Oral and Maxillofacial Surgery (2019) 23:285–289
https://doi.org/10.1007/s10006-019-00766-1

ORIGINAL ARTICLE

A prospective comparative clinical study on modified screw retained arch bar (SRAB) and conventional Erich's arch bar (CEAB)

Pankaj Pathak[1] · Shaji Thomas[1] · Darpan Bhargava[2] · Sivakumar Beena[1]

Received: 21 August 2018 / Accepted: 30 April 2019 / Published online: 24 May 2019

Abstract

Introduction Intermaxillary fixation (IMF) is commonly performed in the management of facial skeleton fractures. Various conventional methods like Erich's arch bar and Ivy eyelet wiring are the most commonly employed methods for achieving IMF, but they have their own disadvantages. Conventional Erich's arch bar (CEAB) has been modified recently by making perforations in the spaces between the winglets and securing the arch bar using 1 mm screws. IMF using intraoral modified screw retained arch bar (SRAB) has been introduced for the treatment of mandibular fractures. The aim of this study was to compare the efficacy, advantages, disadvantages, indications, and potential complications associated with CEAB versus modified SRAB in the management of mandibular fractures.

Materials and methods A randomized prospective study included 20 patients with mandibular fracture who were randomly allotted to two groups. Group A patients received modified SRAB and group B patients received CEAB. The parameters considered were time taken to place the arch bar, perforation in the gloves, patient acceptance, oral hygiene, iatrogenic dental injuries, and needle (wire) stick injuries during IMF.

Results The mean time taken for arch bar placement was 27.20 min with modified SRAB as compared with 82.50 min with CEAB. Incidence of glove perforations was more in group B patients. Oral hygiene status was good in 90% of the patients from group A whereas it was 100% fair in group B patients.

Conclusion This study has shown that both the techniques achieve satisfactory IMF with post-operative occlusion. IMF with modified SRAB reduces the operating time and the incidence of the needle (wire) prick injuries. But modified SRAB has its own limitations in spite of its ease of application.

Keywords Intermaxillary fixation (IMF) · Modified Erich's arch bar · Malocclusion · Jaw fixation techniques

Introduction

Maxillomandibular fixation (MMF) is an essential principle in the management of the maxillofacial trauma patient. MMF serves as a cornerstone of maxillofacial reconstruction, providing a stable base from which facial form and function can be restored. It re-establishes the patient's natural occlusion assisting in the reduction and fixation of simple or complex facial fractures. A variety of MMF techniques have been described. The introduction of bone plating system has reduced the prolonged periods of intermaxillary fixation (IMF). There are many methods for attaining intermaxillary fixation such as conventional Erich's arch bar (CEAB), IMF screws, Ivy's eyelet, bonded brackets, cast metal or acrylic splints, S-shaped hooks, and many other wiring techniques. Presently, with the advent of open reduction and internal fixation, IMF is predominantly used as only an intra-operative technique to aid reduction [1–3].

✉ Darpan Bhargava
drdarpanbhargava@gmail.com

Pankaj Pathak
pathak.p77@gmail.com

Shaji Thomas
shajihoss@gmail.com

Sivakumar Beena
beenasivakumar1@gmail.com

[1] Oral and Maxillofacial Surgery, Peoples College of Dental Sciences and Research Centre, Peoples University, Bhanpur, Bhopal 462 037, Madhya Pradesh, India

[2] Oral and Maxillofacial Surgeon, Private Practice, H-3/2, BDA Colony, Nayapura, Lalghati, Airport Road, Bhopal 462 001, Madhya Pradesh, India

The wires that are secured around the teeth during the arch bar application may cause ischemic necrosis of the mucosa, extrusion, and subsequent loss of vitality of the teeth. These wires also make it difficult to maintain gingival health. Although these techniques are widely used, there are several drawbacks that have led to the development of other means for maxillofacial fixation including modified arch bar and screws developed by S. B. F de Queiroz in 2013 [1].

