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Original Article

Maxillomandibular Fixation Screws VS Erich Arch Bar in the Management of Maxillofacial Trauma: A Comparative Study

Fazal Dad[1]

[1] Associate Professor, Maxillofacial Surgery Department, Civil Hospital Quetta, Quetta, Pakistan

Corresponding author: Fazal Dad, kakarfazal919@gmail.com

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ABSTRACT

Background: Maxillomandibular fixation is important for establishing dental occlusion during management of maxillofacial fractures, although conventional Erich arch bars may require prolonged application and complicate oral hygiene. Objective: To compare self-tapping intermaxillary fixation screws with Erich arch bars for procedural time, oral hygiene, and occlusal outcomes in patients with maxillomandibular fractures. Methods: This randomized controlled trial included 128 patients treated at the Oral and Maxillofacial Surgery Department, Bolan Medical College, Quetta, from 22 January 2025 to 22 February 2026. Participants were allocated equally to IMF screws or Erich arch bars. Placement and removal times were compared using independent-samples t-tests, while oral-hygiene and occlusal outcomes were compared using chi-square tests. Results: Placement time was 17.67±4.14 versus 81.64±17.07 minutes, with a mean difference of −63.97 minutes (95% CI, −68.35 to −59.59; p<0.001). Removal time was 16.59±2.44 versus 28.94±3.80 minutes (difference −12.35 minutes; 95% CI, −13.47 to −11.23; p<0.001). At six weeks, good oral hygiene was observed in 81.3% versus 51.6%, while satisfactory occlusion was present in 84.4% versus 54.7% of participants treated with IMF screws and Erich arch bars, respectively (both p<0.001). Conclusion: IMF screws substantially reduced placement and removal times and produced more favorable later oral-hygiene and occlusal outcomes than Erich arch bars. Keywords: Erich arch bar; intermaxillary fixation screws; maxillofacial fracture; maxillomandibular fixation; occlusion; oral hygiene.

INTRODUCTION

Maxillofacial fractures constitute an important component of traumatic injuries and may substantially disrupt facial form, mastication, dental occlusion, speech, and other functions of the stomatognathic system. Restoration of an anatomically appropriate and stable dental relationship is therefore a fundamental component of maxillofacial fracture management. Maxillomandibular fixation (MMF) is commonly used to establish and maintain occlusal alignment during fracture reduction and stabilization and may serve as either a temporary intraoperative measure or part of postoperative fixation according to the characteristics of the fracture and the definitive treatment strategy (1,2).

Several tooth-borne techniques have historically been used to achieve MMF, including interdental wiring and Erich arch bars. Erich arch bars remain a versatile method because they provide multiple fixation points and permit control of the dental arches; however, their application may be technically demanding and time-consuming. Their placement and removal require manipulation of circumdental wires, which may expose the gingival and periodontal tissues to repeated instrumentation, interfere with routine oral-hygiene practices, and increase the possibility of wire-related sharps injury to the operating team. These

practical limitations have encouraged the evaluation of alternative methods capable of achieving satisfactory fixation while simplifying application and removal (2–4).

Intermaxillary fixation screws have emerged as a bone-supported alternative to conventional tooth-borne fixation. The screws are inserted transmucosally into the alveolar bone and provide anchorage points through which wires or elastics can be applied to establish maxillomandibular fixation. Different screw-placement configurations have been described according to fracture location and clinical requirements, including four-point fixation with at least one screw positioned in each quadrant (5,6). Compared with circumdental arch-bar fixation, the screw technique reduces the amount of wiring around individual teeth and may consequently shorten application and removal procedures while facilitating access for oral hygiene. Nevertheless, the technique has its own anatomical and technical considerations, and appropriate screw positioning is required to minimize complications involving dental roots, adjacent structures, and fixation stability (5,6).

