 to September 2015. The patients were obtained from the records of outpatients of Bangabandhu Sheikh Mujib Medical University and inpatients admitted under Oral and Maxillofacial Surgery department of Bangabandhu Sheikh Mujib Medical University of Dhaka of Bangladesh. A detailed medical history, clinical examination and radiological examination were done. Findings were collected and recorded in a semi-structured questionnaire. Data were collected by a face-to-face interview.

**Randomization and Blinding:** Computer generated simple random sampling technique was applied to divide the study population into two groups designated as group A and group B. Single blinding was applied.

**Allocation:** Maxillo-mandibular fixation was done in group A patients with Erich's arch bar and Maxillo-mandibular fixation was done in group B patients with self-tapping screws. After thorough history and clinical examination, the trauma cases having only mandible fracture a single line fracture or comminuted fracture in non-tooth bearing area of mandible in patients according to inclusion and exclusion criteria were selected for this study. Maxillo-mandibular fixation was achieved before miniplate osteosynthesis by using Erich's arch bar in patients and in another patients of same criteria by Self tapping titanium coated center drive Maxillo-mandibular fixation screw of 2 mm diameter having hole in the head.

**Follow Up and Outcomes Measures:** The findings were recorded as per the criteria like time consumed for achieving Maxillo-mandibular fixation was recorded in minutes from start of procedure till IMF was achieved, needle stick injury, incidence of perforations in the gloves of surgeon and first assistant were identified by water inflation method. A puncture in any of the team member's gloves was taken as positive finding, stability of inter maxillary fixation by criteria of stable occlusion. Oral hygiene index simplified was given and was used to evaluate the oral hygiene status of the patient at the time of 14th day after the splint placement and was scored accordingly. All the cases were taken up for open reduction and mini-plate osteosynthesis under general anesthesia. Single line fracture cases had no postoperative occlusal discrepancy hence elastic traction was not used. Mild postoperative occlusal discrepancy was noted in cases with single line fracture in tooth bearing area & multiple fracture line in non-tooth bearing area of mandible and this was

corrected by elastic traction for 14 days. All the MMF screws were removed on the 14th postoperative day with local anesthesia.

**Statistical Analysis:** Statistical analysis was performed by Windows based software named as Statistical Package for Social Science (SPSS), versions 22.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Continuous data were expressed as mean, standard deviation, minimum and maximum. Categorical data were summarized in terms of frequency counts and percentages. Chi-square test was used for comparison of categorical variables and Student t test was applied for continuous variables. Every efforts were made to obtain missing data. A two-sided P value of less than 0.05 was considered to indicate statistical significance. Differences between case and control were tested.

**Ethical Clearance:** Prior to the commencement of the study, the research protocol was approved by the ethical Institutional Review Board of BSMMU Dhaka. A written informed consent was taken for participation after explaining the purpose and design of the study to each subject (IRB/BSMMU/2101).

**Results**

Group A consists of 13 patients and Group-B consists of 13 patients. MMF was done in 13 patients with Erich's arch bar and MMF was done in 13 patients with self-tapping screws. Twenty six patients with mandibular fracture according to inclusion and exclusion criteria were selected randomly. They are treated by open reduction and miniplate osteosynthesis under G/A. Of them, in Group A, temporary MMF was done in thirteen patients with Erich's arch bar and other thirteen patients in Group B with self-tapping screws. Majority 10 (38.46%) of the patient were in 22 to 34 years group (Figure I).

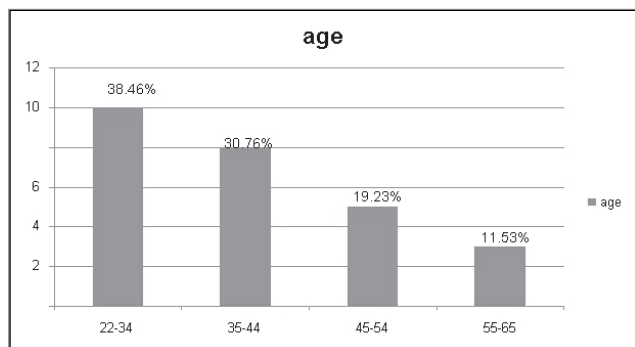


Figure I: Showing age distribution of study population

It was observed that majority 21(80.76%) of the patient were male whereas 5 (19.23%) were female (Figure II).

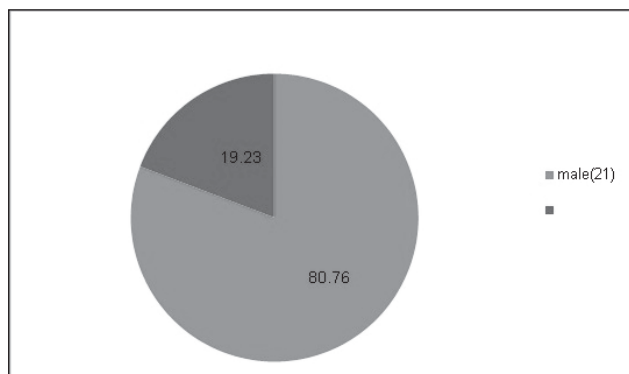


Figure I: Showing age distribution of study population

Table I showed time required to achieve MMF method in the study patient. It was observed that mean time for achieving temporary MMF in Group A was 84±14.30 minutes and 11.31±2.46 minutes in Group B. The mean total time difference was statistically significant (P value <0.001) between two groups.