Literature suggests that modified screw retained arch bar (SRAB) has some advantages over conventional arch bar [1]. However, there is minimal evidence in the literature to compare the two methods of IMF namely CEAB and modified SRAB with each other in terms of advantages and disadvantages.

Materials and methods

A randomized prospective clinical study was performed after obtaining clearance from the institutional ethical committee. The study included a total of 20 patients and they were allotted randomly to two groups who required IMF following maxillofacial trauma. Group A included patients who received modified SRAB and group B included patients who received CEAB. A single qualified operator placed the arch bar in all the 20 patients. The patients included in the study were from 18 to 60 years, non-pathologic fracture of mandible, favorable or unfavorable fracture of mandible and maxillary fracture where occlusion is affected requiring IMF for intraoperative definitive reduction. Patients having pathologic fracture, edentulous ridge fracture, and comminuted maxillofacial fractures were excluded from the study.

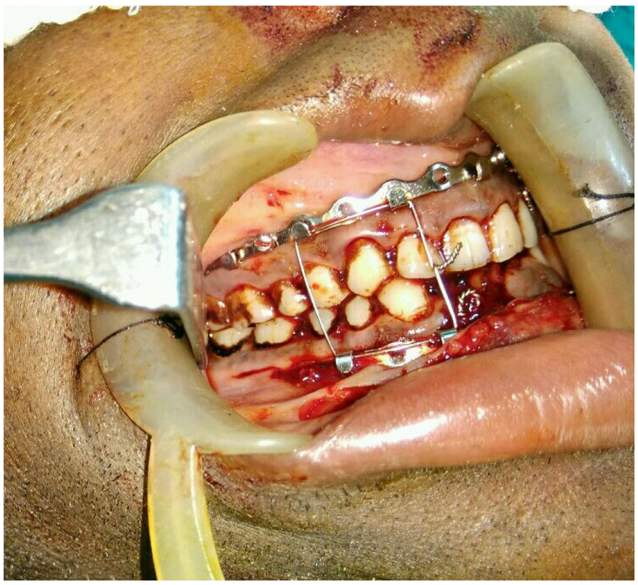


Fig. 1 Intra-oral clinical photograph depicting modified screw retained arch bar (SRAB) in situ secured with screw dimensions 1.5 × 8 mm were placed after drilling a suitable hole using a 1-mm drill bit in the interradicular space

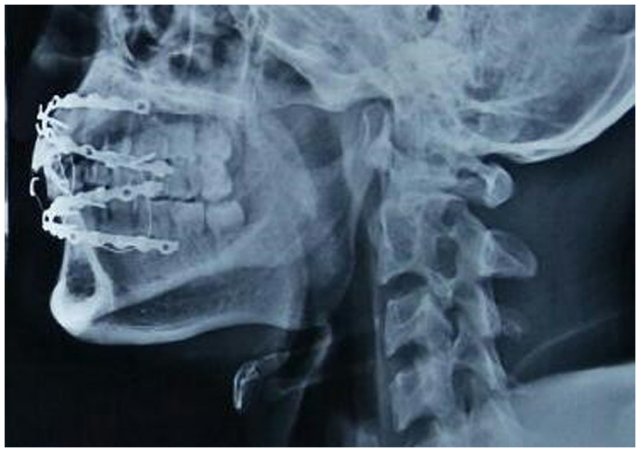


Fig. 2 Lateral radiograph of the mandible depicting modified Screw Retained Arch Bar (SRAB) in situ in the post-surgical period