Previous comparative investigations have evaluated MMF screws against Erich arch bars and other conventional interdental fixation methods. These studies have generally focused on procedural efficiency, clinical fixation, oral hygiene, periodontal considerations, and patient-related outcomes (2–4,7,8). Randomized and comparative clinical investigations have particularly suggested that screw-based fixation can substantially reduce the time required to establish MMF while providing clinically acceptable fixation in appropriately selected maxillofacial fractures (2,7,8). Evidence comparing these techniques remains clinically relevant because treatment selection must consider not only the ability to obtain occlusion but also procedural burden, subsequent device removal, maintenance of oral hygiene, and the stability of postoperative occlusal relationships.

A direct comparison of these approaches within a defined clinical population can therefore provide practical evidence regarding their relative performance during treatment and early follow-up. Accordingly, the present randomized controlled trial compared self-tapping intermaxillary fixation screws with Erich arch bars in patients with maxillomandibular fractures. The study specifically evaluated the time required for fixation placement and removal and compared postoperative oral-hygiene status and occlusal outcomes between the two treatment groups during follow-up.

MATERIALS AND METHODS

This randomized controlled trial was conducted in the Department of Oral and Maxillofacial Surgery, Bolan Medical College, Quetta, from 22 January 2025 to 22 February 2026. A total of 128 patients presenting with maxillomandibular fractures within 72 hours of injury were enrolled after written informed consent and allocated in a 1:1 ratio to two treatment groups, with 64 participants in each group. Diagnosis was established on the basis of clinical examination and radiographic assessment, which included panoramic radiography, posteroanterior radiography, and computed tomography as clinically applicable. The study was undertaken after approval of the research synopsis by the College of Physicians and Surgeons Pakistan and ethical approval by the relevant institutional review board.

Participants were allocated to Group A or Group B using a random-number table. Preoperative evaluation included assessment of the etiology of injury and fracture displacement. Group A comprised 64 patients treated using self-tapping intermaxillary fixation screws, whereas Group B comprised 64 patients treated using a conventional Erich arch bar. The same group definitions were maintained throughout data collection, follow-up, and statistical analysis.

In Group A, intermaxillary fixation was achieved using four to six stainless-steel self-tapping fixation screws measuring 2 mm in diameter and 8 or 10 mm in length. Screw placement was performed through the oral mucosa into the alveolar bone, with the region between the canine and first premolar serving as the preferred placement site in each dental arch where anatomically appropriate. The screw heads provided anchorage for establishing intermaxillary fixation. In Group B, fixation was achieved using an

Erich arch bar secured with 26-gauge wire. The duration required to place the assigned fixation system was recorded for each participant. The time required for subsequent removal of the fixation system was also recorded as a procedural outcome.

Postoperatively, participants in both groups received standardized oral-hygiene instructions, including brushing with a soft baby toothbrush and using mouthwash at least four times daily. Regular follow-up was advised for all participants. Clinical follow-up assessments evaluated oral-hygiene status and dental occlusion. Oral hygiene was recorded using the categories good, fair, and poor, while occlusion was categorized as satisfactory or unsatisfactory. Assessments were recorded immediately postoperatively and at the first, fourth, and sixth postoperative weeks. All observations and procedural measurements were entered into a predesigned study proforma.

