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Comparison of Efficiency of Intermaxillary Fixation Screws Versus Erich Arch Bars for Maxillomandibular Fixation in Maxillofacial Trauma

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ABSTRACT

Maxillomandibular fixation (MMF) is a popular intervention tool for maxillofacial fractures. Erich arch bars are used historically, but intermaxillary fixation screws provide some potential benefits, including less time in surgery and better oral health. **Objective:** To compare the Erich arch bar with intermaxillary fixation screws in maxillomandibular fixation in facial fractures. **Methods:** This prospective comparative trial was carried out in Sharif Medical and Dental College and involved 60 patients who needed maxillomandibular fixation after maxillofacial trauma. There were two groups of patients: intermaxillary fixation screws (n=30) and Erich arch bars (n=30). The assessment of the post-operative occlusal stability, duration of the surgery, and the assessment of oral hygiene based on the Oral Hygiene Index were performed with the help of SPSS version 23.0. **Results:** The intermaxillary fixation screw group showed a shorter surgical time, as well as superior oral hygiene ($p<0.05$). The groups did not show any significant difference in the postoperative occlusal stability ($p=0.389$). **Conclusion:** intermaxillary fixation screws offer similar occlusion potentialities at lower operative duration and with improved oral health as compared with Erich arch bar.

INTRODUCTION

Facial trauma is one of the most prevalent problems in maxillofacial surgery and can occur as a result of physical violence, injuries from sports, or a car accident. About 42% of face injuries affect the facial bones, with the maxilla accounting for about 30% of all instances and the mandible for nearly 70%. Restoring occlusion, functioning, and aesthetic appeal is the main objective of treatment for such fractures. Maxillomandibular fixation (MMF), whereby momentarily immobilizes shattered fragments to allow adequate healing to occur, is one of the most crucial components of this therapy [1, 2]. MMF has historically been obtained by using wire techniques and Erich arch bars. Although they have a number of drawbacks, including lengthy application times, soft tissue damage, the possibility of needlesticks to medical personnel, and challenges with maintaining oral hygiene, they offer firm fixing and repeatable outcomes [3, 4]. Gingival manifestation, mucosal damage, and patient discomfort during the fixation period are additional consequences of the extensive use of metal wiring and frames of metal [5]. Intermaxillary fixation (IMF) screws were created in 1989 as a more straightforward and efficient way to overcome

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these limitations. Since IMF screws are self-tapping and self-drilling implants that are inserted straight into the alveolar bone, they do not require tooth anchors. Their use has been shown to prevent periodontal damage, significantly shorten operating times, and improve post-operative dental hygiene [6, 7]. Additionally, since they tend to be more comfortable, they improve patient compliance and lower occupational risks such as wire-stick injuries [8]. Erich arch bars and IMF screws have been tested before with varying degrees of success. While some researches have shown similar occlusional results between the two methods, others have shown that IMF screws were better in terms of practicality and hygiene. Despite all of the research, there is still debate on the optimal method of fixation in various institutional and clinical settings, particularly in settings with limited resources [9–13].

There exists a discrepancy in comparative IMF screws and Erich arch bar application in maxillofacial fixation, which leaves a localized clinical guidance gap. It is discussed in this study through the direct comparative data of our setting, which is necessary to make an informed surgical choice. Therefore, the goal of this research is to assess how well intermaxillary fixation screws and Erich arch bars work for treating craniofacial fractures. This study aimed to evaluate surgery time, dental hygiene situation, and occlusal stabilization in order to determine whether the maxillomandibular fixation technique is more effective and comfortable for patients.