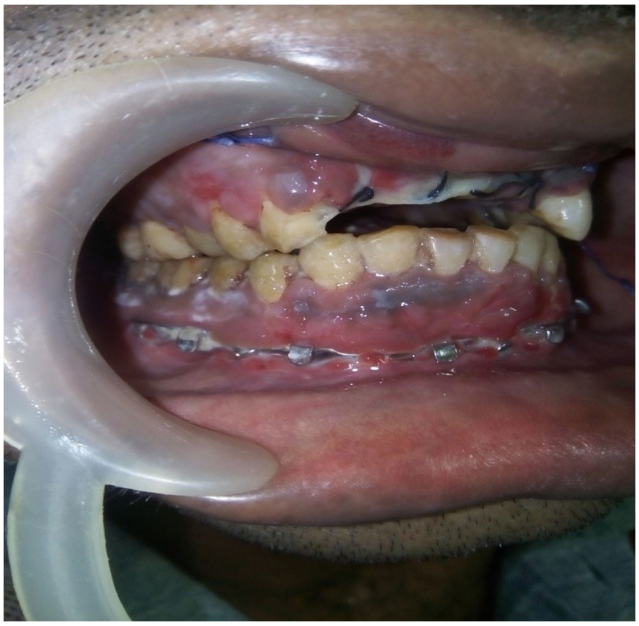
Group A patients received modified SRAB (Figs. 1 and 2) secured with 1.5 × 8 mm screws which were placed after drilling a suitable-sized hole using a 1-mm drill bit in the interradicular space with two screws in the anterior and two screws in the posterior region. IMF was achieved using Tru-Force Latex Elastic system (Size 3/16″). The Modified SRAB and IMF screws were retrieved after sixth post-operative week in the outpatient department under local anesthesia. Group B patients received CEAB secured using 26 gauge stainless steel wire in the standard manner followed by removal on the sixth post-operative week.

Results

The study is comprised of 20 patients with 10 patients in each group. The demographic data of both groups was hispanic. The time duration taken to complete the procedure was higher in group B as compared with group A. Mean time duration was 27.20 + 3.53 min for group A patients as compared with 82.50 + 18.85 min for group B patients (Graph 1). There was a statistically significant p value in the meantime duration in group B patients ($p = 0.0001$) (Table 1). The incidence of perforation in the gloves was 0% ($n = 0$) in group A and 30% ($n = 3$) in group B with a p value of 0.2105 which is statistically not significant (Table 2).

Patient's acceptance was good in 80% ($n = 8$) of the patients and fair in the 20% ($n = 2$) in group A patients. Among group B patient, acceptance was good in 20% ($n = 2$), fair in 70% ($n = 7$), and poor in 10% ($n = 1$) of the patients with a significant p value of 0.025 (Table 3). On the sixth post-operative week, the oral hygiene status was good in 40% ($n = 4$) and fair in 60% ($n = 6$) patients of group A and 20% ($n = 2$) good and 80% ($n = 8$) fair in group B patients (Table 4).

The stability between modified SRAB and CEAB were evaluated after first and sixth post-operative week. In group



Graph 1 Intraoral clinical photograph depicting mucosal overgrowth evident in a patient who received modified screw retained arch bar (SRAB)

A, the stability was adequate in 90% ($n = 9$) of the patients and in group B, it was adequate in 80% ($n = 8$) of the patients.

The incidence of root damage was only 10% ($n = 1$) in group A, whereas the incidence was 0% ($n = 0$) in group B. Statistically, there was no significant difference in the incidence of root damage with CEAB and modified SRAB. ($p = 0.305$).

The other parameter evaluated was bleeding present during securing the arch bar and removal of the arch bar. Bleeding was more observed while removing modified SRAB because in 4 patients the screw was covered by mucosa overgrowth (Fig. 3). In group B patients, minimal blood loss was observed in all the patients at the time of placing and removing CEAB.

Discussion

The main goal in a successful treatment of mandibular fracture includes reduction, stabilization, and immobilization along with achieving proper occlusion. In achieving these steps, it is essential to formulate techniques that minimize the risk of blood-borne diseases, minimize trauma to periodontium, and reduce operating time and duration of anesthesia [3].

