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Evaluating the effectiveness of Hybrid arch bar with Erich arch bar during maxillomandibular fixation: A prospective, randomized, single-blinded study

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Abstract---Aim: To evaluate the effectiveness of Hybrid arch bar and Erich arch bar during Maxillomandibular Fixation. Materials And Methods: We designed a parallel-group, randomized controlled trial to compare the 2 types of arch bars. A total of 20 patients with mandibular parasymphysis fractures within the age group of 25 - 30 years presenting to our institution were enrolled in the study and randomized into 1 of 2 groups: the hybrid arch bar group and the Erich arch bar group. The primary outcome variable was arch bar placement time. The secondary outcomes were glove tears during application and removal, patient comfort and the removal time of the device. The groups were compared using *t* tests. Results: A total of 20 patients participated in the study, out of which 10 were females and 10 were males. In group A the mean application time noted was 7 minutes. In group B the mean application time noted was 30 minutes ($P < .0001$). Significantly more glove tears or penetrations occurred during application in the Erichs arch bar when compared to the Erichs arch bar. The average time for removal for the hybrid arch bars was 9 minutes, which was significantly less than the average 17 minutes for the removal of erichs bar ($p < .0001$). The patients were more comfortable during the maxillomandibular fixation in group A when compared to group B. No adverse effects during the placement of hybrid arch bar. Conclusion: In this study, we conclude that there

were Hybrid arch bar system proved to be more efficient than the Erich arch bar.

Keywords---evaluating effectiveness, Hybrid arch bar, Erich arch bar.

Introduction

Facial fractures is very common in the Indian health care system due to a variety of reason. Among the various locations in which facial fracture can occur, the mandible is considered as the most commonly location for mandibular fractures which requires medical intervention (Edmunds et al. 2019). The objective for the treatment of mandibular fracture is to reestablish the occlusion and the masticatory function. The various modalities used in the treatment of fractures are the usage of Erich arch bars, interdental eyelet wiring, external pin fixation, bonded brackets, embrasure wires, cast metal splints, and pearl steel wires. For the purpose of closed reduction and internal fixation Erichs arch bar is a standard treatment protocol practiced by many oral and maxillofacial surgeon . Erichs arch bars provide an effective and versatile means of maxillomandibular fixation however it is associated with certain disadvantages . The risk of penetrating injury to surgeon, increased surgical time both in removal and placement, trauma to periodontium, and compromised oral hygiene are few of the shortcomings of traditional arch bars (Qureshi et al. 2016).

In the dawn of 2013 , the Stryker SMARTLock system was released .This system consists of the SMARTLock Hybrid MMF Plate (arch bar), which is made of commercially pure titanium plates. The plate consists of an arch bar segment and nine screw hole segments that project from the arch bars. This plate is secured with monocortical titanium alloy screws placed through the oral mucosa into the supporting bone in a fashion similar to maxillomandibular fixation screws. These screws are 2.0 mm in diameter and come in lengths of 6 and 8 mm. The system also includes a screwdriver, plate cutter, plate bender, and screw spacer. The spacer is used to hold the plate away from the oral mucosa until the screws lock into the plate (Fernandes et al. 2021)

The purpose of this study was to compare the conventional Erichs arch bar system with smart lock Hybrid MMF system. The success, complications, and radiographic findings of both the systems were evaluated in this study. Previously our team has a rich experience in working on various research projects across multiple disciplines (Govindaraju and Gurunathan 2017; A. Christabel et al. 2016; Soh and Narayanan 2013; Mehta et al. 2019; Ezhilarasan, Apoorva, and Ashok Vardhan 2019; Campeau et al. 2014; Kumar and S 2016; S. L. Christabel 2015; Kumar and Rahman 2017; Sridharan, Ramani, and Patankar 2017; Ramesh et al. 2016; Thamaraiselvan et al. 2015; Thangaraj et al. 2016; Ponnulakshmi et al. 2019; “Fluoride, Fluoridated Toothpaste Efficacy and Its Safety in Children - Review” 2018) Now the growing trend in this area motivated us to pursue this project.

