Self Tapping Screws v/s Erich Arch Bar for Inter Maxillary Fixation: A Comparative Clinical Study in the Treatment of Mandibular Fractures

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Abstract

Introduction and Objective Numerous methods have been described for achievement of Intermaxillary fixation in the treatment of fractures of facial skeleton. Conventional methods like Erich arch bars and eyelet wires are currently most common methods for achieving intermaxillary fixation (IMF), but they have their own disadvantages. Since 1989, IMF using intraoral self tapping IMF screws has been introduced for treatment of mandibular fractures. The aim of this work was to compare the efficacy, advantages, disadvantages indications and potential complications associated with Erich archbar v/s self tapping IMF screws in the management of mandibular fractures.

Methods Twenty patients with mandibular fractures, reporting to Department of Oral and Maxillofacial Surgery, The Oxford Dental College, Bangalore were evaluated, to compare the efficacy of two techniques. The parameters considered were, time taken, perforations in the gloves, patient acceptance, oral hygiene, iatrogenic dental injuries, and needle stick injuries during IMF with Erich arch Bar and self tapping IMF screws.

Results The mean time taken for IMF was 8.52 ± 2.7 min with screws as compared to 100 min with Erich arch bars. Mean number of perforations were significantly more in Group II. Oral hygiene status was good in 90% and fair in 10% of Group I and 100% fair in Group II patients.

Conclusion Use of self tapping IMF screws for intermaxillary fixation is a valid alternative to conventional Erich arch bars in the treatment of mandibular fractures. Iatrogenic injury to dental roots is the most important problem to this procedure, which can be minimized by careful radiographic evaluation and treatment planning.

Keywords Inter maxillary fixation (IMF) · American society of anaesthesiologist (ASA) · General anaesthesia (GA)

Introduction

Any discussion on management of mandibular fractures opens with history and evolution of treatment and dates back to *Edwin Smith, an ancient Greek*. He provides a clear cut documentation for the treatment of mandibular fractures dating back as early as the seventeenth century. Mandibular fractures can be treated by Intermaxillary fixation alone, or by osteosynthesis with or without intermaxillary fixation. Intermaxillary fixation can be achieved by Eyelets, Arch bars, Bonded brackets, Cast metal splints, Vacuum formed splints, Pearl steel wires, Self-tapping IMF screws and Self drilling IMF screws. The introduction of bone plating system has reduced the prolonged periods of intermaxillary fixation (IMF). However, there is a need for temporary intermaxillary fixation intraoperatively to assist in reduction of fractures with the teeth in correct occlusion and post operatively to assist in fixation or to correct minor occlusal discrepancies. Different methods have been used for intermaxillary fixation including custom-made arch bars, eyelet wires, and Schuchardt arch-shaped splints made of metal and acrylic (Schuchardt and Metz 1966). However, these are time-consuming methods, with a constant danger of trauma to the

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surgeon's fingers by the sharp wire ends. Twisting a wire around a tooth conveys little feel as to its tightness and there is a danger of avulsion if force is too great. Wires tightened during the application of arch bars around the teeth may cause *Ischemic necrosis* of the mucosa and the periodontal membrane and if damage is extensive, tooth loss may result (Wilson and Hohmann 1976). Recently self-tapping IMF screws have been advocated for intermaxillary fixation (Jones 1999). Despite the fact that the method is easy to apply it carries the risk of damage to the roots of the teeth. Self tapping IMF screws are quick and easy to use and greatly shorten the operating time to achieve maxillomandibular fixation. They are relatively inexpensive and reduce the risk of needle stick-type-injuries associated with wires [1]. There is also no trauma to gingival margins and gingival health is easier to maintain as compared to arch bars or eyelets.