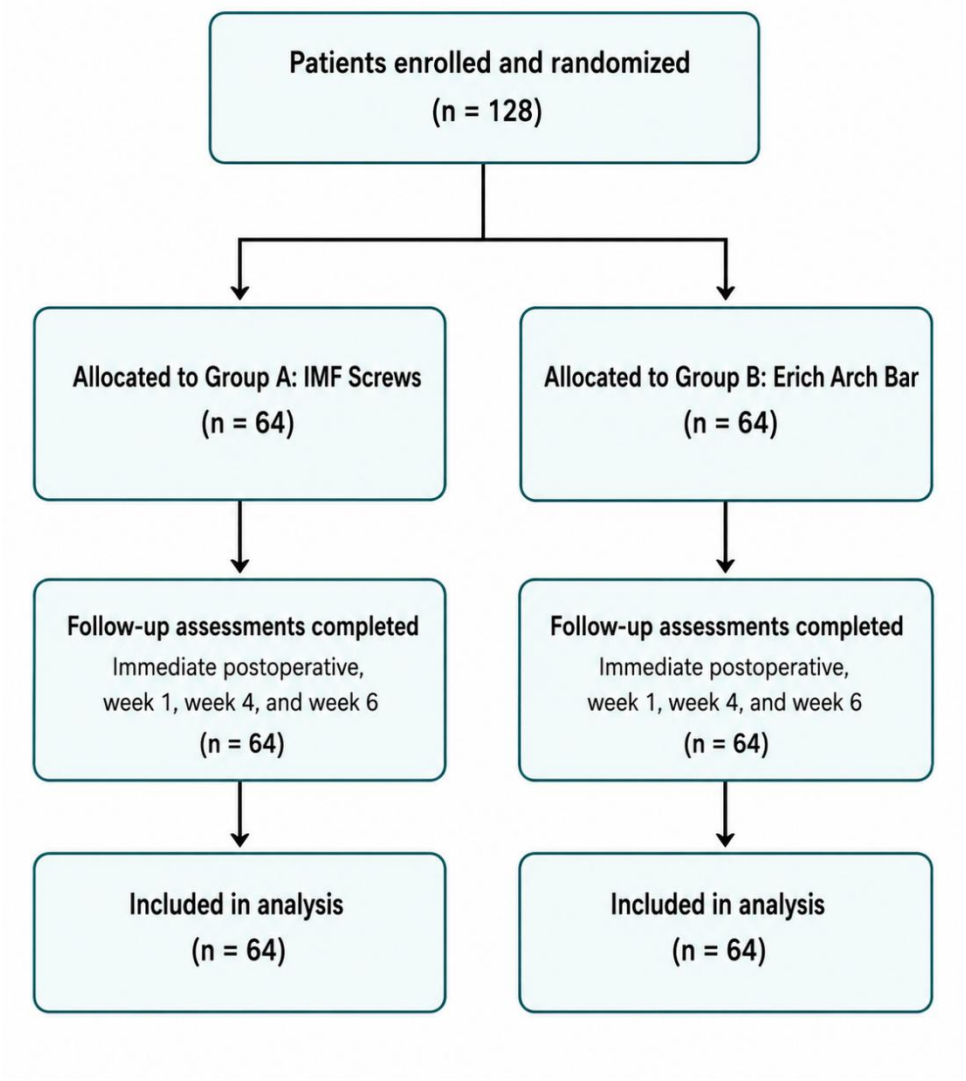

Figure 1 CONSORT Flowchart

The principal quantitative procedural outcomes were the time required for placement and the time required for removal of the fixation system. Oral-hygiene status and occlusal status constituted categorical clinical outcomes assessed longitudinally during postoperative follow-up. Age was treated as a continuous variable, whereas sex, occupation, socioeconomic status, education, oral-hygiene category, and occlusal category were treated as categorical variables where applicable to the recorded analyses.

Data were analysed using IBM SPSS Statistics version 23. Continuous variables, including age and procedural times, were summarized as mean and standard deviation, while categorical variables were summarized as frequencies and percentages. Between-group comparisons of continuous procedural outcomes were performed using the independent-samples t-test. Categorical outcomes, including oral-

hygiene status and occlusal status, were compared between the treatment groups using the chi-square test at the reported postoperative assessment points. Age, sex, education, and socioeconomic status were considered in the planned stratified analysis; post-stratification comparisons were performed using the independent-samples t-test for quantitative variables and the chi-square test for qualitative variables, as applicable. Statistical significance was defined as a two-sided p-value ≤0.05. Written informed consent was obtained from all participants before inclusion in the study and before surgical intervention. The study was conducted after approval of the research synopsis by the College of Physicians and Surgeons Pakistan and ethical approval by the institutional review board.