Materials and Methods

This was a single-center, parallel-group, single blinded randomized control trial. A total of 20 patients participants in the study out of which 10 were males and 10 were females. A written informed consent was obtained from all the participants. Ethical committee approval was obtained from the institutional ethical committee. The participants involved in the study were between the age group 25 - 30 years. All the patients with mandibular parasymphysis fractures were enrolled in the study. Patients with systemic diseases, active infections, pregnant women, drug abusers, alcohol users were excluded from the study. These patients were also excluded if they declined to participate. The treating surgeon explained the risks and benefits of study participation in detail to each patient, and patients were enrolled in the study. All the participants were enrolled into 2 groups based on the computerized research randomization software. In group A the patients received hybrid MMF arch bar. In group B the patients received Erichs arch bar. A single operator performed the arch bar fixation on both the groups. All the patients underwent maxillomandibular fixation using lignocaine which consisted of 1:200000 adrenaline.

In group A the hybrid group had the arch bars placed and secured with self-drilling locking bone screws. In group B the arch bars are placed and secured with 24-gauge stainless steel circumdental wires. In group B, the arch bars placed and secured with 24-gauge stainless steel circumdental wires. The arch bars were adapted to the maxillary and mandibular dentitions spanning from first molar to first molar and cut to an appropriate length for each arch.

In the hybrid group, the Stryker Universal SMARTLock Hybrid small arch bars were adapted to the maxilla and mandible. The midline locking screw was typically the first screw placed on each arch using a screwdriver. Next, a series of additional self-drilling bone-borne locking screws were placed in each arch, adapting the arch bar eyelets as needed to ensure placement in bone while avoiding the roots of the dentition, with 5 screws used in each arch for a total of 10 bone screws placed for both the upper and lower arches, except in cases in which additional screws were placed as clinically indicated. (Fig 1)

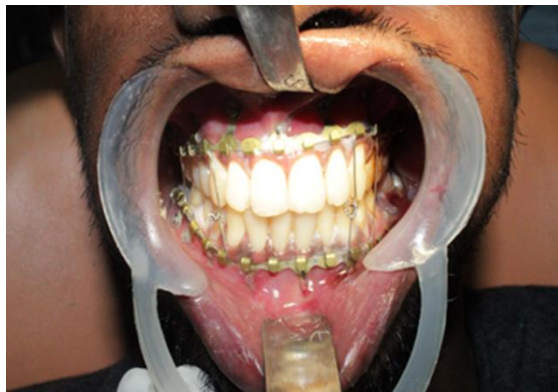


Fig 1

Patients in each group were followed at typical postoperative follow-up intervals for mandibular fracture patients at our institution: 1 week, 3 weeks, and 6 weeks. Additional follow-up between these intervals, when indicated, was recorded. Typically, the devices were removed at 6 weeks after surgery by an operating surgeon without an assistant with the patient under local anesthesia. At each follow-up appointment, any issues or findings directly or indirectly related to the devices as well as other unrelated issues that occurred during the postoperative period were recorded. The primary outcome variable was arch bar placement time. The secondary outcomes were glove tears during application and removal, patient comfort, and the removal time of the device. The groups were compared using *t* tests.

Results

In group A the mean application time noted was 7 minutes. In group B the mean application time noted was 30 minutes ($P < .0001$). Significantly more glove tears or penetrations occurred during application in the Erichs arch bar when compared to the Erichs arch bar. The average time for removal for the hybrid arch bars was 9 minutes, which was significantly less than the average 17 minutes for the removal of Erichs bar ($p < .0001$). The patients were more comfortable during the maxillomandibular fixation in group A when compared to group B. No adverse effects during the placement of hybrid arch bar.

