

COMPARISON OF INTER-MAXILLARY FIXATION SCREWS WITH ARCH BARS FOR THEIR EFFECTIVENESS IN ESTABLISHING OCCLUSION BEFORE OPEN REDUCTION AND INTERNAL FIXATION IN MANDIBULAR FRACTURES

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ABSTRACT

Objective: To compare the effectiveness of inter-maxillary screws in establishing occlusion over arch bars and to determine possible complications associated with both techniques.

Study Design: Comparative prospective study.

Place and Duration of Study: Department of Oral & Maxillofacial Surgery, Armed Forces Institute of Dentistry, Rawalpindi from Jul 2018 to Jul 2019.

Methodology: Forty-four patients having mandibular fractures were selected. Participants were divided into group A (arch bar) and group B (inter-maxillary screws). Randomization was done through lottery method. Patients with permanent dentition and unilateral fractures in dentate area of the mandible were included in the study. Glove punctures, time taken for establishing intermaxillary fixation, stability of occlusion, hardware tolerability, oral hygiene and associated complications were recorded at per-op and 04 weeks follow up.

Results: Glove puncture was more frequent in arch bar group 13(65%) than intermaxillary screw group 3 (13%) [$p.001$]. The time needed for establishing intermaxillary fixation with intermaxillary screws was less than that of arch bar group ($p<0.001$). The hardware tolerability ($p=0.001$) and oral hygiene ($p=0.001$) were statistically better in intermaxillary screw group than arch bar group. The associated complications were statistically different between the two methods of intermaxillary fixation ($p=0.034$).

Conclusion: Intermaxillary screws are more effective than arch bar in establishing intermaxillary fixation.

Keywords: Arch bar, Intermaxillary fixation screws, Maxillomandibular fixation, mandibular fractures.

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INTRODUCTION

In the maxillofacial region the mandible has a complex role in facial aesthetics and functional occlusion. Due to the prominence of mandibular bone, its fractures are the most common among the facial skeleton¹.

Though mandibular fractures managing principles have changed recently but the aim to re-establish the occlusion and restore masticatory function are still valid². Although the standard method is reduction and rigid internal fixation for simple and complex facial fractures, but temporary inter-maxillary fixation (IMF) with wires or elastics during operation is mandatory to establish occlusion³. Different methods to achieve IMF are Erich arch bars, IMF screws, dental eyelets,

bonded brackets, cast metal splints, external pin fixation, embrasure wires, and pearl steel wires^{4,5}. Although IMF can be done effectively by arch bars but their use is not free from disadvantages. Risk of injury to operator, longer surgical time for placement and removal, injury to periodontium, and poor oral hygiene are all drawbacks of traditional arch bars⁶. The arch bar is also associated with dentition movement in lateral and extrusive direction. Arch bar is difficult to secure, and it is not suitable for dentition with extensive crown and bridge work^{7,8}.

The introduction of self-drilling screws was done in 1989 which eliminate many arch bar disadvantages⁶. Quick and easy insertion, reduced risk of needle stick injuries and less operating time to obtain IMF are advantages of self-drilling IMF screws. They have no risk of trauma to the periodontium and oral hygiene is easier to maintain as compared to arch bars⁹.

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Qureshi *et al*⁹, conducted a comparative study on IMF screws and Erich arch bars in mandibular fractures on 60 patients in India. They reported that IMF with IMF screws is more effective than Erich arch bars in the treatment of mandibular fractures in term of oral hygiene, operating time, needle stick injury, hardware tolerability etc. Sandhu *et al*¹⁰, in a prospective randomized clinical study made comparison of the IMF technique using bone screws (group-I) and Erich arch bars (group-II). They randomly allocated the participants into two groups; thirty patients in each group. Total time taken, rate of glove perforation, intraoperative and postoperative complications were noted in both the groups. Their results showed the time taken for IMF and frequency of glove puncture were less for screw group than arch bar group and the difference was statistically significant ($p < 0.05$). However between the groups the difference in term of oral hygiene was not significant. The associated complications were screw breakage (4.67%), wire breakage (5.12%), non-vitality due to iatrogenic dental damage (01.66%), soft tissue injury and tooth loss.

Different techniques have been used from time to time to obtain fixation of jaws. Though arch bars are an effective and versatile way of IMF, however, arch bars are not free from shortcomings. According to the literature with the availability of IMF screws, the needs of arch bars have been eliminated. However, in our set up arch bar is mostly used. So the rationale of the study is to document the efficacy of IMF screws over arch bar and ultimately to change the health policy.

The objective of study was to compare the effectiveness of IMF screws in establishing occlusion over arch bar and also to determine possible complications associated with both techniques.

METHODOLOGY

This comparative prospective study was conducted at Armed Forces Institute of Dentistry (AFID), Rawalpindi from July 2018 to July 2019. Sample size of 44 (22 in each group) was calculated using WHO calculator for "Hypothesis

testing for two population proportions (one sided test) using the proportion of good oral hygiene to be 0.07 in arch bar group and 0.27 in IMF screw group at 80% power of test and 5% level of significance. Sampling was done by using non-probability consecutive method. Verbal informed consent was obtained from all participants after explaining the purpose and details of this research. The research was approved first from institutional ethics review committee (Letter # 905/Trg-ABP1K2).