RESULTS

A total of 128 participants were allocated equally between the two treatment groups, with 64 participants treated using self-tapping intermaxillary fixation screws in Group A and 64 treated using Erich arch bars in Group B. The overall mean age was 31.25 ± 9.65 years, and the study population comprised 66 men (51.6%) and 62 women (48.4%). Mean age was 30.47 ± 9.59 years in Group A and 32.03 ± 9.72 years in Group B, corresponding to a between-group mean difference of −1.56 years (95% CI, −4.94 to 1.82; p=0.362).

Fixation using IMF screws required substantially less procedural time than fixation with an Erich arch bar. Mean placement time was 17.67 ± 4.14 minutes in Group A compared with 81.64 ± 17.07 minutes in Group B, representing a mean difference of −63.97 minutes (95% CI, −68.35 to −59.59; p<0.001). The standardized between-group difference was large (Cohen's d=−5.15). Removal was also faster with IMF screws, with mean removal times of 16.59 ± 2.44 minutes and 28.94 ± 3.80 minutes in Groups A and B, respectively. The corresponding mean difference was −12.35 minutes (95% CI, −13.47 to −11.23; p<0.001), with a Cohen's d of −3.87.

The distribution of oral-hygiene categories differed between the groups immediately after the procedure (p<0.001). Although the proportion classified as having good oral hygiene was 35.9% in Group A and 42.2% in Group B, poor oral hygiene was markedly less frequent in Group A than in Group B (4.7% vs 28.1%), while fair oral hygiene accounted for 59.4% and 29.7%, respectively. At week 1, the oral-hygiene distributions were comparable between groups (p=0.937), with good oral hygiene recorded in 51.6% of participants in each group.

Table 1. Participant Age Characteristics by Treatment Group

Characteristic	Group A: IMF Screws (n=64)	Group B: Erich Arch Bar (n=64)	Mean Difference (95% CI)	p-value
Age, years, mean ± SD	30.47 ± 9.59	32.03 ± 9.72	−1.56 (−4.94 to 1.82)	0.362
Minimum–maximum, years	18–50	18–49	—	—

Overall age: 31.25 ± 9.65 years. Overall sex distribution: Male, 66/128 (51.6%); female, 62/128 (48.4%).

Abbreviations: CI, confidence interval; IMF, intermaxillary fixation; SD, standard deviation. The between-group age comparison was derived from the reported group means, standard deviations, and sample sizes using an independent-samples t-test.

Table 2. Comparison of Fixation Placement and Removal Times Between Groups

Outcome	Group A: IMF Screws (n=64), Mean ± SD	Group B: Erich Arch Bar (n=64), Mean ± SD	Mean Difference, min (95% CI)	Cohen's d	p-value
Fixation placement time, min	17.67 ± 4.14	81.64 ± 17.07	−63.97 (−68.35 to −59.59)	−5.15	<0.001
Fixation removal time, min	16.59 ± 2.44	28.94 ± 3.80	−12.35 (−13.47 to −11.23)	−3.87	<0.001

Abbreviations: CI, confidence interval; IMF, intermaxillary fixation; SD, standard deviation. Mean differences are Group A minus Group B. Confidence intervals and standardized mean differences were derived from the reported means, standard deviations, and group sizes. p-values correspond to independent-samples comparisons.