Discussion

Proper fracture reduction in any facial fracture can be easily achieved by maxillomandibular fixation. Majority of the oral and maxillofacial surgeons advocates Erich arch bar to be a gold standard in maxillo mandibular fixation. However, this system presents with disadvantages such as long operation time, pain, and injury to the surgeon during the placement. There are studies which have reported Erich bar application leads to needle-stick injuries, the high plaque index, periodontal damage, movement of the teeth in lateral and extrusive direction (Falci et al. 2015). The aim of this study was to analyse the traditional placement of EABs secured with circumdental stainless steel wires with a hybrid arch bar system secured with bone-borne self-drilling locking screws in the treatment of parasymphysis mandibular fractures. The results of our study showed that the hybrid arch bar system significantly improves the speed of arch bar placement by over 20 minutes and that there is greater surgeon and patient safety and satisfaction.

According to a study conducted by King et al the mean application time was 31 minutes for Erich arch bars and 6 minutes for hybrid arch bars. This finding was similar to the results that we obtained (King and Christensen 2019). A study published by Chao and Hulsen, also compared EABs with hybrid arch bars. An average time of 42 minutes to place the hybrid arch bars, which was significantly less than the 62 minutes required to place the EABs. The difference in application time between the two groups is 20 minutes. This finding was similar to the result that we obtained (Put citation)

In another study conducted in 2018 it was stated that though a reduction in application time with the use of the Hybrid Arch-bars was present the overall length of surgery was not different between the Erich arch bar group and hybrid arch bar group. However, it was stated that for relatively quick procedures such as closed reduction (CR) of routine mandible fractures that overall length of surgery time would also be significantly reduced when the Hybrid system is used (Bouloux 2018).

The potential safety benefit is a significant advantage to the surgeon. Surgical glove perforation during maxillomandibular fixation can pose to be a serious threat to the surgeon. The applications of Erichs arch bar consists of extended time using sharps via interdental wiring and other instrumentations. The reported rates of sharp injury is between 23 - 27. percentage (Zhang et al. 2021).

There are studies that demonstrates that the surgical treatment of a mandibular fracture is associated with a relatively high incidence of glove perforation. Furthermore, the overall incidence of perforation is especially high when a wiring technique is used. It was observed that wire-stick injuries occurred whilst passing wire interproximally and also due to an inadequately positioned interproximal wire. Majority of the glove perforations goes unnoticed (Avery and Johnson 1992). This study also proved that high incidence of glove perforation were present when Erichs bar was used for fixation. This draw back can be overcome by the usage of hybrid arch bar which consists of self tapping screws used for the stabilisation the arch bar. The versatility of this hybrid arch bar system includes the placement of wire and elastic in different vectors as in the need of the situation. These are factors which offered surgeon satisfaction during the usage of hybrid arch bar when compared to Erichs arch bar .. (Pigadas et al. 2008) .

The hybrid arch bar system is associated with high cost, which makes it difficult for the patients to afford it. According to our experience this draw back can be addressed by sterilising and reusing the titanium arch bar and the screws. The limitations of this study included the small sample size and the subjective judgments of the surgeons. Further reliable evidence with an adequate sample size, study design, and diagnostic methods is required to examine the efficacy of hybrid arch bar over the Erichs arch bar.

Our institution is passionate about high quality evidence based research and has excelled in various fields (Jayaseelan Vijayashree Priyadharsini 2019; Pc, Marimuthu, and Devadoss 2018; Ramesh et al. 2018; Ramadurai et al. 2019; Sridharan et al. 2019; Ezhilarasan, Apoorva, and Ashok Vardhan 2019; Mathew et al. 2020; Samuel 2021; R et al. 2020; Chandrasekar et al. 2020; J. Vijayashree Priyadharsini, Smiline Girija, and Paramasivam 2018).

Conclusion

The hybrid Maxillomandibular fixation system is an efficient and versatile tool in the arsenal of an oral and maxillofacial surgeon. Hybrid arch bar system is associated with significantly less operating time and greater safety to the surgeon. The benefits associated with this novel system has led to the evolution of this system into a surgeons practice.

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