Materials and Methods

Objectives of the Study is to compare the efficacy and advantages of—“*Self Tapping Screws V/S Erich Arch Bar for Inter Maxillary Fixation in the Treatment of Mandibular Fractures*” through various parameters like—(i) The time taken for inter-maxillary fixation, (ii) Incidence of needlestick injury, (iii) The tooth morbidity, (iv) The stability of fixation, (v) The patient acceptance, and (vi) The periodontal health and hygiene.

The findings were recorded as per the criteria described below: (i) Time consumed for achieving inter-maxillary fixation was recorded in minutes from start of procedure till inter-maxillary fixation was achieved. (ii) Needle stick injury: Incidence of perforations in the gloves of surgeon and first assistant were identified by water inflation method [2]. A puncture in any of the team member gloves was taken as positive finding. (iii) Iatrogenic injury to adjacent teeth: Vitality of teeth was checked using electronic pulp tester pre-operatively and post-operatively at the time of splint removal. Any positive findings were recorded and noted. (iv) Stability of inter maxillary fixation; adequate/inadequate. (v) Patient acceptance graded as good, fair and poor. (vi) Oral hygiene index simplified given by Greene and Vermillion was used to evaluate the oral hygiene status of the patient at the time of 1st and 6th weeks after the splint placement and were scored accordingly.

Twenty patients with mandibular fractures were randomly selected and grouped into 2 groups of 10 each—Group-I and Group-II.

Inclusion criteria's were (a) The patients with isolated non pathologic fracture of mandible, (b) Age group of –15 to 60 years, (c) Patients with vital teeth in the area of self tapping screw fixation, (d) Favorable and Unfavorable fractures of the mandible.

Fig. 1 Erich arch bar

Fig. 2 IMF screw

Exclusion criteria's were (a) Edentulous patients, (b) Patients with underlying systemic disease [American society of anaesthesiologist (ASAIII and ASAIV)], (c) Pathologic fractures, (d) Comminuted fracture of mandible.

Group-I—Patients received inter-maxillary fixation with arch bars, using “Dentaurum” Erich arch bars and 26 gauge “Sendent” stainless steel wire (Fig. 1). Group-II—Patients received inter maxillary fixation screws (Fig. 2). Self Tapping IMF screws of 2 mm diameter and 12–14 mm were placed after drilling a hole using a 1.5 mm drill bit at the junction of attached and reflected mucosa with one screw in each quadrant. Temporary IMF was achieved with 26 gauge stainless steel wire.

The Erich arch bar and IMF screws were retrieved after 6th post operative week in the out patient Department under local anaesthesia.

Results

The time taken ranged from 5.7 to 14.0 min with mean time of 8.52 min for Group I (IMF screws) as compared to Group

Table 1 Comparison of time taken in minutes to perform the procedure between two groups

Time taken in mins	Group I	Group II
Range	5.71–14.0	75–115–6900
Mean $\pm$ SD	8.52 $\pm$ 2.73	100.8 $\pm$ 11.66
Inference	Group II has taken significantly more time with $P < 0.001^{**}$	

Table 2 Comparison of incidence of perforations in the gloves between two groups

Perforation	Group I ($n = 10$)	Group II ($n = 10$)
Present	3 (30.0%)	10 (100.0%)
Absent	7 (70.0%)	–
Inference	Group II had significantly more perforation with $P = 0.003^{**}$	

Table 3 Comparison of vitality of teeth between two groups

Vitality	Group I ($n = 10$)	Group II ($n = 10$)
Vital	6 (60.0%)	10 (100.0%)
Non-vital	2 (20.0%)	0
Delayed	2 (20.0%)	0
Inference	Non-vital and delayed characteristics are significantly more in group I with $P = 0.0866+$	

II (Arch bars) patients were the time taken ranged from 75 to 115 min with mean of 100 min (Graph-I, Table 1). The perforation in the gloves was 30% in Group I and 100% in Group II (Graph-II, Table 2). The mean number of perforations were significantly more in Group II (13.4 ± 5.13) as compared to Group I (0.60 ± 0.96). The tooth morbidity depending on the radiographic findings was 30% in Group I and was 0% in Group II patients. In Group I the vitality test was positive in 60% of patients, 20% had delayed response and 20% non responsive. In Group II vitality test was positive in 100% (Graph-III, Table 3).