Table 1 Mean time duration of procedure among group A and B

Time duration (minutes)	Group A	Group B
Mean	27.20	82.50
Standard deviation	3.553	18.858
t value	9.1130	
p value	0.0001	

Table 2 Incidence of perforation in the gloves in the two groups during arch bar placement

Perforation of gloves	Group A (modified screw retained arch bar) *N* (%)	Group B (conventional Erich's arch bar) *N* (%)	Total *N* (%)
Present	0 (0%)	3 (30%)	3 (15.0%)
Absent	10 (100%)	7 (70%)	17 (85.0%)
p value	0.2105		

Busch RF et al. [4] advocated in their study that the risk of blood-borne diseases are a great concern during maxillofacial fracture treatment. The risk of infection spread is high during wiring procedures as they get contaminated by saliva and blood. He used self-tapping screws (STS) for IMF. He concluded that the risk of blood-borne disease and inadvertent skin puncture is less with superior stabilization and reduced intraoperative time. The time duration and patient compliance for removal of STS were good as compared with the CEAB.

Nandini GD et al. [5] in their clinical study compared the use of STS and CEAB for IMF of mandibular fractures and observed that there was statistically significant more time ($p = 0.001$) consumed for arch bar placement in the CEAB group. The mean number of glove perforations was significantly higher in CEAB group (13.4 ± 5.13) as compared with the STS group (0.60 ± 0.96) (Graph 2). They inferred that tooth which was non-vital and exhibited delayed response are significantly more in the STS group. The patient acceptance was 100% good in patients with STS in contrast to 10% in the CEAB group. The stability of the arch bar was adequate in 80% of the patients in STS group whereas it was 70% in the CEAB group. They have also inferred that the oral hygiene was good significantly more in STS group. In the present study, we observed similar findings with a complication of mucosal coverage of the screw in 20% patients ($n = 2$) in modified SRAB group which required a stab incision for removal under local anesthesia (LA).

Table 3 Patient's acceptance for the arch bar placement in the two groups

Patient acceptance	Group A (modified screw retained arch bar) *N* (%)	Group B (conventional Erich's arch bar) *N* (%)	Total *N* (%)
Good	8(80.0%)	2(20.0%)	10(50.0%)
Fair	2(20.0%)	7(70.0%)	9(45.0%)
Poor	0(0.0%)	1(10.0%)	1(5.0%)
Chi-square value	7.378		
p value	0.025		

Table 4 Oral hygiene maintenance in group A and group B patients

Periodontal health and oral hygiene	Group A (modified screw retained arch bar) *N* (%)	Group B (conventional Erich's arch bar) *N* (%)	Total *N* (%)
Good	4 (40%)	2 (20%)	6 (30%)
Fair	6 (60%)	8 (80%)	14 (70%)
Chi-square value	0.9524		
p Value	0.329		

Chandan S et al. [6] modified the arch bar by soldering orthodontic mesh on the back side of CEAB which was bonded to the maxillary and mandibular arch. They compared the resin bonded arch bar (RBAB) with CEAB and found that the RBAB was superior in terms of oral hygiene maintenance, stability, procedural time, minimizes periodontal injury, and less percutaneous injury to the operator. In contrast, the procedural and removal of arch bar time and injury to mucosa were more in CEAB patients. They concluded that RBAB was an economical and safe method of achieving IMF in patients with mandibular fracture.

Ayoub AF et al. [7] investigated the advantages of Dimac wire (US Food and Drug Administration No. K910090; Dimac Medical Inc., Blaine, Wash) over the CEAB. The study was carried in patients with minimally displaced mandibular fractures with complete dentition. They observed that the average time required to place Dimac wire was less (20 min) as compared with the CEAB (35 min). The incidence of skin-penetrating injuries with Dimac wires was less (8%) as compared with the CEAB (27.2%) during IMF. The damage to the periodontal tissues surrounding the teeth was recorded subjectively during arch bar removal. They concluded Dimac wire is less traumatic during placement as well as removal.