Table 3. Oral-Hygiene Status During Postoperative Follow-up

Assessment	Oral-Hygiene Category	Group A: IMF Screws, n (%)	Group B: Erich Arch Bar, n (%)	RR for Good Hygiene (95% CI)	p-value
Immediate postoperative	Good	23 (35.9)	27 (42.2)	0.85 (0.55–1.32)	<0.001
	Fair	38 (59.4)	19 (29.7)	—	—
	Poor	3 (4.7)	18 (28.1)	—	—
Week 1	Good	33 (51.6)	33 (51.6)	1.00 (0.71–1.40)	0.937
	Fair	27 (42.2)	26 (40.6)	—	—
	Poor	4 (6.3)	5 (7.8)	—	—
Week 4	Good	43 (67.2)	29 (45.3)	1.48 (1.08–2.04)	0.040
	Fair	17 (26.6)	30 (46.9)	—	—
	Poor	4 (6.3)	5 (7.8)	—	—
Week 6	Good	52 (81.3)	33 (51.6)	1.58 (1.21–2.05)	<0.001
	Fair	9 (14.1)	11 (17.2)	—	—
	Poor	3 (4.7)	20 (31.3)	—	—

Abbreviations: CI, confidence interval; IMF, intermaxillary fixation; RR, risk ratio. Each treatment group contained 64 participants at each tabulated assessment. p-values compare the complete three-category oral-hygiene distribution between groups using Pearson's chi-square test. RR compares the probability of being classified as having good oral hygiene in Group A relative to Group B.

Table 4. Occlusal Status During Postoperative Follow-up

Assessment	Group A: IMF Screws, Satisfactory n (%)	Group B: Erich Arch Bar, Satisfactory n (%)	Risk Difference, % (95% CI)	RR (95% CI)	p-value
Immediate postoperative	23 (35.9)	27 (42.2)	−6.3 (−23.1 to 10.6)	0.85 (0.55–1.32)	0.469
Week 1	46 (71.9)	48 (75.0)	−3.1 (−18.4 to 12.2)	0.96 (0.78–1.18)	0.689
Week 4	47 (73.4)	32 (50.0)	23.4 (7.1–39.8)	1.47 (1.10–1.95)	0.006
Week 6	54 (84.4)	35 (54.7)	29.7 (14.6–44.8)	1.54 (1.21–1.97)	<0.001

Abbreviations: CI, confidence interval; IMF, intermaxillary fixation; RR, risk ratio. Risk difference is Group A minus Group B. Pearson's chi-square test was used for between-group comparisons.

Table 5. Corresponding Unsatisfactory Occlusion Counts

Assessment	Group A, n (%)	Group B, n (%)
Immediate postoperative	41 (64.1)	37 (57.8)
Week 1	18 (28.1)	16 (25.0)
Week 4	17 (26.6)	32 (50.0)
Week 6	10 (15.6)	29 (45.3)

A divergence in oral-hygiene outcomes became apparent during later follow-up. At week 4, good oral hygiene was present in 67.2% of Group A and 45.3% of Group B, corresponding to a risk ratio of 1.48 (95% CI, 1.08–2.04), and the overall three-category distribution differed significantly between groups (p=0.040). By week 6, good oral hygiene had increased to 81.3% in the IMF-screw group compared with 51.6% in the Erich arch-bar group, corresponding to a risk ratio of 1.58 (95% CI, 1.21–2.05; p<0.001 for the overall oral-hygiene distribution). Poor oral hygiene at the same assessment was observed in 4.7% of Group A compared with 31.3% of Group B.

Occlusal status was similar between groups during the early postoperative period. Immediately postoperatively, satisfactory occlusion was recorded in 23 participants (35.9%) in Group A and 27 (42.2%) in Group B (RR, 0.85; 95% CI, 0.55–1.32; p=0.469). At week 1, satisfactory occlusion increased to 71.9% and 75.0%, respectively, with no statistically significant between-group difference (RR, 0.96; 95% CI, 0.78–1.18; p=0.689).