Table 1: Comparison of Time Required to Perform the Procedure between the Two Study Groups (n=26)

Operating time (Minutes)	Group A (n=13)	Group B (n=13)	P value
Mean ±SD	84.77±14.30	11.31±2.46	
Range	67.00-115.00	7.00-15.00	<0.001***
Median	84.00	12.00	

n= number of patient; P value reached from Mann- Whitney U test;\*\*\* = Significant; Group A=MMF done by arch bar; Group B= MMF done by Self tapping screw

Table II showed number of needle stick injury to surgeon's hand. It was observed that the mean number of perforation of hand gloves were significantly more in Group A (4.15 ± 1.46) as compared to Group B (0). The difference was statistically significant (P value <0.001) between two groups

Table 2: Comparison of Number of Needle Sticks Injury to Surgeon's between the two study groups (n=26)

Number of Needle sticks Injury	Group A (n=13)	Group B (n=13)	P value
Mean ± SD	4.15±1.46	0	
Range	2-7	0	<0.001***
Median	4.00	0	

n=number of patient; P value reached from Mann Whitney U test;\*\*\* = Significant; Group A= MMF done by arch bar; Group B = MMF done by Self tapping screws

Table 3 showed the occlusion status of the study patients. It was observed that majority11 (84.6%) patients of group B and 9 (69.2%) patient of group A

had stable occlusion. The difference was not statistically significant (P value =0.642) between two groups.

Table 3: Comparison of Occlusion Stability Achieved Per-Operatively between the Two Study Groups (n=26)

Occlusion stability	Group A (n=13)	Group B (n=13)	P value
Stable occlusion	9(69.2)	11(84.6)	0.642 <sup>ns</sup>
Unstable occlusion	4(30.8)	2(15.4)	

n=number of patient; P value reached from Chi-square test with Yates's correction. ns = Not significant; Group A= MMF done by arch bar; Group B = MMF done by Self tapping screws

Table 4 showed the mean value of plaque index of both groups and observed that mean debris index was  $2.85 \pm 0.25$  in Group A and  $1.15 \pm 0.16$  in Group B. The result signifies that plaque was more in Group A.

Table 4: Comparison of Oral Hygiene (Debris index) between the Two Study Groups (n=26)

Oral hygiene (Debris index)	Group A (n=13)	Group B (n=13)	P value
Mean $\pm$ SD	$2.85 \pm 0.25$	$1.15 \pm 0.16$	
Range	2.50-3.30	1.00-1.50	0.001***
Median	2.90	1.10	

n=number of patient; P value reached from Mann Whitney U test;\*\*\* = Significant; Group A= MMF done by arch bar; Group B = MMF done by Self tapping screws

## Discussion

The MMF with screws is a quick and easy method, as the mean time required for placement and removal in Group B was significantly less than in Group A. Gordon et al<sup>5</sup> reported that the average working time was 25.8 minutes. In contrast we took average 11 minutes for fixation of four MMF screws. There was no requirement of any additional armamentarium. In the present study, the time taken to achieve temporary MMF with self-tapping MMF screws and Erich's arch bar was noted. According to the results, it is evident that the maximum time taken was for arch bar fixation 115 min and the average time taken for MMF with the self-tapping screw was found to be 11.31 min. The results of the present study are in agreement with the data from various studies. Rai et al<sup>6</sup> reported that the mean time taken for screw was 18 minutes and for arch bar was 95 minutes.

The insertion of MMF screws is a rapid and elegant technique to provide abutments for jaw immobilization with wire or elastic loops and secure occlusal relationships. MMF screws are claimed to improve the

safety of the procedure, since only a few wire ligatures are used as jaw linking cerclages. Minimizing intraoral manipulation with sharp stainless steel wire tips diminishes the rate of glove perforations and puncture injuries as risk factors for blood borne virus transmission like hepatitis B, hepatitis C, HIV<sup>7</sup>. An incidence of glove perforations up to 50% due to wire stick trauma was reported, when inter-maxillary wire fixation was employed as the single treatment modality in a series of mandible fractures.

In Group A, there was incidence of wire stick injury causing glove perforation, gingival papillary hyperplasia and trauma to the operators fingers whereas no such complications were seen in Group B. Avery and Johnson<sup>8</sup> showed that the incidence of glove perforation was significantly high with wiring techniques. The incidence of surgical glove perforation during treatment of some maxillofacial fractures was as high as 50.0% cases.