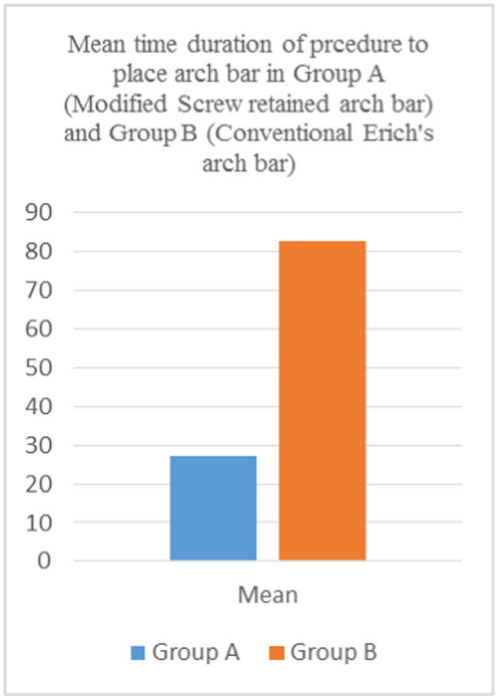
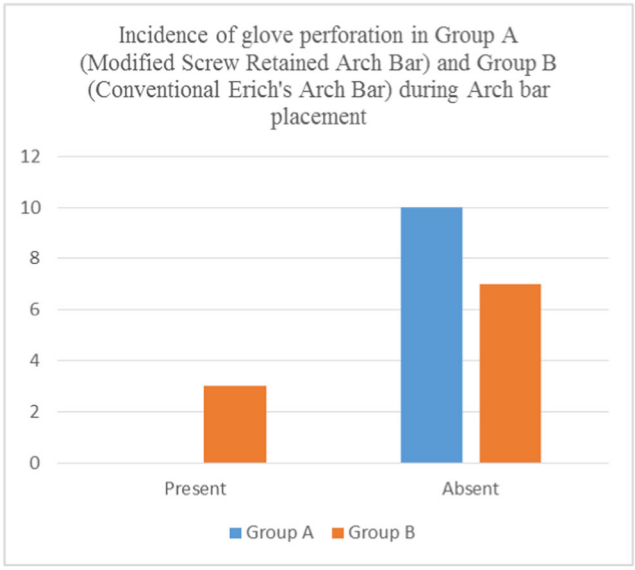


Fig. 3 Mean time duration for arch bar placement in group A (modified screw retained arch bar) and group B (conventional Erich's arch bar)



Graph 2 Graph depicting the incidence of glove perforation in group A, modified screw retained arch bar ($n = 0$), and B, conventional Erich's arch bar ($n = 3$) during arch bar placement

Avery CME et al. [8], in his prospective study, compared small plate osteosynthesis (SPO) with interdental wiring to find the surgical glove perforations acquired during management of mandibular fractures. There was a significant reduction in SPO technique in the incidence of skin-penetrating injuries in the operating surgeon and assistant surgeon. He concluded that SPO technique is superior to interdental wiring in terms of reducing the risk of intraoperative cross- infection transmitted by penetrating injury.

Rothe MT et al. [9] conducted a randomized clinical trial by comparing CEAB, IMF screws, and modified arch bar (MAB) in mandibular fracture patients. They observed that the average working time was more for placement of CEAB (110 min) followed by MAB (29 min) and IMF screws (16 min). Maximum oral hygiene was maintained in IMF screw group followed by MAB group and CEAB group. Maximum stability of IMF was observed in the CEAB group followed by MAB group and IMF screw group. There was maximum mucosal coverage seen in IMF screw group. When complications were taken into consideration, maximum complications were reported in CEAB group followed by IMF screw group and least in MAB group. From this study, they concluded that MAB is a viable option for patients who will require long-term IMF with minimal trauma to the surrounding hard and soft tissue as compared with CEAB and IMF screws.