At later follow-up, satisfactory occlusion was more frequent in the IMF-screw group. At week 4, 47 of 64 participants (73.4%) in Group A had satisfactory occlusion compared with 32 of 64 (50.0%) in Group B, yielding an absolute difference of 23.4 percentage points (95% CI, 7.1–39.8), a risk ratio of 1.47 (95% CI, 1.10–1.95), and p=0.006. At week 6, satisfactory occlusion was present in 54 participants (84.4%) in Group A and 35 (54.7%) in Group B. This represented an absolute difference of 29.7 percentage points (95% CI,

14.6–44.8) and a risk ratio of 1.54 (95% CI, 1.21–1.97; p<0.001). Correspondingly, unsatisfactory occlusion at six weeks occurred in 15.6% of participants treated with IMF screws compared with 45.3% of those treated with Erich arch bars.

DISCUSSION

The present randomized controlled trial demonstrated substantial differences between self-tapping intermaxillary fixation screws and conventional Erich arch bars in several clinically relevant outcomes. The most pronounced advantage of IMF screws was procedural efficiency: fixation placement was approximately 64 minutes shorter and removal approximately 12 minutes shorter than with Erich arch bars. Oral-hygiene outcomes were comparable between groups at the first postoperative week but subsequently favored IMF screws, with the proportion of participants classified as having good oral hygiene reaching 81.3% at six weeks compared with 51.6% in the arch-bar group. A similar temporal pattern was observed for occlusal status. Early postoperative occlusion was comparable between groups, whereas satisfactory occlusion at six weeks was observed in 84.4% of participants treated with IMF screws and 54.7% treated with Erich arch bars. These findings indicate that the principal advantages of the screw-based technique in this population were markedly shorter placement and removal procedures together with more favorable later oral-hygiene and occlusal outcomes.

The large difference in procedural duration is consistent with previous comparative studies evaluating screw-based and conventional tooth-borne fixation. Qureshi et al. reported shorter fixation times with IMF screws than with Erich arch bars, while Nandini et al., Barodiya et al., Jain et al., and Rai et al. similarly described substantial reductions in the time required to establish maxillomandibular fixation using screw-based approaches (2,9–12). In the present study, the mean placement time was 17.67 minutes with IMF screws compared with 81.64 minutes with Erich arch bars, corresponding to a mean difference of 63.97 minutes. The magnitude of this difference is clinically important because arch-bar placement requires sequential adaptation and circumdental wiring across multiple teeth, whereas IMF screws provide direct bone-supported fixation points with fewer individual wiring steps (2,6,9,10). The similarly shorter removal time observed with IMF screws further supports the procedural efficiency of the technique.

Oral-hygiene outcomes also progressively favored IMF screws during later follow-up. Immediately after treatment, the three-category distribution differed between groups, although the proportion classified specifically as having good oral hygiene was not greater with IMF screws. By the first postoperative week, the distributions were almost identical. Thereafter, the groups diverged: good oral hygiene was 67.2% versus 45.3% at four weeks and 81.3% versus 51.6% at six weeks in the IMF-screw and Erich arch-bar groups, respectively. These findings are consistent with previous comparative reports describing easier maintenance of oral hygiene and less plaque accumulation with IMF screws than with conventional arch bars (2,9–11,13). This difference is clinically plausible because arch bars and circumdental wires create multiple plaque-retentive areas around the teeth and gingival margins, whereas transmucosal screws reduce the amount of hardware positioned around individual teeth (6,10,13). The marked six-week difference in poor oral hygiene, 4.7% with IMF screws compared with 31.3% with arch bars, further supports the practical relevance of this finding.

Occlusal recovery showed a different pattern during early and later follow-up. Immediately postoperatively and at one week, satisfactory occlusion was similar between groups, indicating that both techniques were capable of establishing acceptable early maxillomandibular relationships. At four weeks, however, satisfactory occlusion was observed in 73.4% of participants treated with IMF screws compared with 50.0% treated with arch bars, and by six weeks the corresponding proportions were 84.4% and 54.7%. Previous clinical investigations have demonstrated that bone-supported IMF screws can provide clinically satisfactory fixation and occlusal stabilization in appropriately selected mandibular and maxillofacial fractures (14–18). The present findings therefore suggest that the procedural

advantages of IMF screws did not compromise the measured occlusal outcome and were accompanied by a higher proportion of satisfactory occlusion during later follow-up.