The preferred site for screw placement was the alveolar bone between canine and first premolar. But the cases having fracture line in canine and premolar area, the screw position was changed depending on the fracture site and line of incision. In two cases we have placed the screw in the edentulous first molar area.

In group A, the occlusion was stable in 69.2% and unstable in 30.8% of the patients. In group B, stable in 84.6% and unstable in 15.4% of patients. Nandini et al<sup>4</sup> reported that the stability was adequate in 80.0% of the patients and it was inadequate in 20.0% of the patients with self-tapping screws and stability was adequate in 70.0% of the patients and inadequate in 30.0% of patients with arch bar.

The mean plaque index value is higher in group A which is 2.85, which suggests that oral hygiene maintenance is easy when MMF was achieved with the screws. As accepted by several authors in the literature, oral hygiene is difficult to maintain when arch bars and eyelets are used for MMF. Rai et al<sup>6</sup> in their study reported that mean value of plaque index was 2.69 with arch bar and 1.88 with Self Tapping Screws. In this study it was 2.85 in Group A and 1.15 in Group B.

The patients were evaluated by radiographs and vitality test. Radiographs revealed that four screws had caused injuries to the dental roots of two premolars and two canines. These lesions consisted of scratching the roots which carried no consequences for vitality or stability of the teeth concerned. Two premolars presented with holes passing through the root and involving the pulp cavity. The injury to the roots of the teeth adjacent to the screw fixation site is a major complication for self-tapping



screws. Majumdar<sup>9</sup> reported one case of tooth root damage using self-tapping screws. The operator must be confident that he/she has felt the bur drop in the medullary bone after having perforated the buccal cortex, before lingual/palatal cortex is encountered. If this change in resistance is not felt, the possibility of bur being partly or fully in a tooth root should be considered. Majumdar<sup>9</sup> mentioned his system include easy placement and removal with minimal hardware, significant reduction in operating time from 45 to 10 min and equal ease of application in dentate and non-dentate patients. The above mentioned advantages were experienced in the present study. Coburn et al<sup>10</sup> reported iatrogenic damage to the tooth root in 4.0% of cases. We feel this complication can be avoided by selecting 2 mm diameter screw instead of 2.5 mm. Secondly during drilling initial resistance is felt while penetrating the outer cortex followed by minimal resistance in cancellous bone. In case of continuous resistance drilling may be abandoned and an alternate site may be selected which can be measured by torque force but was not available.

The possible cause of root injury may be due to lower density than the dental roots, with consequently different resistance to the bur. If resistance is felt to drilling, one must stop and prepare another hole, because this could indicate that the bur is partly or fully within a tooth root. It is certainly important to evaluate a dental panoramic radiograph and CBCT prior to drilling and inserting the screws in order to accurately visualize the position of the roots, especially in cases of dental crowding.

Self-tapping IMF screws provided good intra operative fixation in all the cases in the present study. Postoperatively, there was no incidence of infection, trauma to the surrounding tissues and nerve injury. There were no signs and symptoms of pain and edema at the screw site in all the cases at the end of 2<sup>nd</sup> week in the present study. Oral hygiene of all the patients was good and in fact it had improved postoperatively after meticulous oral hygiene instructions with screws but it was fair with Erich's arch bars. It was easier to maintain oral hygiene with MMF screws compared to arch bar. The MMF screws technique is good alternative to Erich's arch bars for temporary MMF.

Contraindications to use of screws include where the function of a "tension band" and postoperative directional traction are required, as in multiple comminuted mandibular fractures, alveolar bone fractures or gunshot fractures. It was impossible to achieve postoperative directional traction to correct a postoperative malocclusion as reported with a patient

suffering from a parasymphiseal and bilateral condylar fractures, pediatric patients with un-erupted teeth, and cases with severe osteoporosis. Therefore, this method is mainly used in cases of single or double mandibular fractures in non-tooth bearing area with minimal displacement, compound condylar fractures. Hence it is our observation that the IMF screw is an ideal device for temporary inter-maxillary fixation (for less than 14 days) for the cases having only mandibular fracture. Use of self-tapping MMF screws for temporary MMF is a valid alternative to conventional Erich's arch bar in the treatment of single line unfavorable fracture of mandible. This technique is a good alternative to arch bars, when correctly applied. Iatrogenic injury to dental roots is the most important problem to this procedure, which can be minimized by careful radiographic evaluation and treatment planning.

### Conclusion

In conclusion the efficacy of Self-tapping screws is better over Erich's arch bar wiring for inter maxillary fixation in the treatment of mandibular fractures. Thus it would be advantageous to use self-tapping MMF screws in the treatment of single line fracture or multiple fractures in non-tooth bearing area of mandible and extend it to the treatment of other fracture. However, the surgeon must evaluate the potential benefits and limitation of MMF screws in order to provide safe and effective treatment.

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