METHODS

This was a prospective comparative study done on 60 patients in order to assess and compare the effectiveness of IMF screws and Erich arch bars in maxillomandibular fixation (MMF) in facial trauma. The study was conducted between November 2023 and October 2024, in the Department of Oral and Maxillofacial Surgery, Sharif Medical and Dental Hospital, after ethical approval of the Sharif Medical Research Center, with the ethical number SMDC/SMRC/310-23. The sample size was determined with the use of the WHO sample size software, where the efficacy of an IMF screw was set at 94.1%. The confidence interval was 95% with precision = 0.06 [13]. The sample size was calculated using the following formula for comparison of two means: $n = 2 \times (Z\alpha/2 + Z\beta)^2 \times \sigma^2 / (\mu1 - \mu2)^2$. The patients aged 18 and above with fractures of the maxilla and mandible requiring maxillomandibular fixation were added to this study. Pathological fracture, polytrauma, neurosurgical patients, or panfacial trauma patients were excluded. All participants (or, in the case of children, their legal parents and guardians) gave written informed consent before being included in the study. While a technique referred to as non-probability convenience sampling was decided on, a number of steps were taken to lessen selection bias. Any prospective participants who satisfied the inclusion criteria and repeatedly visited the Department of Oral and Maxillofacial Surgery during the study period were invited to participate, regardless of age, gender, or socioeconomic background. For both groups, the lead researcher consistently used the same inclusion and exclusion criteria. Allocation into the IMF screw (Group A) versus the Erich arch bar (Group B) was based only on the type of fractures (whether there was a lack of dentoalveolar inclusion) rather than operator preference to ensure comparison between groups. Patients with no dentoalveolar fracture were added to group A and were treated with IMF screws, and patients with dentoalveolar fractures were added to group B and treated with Erich Arch bar. Group A included six self-drilling, self-threading screws (2.0x7 mm), which were positioned bilaterally at the maxilla and mandible. As per imaging, the insertion site was selected B/L between premolars and midline for screws insertion due to the absence of roots between them. Using flexible stainless-steel wires, IMF was attained. In Group B, MMF was done by attaching Erich arch bars to the labial surfaces of upper and lower teeth by using stainless steel wire, and then MMF was done by using elastics. The time of procedure was measured, from the start of the procedure till the MMF was done in minutes [6]. Efficiency was assessed using three measurable factors: operation time (in minutes), postoperative oral hygiene index ratings, and patient-reported comfort. Based on the patient's medical history and clinical examination, pre-trauma occlusion was identified. On the first postoperative day, the same operator conducted a clinical review of occlusion. The patient was instructed to achieve maximal intercuspation, and the outcomes were compared to the occlusal relations recorded before the trauma. Occlusion was categorized as adequate if the postoperative occlusion and midline alignments matched the pre-trauma condition, and as unacceptable if any early interactions, open bites, or midline deviations were noted. [14]. On the very first follow-up after seven days, the patients' hygiene was evaluated using the Oral Hygiene Index [6], which was graded as 0 (no evidence of soft plaque), 1 (1/3 of the surface of the tooth coated with soft plaque), 2 (one-third to two thirds of the tooth surface was coated with soft plaque), and 3 (over two thirds of the tooth surface was coated with soft plaque). To prevent bias, one surgical staff member was assigned to perform both procedures.

The data were analyzed using SPSS version 23.0. While continuous factors (surgical time, Oral Hygiene Index) are displayed as mean ± SD, categorical variables (occlusal outcomes) are displayed as frequency and %. The Shapiro-Wilk test was used to test the normality of continuous variables. The time of surgery was normally distributed and was compared by the independent samples t-test to

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determine the mean time of surgery between the two groups. The data scores on oral hygiene were not normally distributed and were tested through the Mann-Whitney U test to compare the median scores among the groups. The Chi-square test was used to determine postoperative occlusal stability, which is a categorical variable. The p-value below 0.050 was declared to be statistically significant.

RESULTS

The study incorporated 60 patients, 30 patients in the IMF screw and 30 patients in the Erich arch bar. An independent-samples t-test showed that there was a significant difference in the surgical time of the groups, t (58) = -23.07, p<0.001. The mean surgical time of the IMF screw group (39.60 ± 3.08 min), in comparison to the Erich arch bar group (66.03 ± 5.47 min), was much shorter. The Mann-Whitney U test was used to compare the scores of the Oral Hygiene Index (OHI). The results indicated a statistically significant difference, U = 47.00, Z = -6.16, p<0.001, and better oral hygiene in the IMF screw group (Mean Rank = 17.07) as compared to the Erich arch bar group (Mean Rank = 43.93) (Table 1).

Table 1: Surgical Time and Oral Hygiene Index (OHI) Outcomes by Group

Parameters	Group	n	Mean / Mean Rank	SD / Sum of Ranks	Test	Test Statistic	p-value
Surgical Time (min)	IMF Screws	30	39.60	08	Independent-Samples t-test	T (58) = -23.07	<0.001
	Erich Arch Bars	30	66.03	5.47			
Oral Hygiene Index (OHI)	IMF Screws	30	0.84 (Mean Rank)	512.00 (Sum of Ranks)	Mann-Whitney U test	U = 47.00, Z = -6.16	<0.001
	Erich Arch Bars	30	1.63 (Mean Rank)	1318.00 (Sum of Ranks)			

The Chi-square test was used to evaluate the results of postoperative occlusion. Satisfactory occlusion (IMF screws: 26/30, 86.7; Erich arch bars: 28/30, 93.3) was observed in most of the patients in each group, and the difference did not differ significantly, $\chi^2(1) = 0.74$, p=0.389 (Table 2).