The selection of the patients was done using simple randomization enveloped method and designated as group I and II. In this first patient of the study was selected by a draw and labeled as group I. After this, all subsequent patients were divided alternatively into groups I and group II randomly while taking into consideration the inclusion criteria. Patients in group I was treated with arch bars. Those in group II was managed with IMF screws.

Patients with permanent dentition, unilateral fractures in dentate area of the mandible, both genders and patients not older than 60 years were included in the study. Patients with primary and mixed dentitions, mandibular fractures associated with other maxillofacial & body fractures, medically compromised and edentulous patients were excluded.

Under general anesthesia 3 screws were inserted in upper jaw one between premolars on right side, one between central incisors and one between premolars on left side. Similarly 3 screws were inserted in the lower jaw. Screws positions were variable depending upon the fracture site. Then IMF was done.

Arch bar of length according to dental arch of the patient was cut and molded to the shape of the arch and attached to the teeth with of help of stainless steel wire. Hooks of upper arch bar were facing upward and of lower arch was facing downward. IMF was done with the help of stainless steel wires of 0.45 diameter. IMF was either being released at the completion of ORIF or may

be left in place for 4 weeks depending upon fracture condition.

The post-operative follow up was weekly for first 4 weeks. After 4 weeks arch bars or IMF screws was removed under local anesthesia (LA) if needed. Glove puncture, duration of fracture management, per-operative occlusion, hardware tolerability, oral hygiene, associated complications and need of LA for removal were recorded at 4 weeks follow up.

The collected data was analyzed using SPSS version 20. Descriptive statistics were computed for all variables. Mean and standard deviation were calculated for continuous variables. Frequency and percentages were calculated for categorical variables. Comparison of the categorical variables (glove puncture, duration of fracture, per-operative occlusion, hardware tolerability, oral hygiene, need of LA for removal, and associated complications) between arch bar and IMF screw group were done using chi-square test. *p*-value ≤ 0.05 was considered significant.

RESULTS

Of total participants 32 (72.7%) were males and 12 (27.3%) were females. The mean age was 31.7 ± 11.98 years. Most frequent age was 18-25 years 12 (56.8%) followed by 41-45 years 9 (20.5%). The least number of participants were in age group 46-50 years 2 (4.5%). The details were given in table-I.

Glove puncture was frequent in arch bar group 13 (65%) than IMF screw group 3 (13%). The results were highly statistically significant ($p < 0.001$). The time required for IMF with IMF screw was < 20 minutes in most of cases 20 (90%) while in arch bar group it was upto 60 minutes 15 (68.2%). The time needed for IMF with IMF screw was highly statistically significantly ($p = 0.001$) less than arch bar group. Per-operative occlusal stability was not statistically different between the two techniques of jaws fixation ($p = 0.680$). The hardware tolerability was better in IMF screw group than arch bar group. In IMF screw group 20 (90%) had good hardware tolerability while it was 8 (36.3%) in arch bar group. The results for

hardware tolerability were highly statistically significant ($p = 0.001$). The oral hygiene was statistically ($p = 0.001$) better in IMF screw group than arch bar group. In cases in which IMF was done with IMF screws had good oral hygiene 17 (77.3%) while in arch bar cases the frequency of good oral hygiene was 6 (27.3%). The associated complications were statistically different between the two methods of IMF ($p = 0.034$). Periodontitis 1 (4.5%) and solely gingivitis 3 (13.6%) was found in arch bar group only. In IMF screw group the complications were loss and breakage of screws 2 (9.1%) and loss of tooth vitality 2 (9.1%). The need of local anesthesia to remove the arch bar and IMF screws did not differ statistically ($p = 0.340$) (table-II).

Table-I: Age and gender distribution of the sample.

	Variable	n (%)
Gender	Male	32 (72.7)
	Female	12 (27.3)
	Total	44 (100)
Age group	18-25	25 (56.8)
	26-30	6 (13.6)
	31-35	2 (4.5)
	41-45	9 (20.5)
	46-50	2 (4.5)
	Total	44 (100.0)

DISCUSSION

This randomized clinical trial was conducted to assess the efficacy of IMF screws over arch bar in jaw fixation after fracture. Our findings showed that there was less risk of glove puncture, less time needed, good hardware tolerability, better oral hygiene, and good periodontal health in IMF screw group than arch bar group. However loss of tooth vitality and breakage/loss of screws were complications associated with IMF screws. Stable occlusion per-operatively was achieved equally in both groups.

Since the World War I, the arch bar has been the mainstay for treating the maxillomandibular bony injuries though other techniques such as external pin fixation, interdental eyelet wiring, bonded brackets, cast metal splints, embrasure

wires, and pearl steel wires were also been used for this purpose according to a study done by Sharma *et al*¹⁵. Although IMF can be done effectively by arch bar but their use is not free from disadvantages. Risk of injury to operator, longer surgical time for removal and placement, injury to periodontium, and poor oral hygiene are all drawbacks of traditional arch bars⁶. The arch bar was also associated with dentition movement in

hanger plate technique for IMF in fracture mandible has also reported more males than females⁸.