Qureshi AA et al. [10] investigated the advantages of IMF screws over CEAB and observed that the surgical time taken and glove perforation was significantly less as compared with the CEAB group. Patient acceptance and oral hygiene was better in a patient who received IMF screws. There was no significant difference in post-operative occlusion and IMF stability between both the groups. But, he observed the incidence of root perforation was more in IMF screw group.

In our study, we observed patients discomfort in 30% (n = 3) patients during placement and 20% (n = 2) during removal in group A patients according to visual analog scale (VAS) and in group B patients, the discomfort during placement and removal of the arch bar was 100% (n = 10) according to visual analog scale.

There are several advantages of using a modified SRAB compared with the other techniques in spite of the universal disadvantage of causing damage to vital tooth root. This can be overcome by the surgeon by processing a sound knowledge of anatomy and the judgment on tactile sensation of feeling the bur drop into the medullary bone. If a resistance is felt, then the bur being still in the cortex or at the root should be considered. It can be used as an IMF technique in isolated mandibular fractures with limited utility in cases of multiple facial fracture, comminuted mandibular fracture, and dentoalveolar fracture.

Conclusion

In this study, we conclude that modified Erich's arch bar provides excellent intraoperative fixation. Postoperatively, there was no incidence of infection, trauma to the surrounding tissues, and nerve injury. The overall oral hygiene status of all the patients had in fact improved postoperatively after meticulous oral hygiene instructions along with ease of placement and patient compliance. Thus, the modified Erich's arch bar is a good alternative to the conventional Erich's arch bar for temporary intermaxillary fixation.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Obtained. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from the patients involved in this study.

References

1. de Queiroz SB (2012) Modification of arch bars used for intermaxillary fixation in oral and maxillofacial surgery. Int J Oral Maxillofac Surg 42(4):481–482
2. Roccia F, Tavolaccini A, Dell'Acqua A, Fasolis M (2005) An audit of mandibular fractures treated by intermaxillary fixation using intraoral cortical bone screws. J Craniomaxillofac Surg 33(4): 251–254
3. Coletti DP, Salama A, Caccamese JF Jr. (2007) Application of intermaxillary fixation screws in maxillofacial trauma. J Oral Maxillofac Surg 65(9):1746–1750
4. Busch RF, Prunes F (1991) Intermaxillary fixation with intraoral cortical bone screws. Laryngoscope. 101:1336–1338
5. Nandini GD, Balakrishna R, Rao J (2011) Self tapping screws v/s Erich arch bar for inter maxillary fixation: a comparative clinical study in the treatment of mandibular fractures. J Maxillofac Oral Surg 10(2):127–131
6. Chandan S, Ramanojam S (2010) Comparative evaluation of the resin bonded arch Bar VERSUS conventional Erich arch bar for intermaxillary fixation. J Maxillofac Oral Surg 9(3):231–235
7. Ayoub AF, Rowson J (2003) Comparative assessment of two methods used for interdental immobilization. J Craniomaxillofac Surg 31(3):159–161
8. Avery CME, Johnson PA (1992) Surgical glove perforation and maxillofacial trauma: to plate or wire? Br J Oral Maxillofac Surg 30(1):31–35
9. Rothe TM, Kumar P, Shah N, Shah R, Mahajan A, Kumar A (2018) Comparative evaluation of efficacy of conventional arch bar, intermaxillary fixation screws, and modified arch bar for intermaxillary fixation. J Maxillofac Oral Surg. https://doi.org/10.1007/s12663-018-1110-7
10. Qureshi AA, Reddy UK, Warad NM, Badal S, Jamadar AA, Qurishi N (2016) Intermaxillary fixation screws versus Erich arch bars in mandibular fractures: a comparative study and review of literature. Ann Maxillofac Surg 6(1):25–30