Table 2: Postoperative Occlusion Outcomes by Group

Outcomes	IMF Screws	Erich Arch Bars	Total
Satisfactory	26	28	54
Unsatisfactory	4	2	6
Total (n, %)	30 (100%)	30 (100%)	60 (100%)

DISCUSSION

This research compared intermaxillary fixation (IMF) screws and Erich arch bars to achieve maxillomandibular fixation (MMF) in the case of facial trauma. Some of the variables that were measured included oral stability after surgery, dental cleaning, and the length of the surgery. The IMF screws exhibited significant gains in both reduced operating room time and better oral health after the surgeries, even when both techniques yielded exquisite outcomes of occlusion. The mean IMF screw group operating time (39.60 +3.08 minutes) was much lower in this research than the Erich arch bar group (66.03 ± 5.47 minutes). According to previous studies conducted by Thukral *et al.* [12], Jain *et al.* [2], Tükel and Benlidayı [15], and Ahmad *et al.* [16], the IMF screws were discovered to cause an immediate reduction in chair-side and operating time. The main causes of the fact that the time of the process is shorter are the simplified placement procedure and the absence of the long and wire ligation required to fix the arch bars. Also, IMF screws reduce the risk of needle stick injuries and intraoperative fatigue in operating surgeons [14, 17]. Following an improved oral hygiene treatment, an evaluation revealed that the IMF screw group was significantly lower in oral hygiene index scores than the Erich arch bar group. This finding correlates with the findings of earlier studies conducted by Tükel and Benlidayı [15], Jain *et al.* [2], and Salavadi *et al.* [18], which have also found that the IMF screws may be used to reduce the inflammation of the gums and facilitate the dental cleaning procedures. Nevertheless, its hard-to-insert wire and limitation to reach the mucosa cause the Erich arch bars to be associated with more accumulation of plaque, mucosal pain, and stress in the gums [9, 18]. It is suggested that maintenance of a high level of oral health following fixation prevents the occurrence of a surgical infection as well as eases the patient during his or her recovery period [19]. The comparison of occlusal stability of the two groups showed that no statistically significant difference was observed. Most of the participants in either category (Erich = 93.3%, IMF = 86.7%) had adequate occlusion. These results are in line with results found by Thukral *et al.* [12], Kumar *et al.* [14], and Qureshi *et al.* [11], who found no difference in the results of IMF screws and Erich arch bars when used correctly. The effects of occlusion in the long term were not, however, examined as the current study merely evaluated the effect of occlusion on the first postoperative day. Jain and Rai [6] and Rai *et al.* [9] also reported similar short-term outcomes. Further studies are needed on long-term follow-up to determine the stability of the occlusion throughout the long healing duration. In general findings of the study, the IMF screws prove to be a reliable, fast, and painless alternative to the traditional Erich arch bar. The IMF screws are extremely useful in the clinic since they reduce the operating time and enhance oral care after surgery. Moreover, the above advantages are achieved

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without compromising occlusion, and it implies that IMF screws could be used safely and effectively for both maxillary and mandibular fractures[20].

The short-term evaluation following surgery and the comparatively small sample size were two of the study's shortcomings. There was no measurement of the long-term effects of occlusion, as well as periodontal health. Additionally, the use of convenient sampling may have contributed to selection bias. However, all of the operations were carried out by operators with the same degree of expertise, which guaranteed consistency and reduced technique bias.

CONCLUSIONS

This study discovered that intermaxillary fixation (IMF) screws were better than Erich arch bars when used to treat mandibular fractures. The IMF screw group exhibited higher efficiency, evidenced by the reduction of treatment time, improvement of postoperative oral hygiene, and more patient comfort. Such findings suggest that IMF screws are a reliable, easy-to-use, and easy-to-swallow alternative to maxillomandibular fixation to treat fractures.

Authors' Contribution

Conceptualization: MK
Methodology: MK, MAK, MJ, IT
Formal analysis: MJ
Writing and Drafting: MK, UBA, KA, MAK, MJ
Review and Editing: MK, UBA, KA, MAK, MJ, IT

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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