The study population had a mean age of 31.25 years, with Group A and Group B showing comparable mean ages. Although maxillofacial and mandibular fracture studies frequently report a predominance of younger adult males, the present sample was comparatively balanced by sex, with men representing 51.6% and women 48.4% of the overall cohort. Natu et al. reported a substantially greater male predominance in an epidemiological investigation of mandibular fractures, illustrating that the demographic profile of maxillofacial trauma may vary according to population, mechanism of injury, referral pattern, and clinical setting (19). The relatively balanced sex distribution in the present trial should therefore be considered a characteristic of this particular study population rather than a general epidemiological pattern.

Despite the procedural advantages of IMF screws, their use requires careful anatomical placement. Bone-supported fixation avoids extensive circumdental wiring but introduces potential screw-specific considerations, including proximity to dental roots, the quality and thickness of alveolar bone, screw positioning, and the relationship of the fixation site to the fracture line. Technical reviews and clinical series have emphasized appropriate screw selection and positioning to minimize tooth-root injury and other placement-related complications (6,20–22). Consequently, the present results should not be interpreted as indicating that IMF screws are universally preferable in every maxillofacial fracture. Selection of fixation technique should remain dependent on fracture configuration, dental condition, anatomical suitability, and the clinical requirements for maxillomandibular stabilization.

The study has several limitations that should be considered when interpreting the findings. It was conducted at a single clinical center and follow-up was limited to six weeks, restricting assessment of longer-term occlusal stability and oral-health outcomes. Oral hygiene and occlusion were evaluated as categorical clinical outcomes, which provided clinically interpretable comparisons but did not permit more granular assessment of changes in plaque burden, periodontal status, or quantitative occlusal parameters. In addition, repeated postoperative measurements were analyzed primarily through time-specific between-group comparisons; consequently, the study did not quantify an overall treatment-by-time interaction across the complete follow-up period. The available results also emphasize procedural and clinical outcomes rather than a comprehensive complication profile. Nevertheless, the equal treatment-group sizes, serial postoperative assessments, and consistency of the observed later differences in oral hygiene and occlusion provide a useful comparative evaluation of these two fixation approaches.

Taken together, the findings support self-tapping IMF screws as an efficient alternative to Erich arch bars in appropriately selected patients requiring maxillomandibular fixation. Their principal demonstrated advantages in this trial were markedly shorter placement and removal times and more favorable oral-hygiene and satisfactory-occlusion proportions during later follow-up. These benefits should be interpreted alongside anatomical suitability, fracture characteristics, and the technical requirements of screw placement rather than as evidence that one fixation method is optimal for every maxillofacial fracture.

The revised Discussion corrects the original confusion in which 16.59 minutes was incorrectly described as screw-placement time, although Table 2 identifies it as removal time; the actual Group A placement time was 17.67 minutes. It also removes unsupported claims concerning disease transmission, improved patient compliance, and reduced periodontal trauma as measured trial outcomes. Those claims were present in the original Discussion/Conclusion without corresponding outcome data.

CONCLUSION

Self-tapping intermaxillary fixation screws provided a clinically effective alternative to Erich arch bars in the studied patients with maxillomandibular fractures. IMF screws were associated with substantially

shorter fixation-placement and removal times and with more favorable oral-hygiene and satisfactory-occlusion outcomes at four and six weeks of follow-up. Early occlusal outcomes were comparable between the techniques, indicating that the procedural efficiency of screw-based fixation was not accompanied by poorer early occlusal results. Within the six-week follow-up period and the population evaluated in this trial, IMF screws therefore offered practical advantages over conventional Erich arch bars while maintaining satisfactory clinical fixation outcomes.

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