Our findings showed that glove puncture was less in IMF screw group. Glove puncture is a risk for cross infection especially in hepatitis and acquired immune deficiency syndrome cases. Similar results were reported in previous studies by Qureshi *et al*⁹, and Satpute *et al*⁴.

In our study the time required for IMF screw

Table-II: Comparison of arch bar and intermaxillary fixation screws in maxillomandibular fixation in mandibular fractures.

Variable	Group		p-value
	Arch Bar n (%)	Intermaxillary screws, n (%)	
Glove Puncture	Yes	13 (65)	0.001
	No	8 (38.1)	
Duration of Placing arch Bar and Intermaxillary Screws	<20 minutes	0 (0)	<0.001
	<30 minutes	0 (0)	
	< 60 minutes	15 (68.2)	
	>100 minutes	7 (33.3)	
Per-Operative OCCLUSION	Stable	19 (86.4)	0.680
	Unstable	3 (14.3)	
Hardware Tolerability	Good	8 (36.3)	0.001
	Fair	5 (22.7)	
	Poor	9 (40.9)	
Oral Hygiene	Good	6 (27.3)	0.001
	Fair	-	
	Poor	16 (72.7)	
Associated Complications	Nil	17 (77.3)	0.034
	loss of tooth vitality	1 (4.5)	
	Gingivitis	3 (13.6)	
	Periodontitis	1 (4.5)	
	loss/breakage of screws	2 (9.1)	
Need of Local Anesthesia for Removal	Loss of tooth vitality ± gingivitis	-	0.340
	Yes	9 (40.9)	
	No	13 (59.1)	

lateral and extrusive direction. Arch bar is difficult to secure, and it is not suitable for dentition with extensive crown and bridge work^{7,8}.

Our results showed that the predominant gender was males in both groups. This may due to the fact the males are more exposed to hazards like road traffic accidents and falls because of their outdoor activities. A study in Indian population on comparison of Erich arch bar versus

placement was less than 20 minutes while it was upto one hour for arch bar placement. Rai *et al*¹¹, reported that the IMF with screws is a quick and easy method, as the mean time required for placement and removal of IMF screws in IMF screws group is significantly less than in arch bar group. Choi *et al*¹², in another investigation found that the meantime required for screw placement was 25.8 minutes, with experience it can be further reduced to about 12 minutes.

Per-operative occlusal stability was not statistically different between the two technique of jaws fixation ($p=0.778$) in the current study. These findings are similar with those reported by Qureshi *et al*⁹, Babu *et al*¹³, and Choi *et al*¹². However, in 3 cases of arch bars and 4 cases of IMF screws, occlusion was unstable. Many factors can be responsible for this. In arch bar group, improper reduction of fracture and inappropriate tightening of wires lead to loosening of the arch bars may be the reasons for occlusal instability. In IMF screws improper reduction of fracture, loss of screws and loosening of screw can cause unstable occlusion.

This randomized trial showed that the hardware tolerability was better in IMF screw group than arch bar group ($p<0.001$). In arch bar group there is more risk of trauma to the periodontal region, complexity in placement and removal of wire, more risk of soft tissue injuries and ulceration and difficult mastication as compared to IMF screws. Similar disadvantages were reported in literature^{6,9}.

The oral hygiene was statistically ($p=0.001$) better in IMF screw group than arch bar group in this study. We used plaque and debris indices to record oral hygiene and followed patients for 4 weeks. Similar methodologies were employed by others⁹. The poor oral hygiene in arch bar can be attributed to their network like and angular framework which retain plaque and need more rigorous tooth brushing. The tooth brushing is difficult for patients with fracture. Previous studies also showed similar results^{9,11}.

This investigation showed that the associated complications were statistically different between the two methods of IMF ($p=0.034$). Periodontitis and solely gingivitis was found in arch bar group only. In IMF group the complications were loss and breakage of screws and loss of tooth vitality. Due to angular nature of arch bar more plaque retention can occurs which ultimately leads to gingivitis and loss of gingival attachment (periodontitis)⁸. The failure of screws can be attributed to lack of following of recomm-

endations for screw placement. According to Coburn *et al*¹⁴, the site of breakage in screw is the junction of screw head and threaded portion. They suggested that drilling of bur hole with low speed handpiece with abundant irrigation and insertion of screw at an even speed and with gentle force will prevent screw breakage.

CONCLUSION

Form our findings it can be concluded that IMF with IMF screws is more effective than Erich arch bars in the management of mandibular fractures. Though both methods of jaw fixation can be used to achieve stable occlusion per-operatively, the IMF screws need less operating time and less risk of iatrogenic injuries to the surgeon and consequently the transmission of infections. IMF screws can maintain good oral hygiene, give less trauma to the periodontium and less discomfort to patient as compared to arch bars.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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