The IMF screws and Arch bars were checked for stability after first post operative week and 6th post operative week. In Group I the stability was adequate in 80% of the patients and it was inadequate in 20% of the patients. In Group II stability was adequate in 70% of the patients and inadequate in 30% of patients. The patient acceptance was significantly good in Group I 100% and in Group II patient acceptance was good in 10%, fair in 70%, poor in 20% of the patient's. On the 6th post operative week the oral hygiene status was good in 90% and fair in 10% of Group I and 100% fair in Group II patients (Graph-IV, Table 4).

Table 4 Comparison of oral hygiene status between two groups

Oral hygiene	Group I ($n = 10$)	Group II ($n = 10$)
Good	9 (90.0%)	0
Fair	1 (10.0%)	10 (100.0%)
Inference	Oral hygiene is significantly more good in Group I and significantly Fair I Group II with $P < 0.001^{**}$	

Discussion

The main goals in successfully treating mandibular fractures include: reduction of the fracture, stabilization of the fracture, and achievement of proper dental occlusion. In the process of fully satisfying these criteria, it is also advantageous to use techniques that reduce the risk of percutaneous transmission of blood-borne diseases, operating time and duration of general anaesthesia, and hospital costs [9, 14].

The treatment of maxillofacial fractures involves different methods from bandages and splinting to methods of open reduction and internal fixation and usually requires control of the dental occlusion with the help of intermaxillary fixation which is time consuming with traditional methods.

The arch bar has been the mainstay for the management of maxillomandibular bony injuries since world war I. The originators of this method, Sauer in Germany and Gilmer in US used an ordinary round bar flattened on one side that was ligated to the teeth with brass ligature wires. Blair and Ivy's modification was a flattened on one side that was about 2 mm in width to conform better to the teeth and provide greater stability [3].

Introduction of bone plating system has reduced prolonged periods of intermaxillary fixation; there is often a need for temporary intermaxillary fixation intraoperatively to check the occlusion and postoperatively to assist in fixation or to correct occlusal discrepancies by elastic traction. Erich Arch bars are currently the most common methods of achieving intermaxillary fixation, although other methods are described. The placement of arch bar is time consuming and uncomfortable to the patient. Among the disadvantages of using arch bar include movement of teeth in lateral and extrusive direction, constant traction applied to the wire can distract the fracture parts and possibly cause additional complications [3], difficulty to secure arch bar in isolated posterior teeth, periodontal tissue injury, needle stick type of injuries to the operator, difficulty in maintaining good oral hygiene [11] and it is not suitable for dentition that carry extensive crown and bridge work.

The self tapping intermaxillary screws were first introduced by Arthur and Berardo [7] in 1989 and later modified by Carl Jones [10] with a Capstan shaped head design. He

suggested the use of threaded titanium screws of 2 mm diameter and 10–16 mm length. According to him, screws with capstan style head are important as it allows the wires and elastics to be held away from the gingival tissue. These screws are quick to insert and have fewer risks of needle stick injury than conventional methods. The operating time is also reduced from 1 h to 15 min. He recommended the use of these screws for temporary intraoperative IMF and postoperative elastic traction. Self tapping intermaxillary fixation screws are not indicated for severely comminuted fractures, extensive alveolar bone fractures and missile injuries to the jaws. The authors used 2.5 mm diameter self tapping screws of variable length and 24 gauge stainless steel wires for IMF. In the present study we used 2.0 mm diameter self tapping screws of 10 mm length and 26 gauge wires for IMF. Contraindication to screws includes pediatric patients with uninterrupted teeth, and patients with severe osteoporosis.

Complications using self tapping intermaxillary fixation screws includes fracture of the screws on insertion, iatrogenic damage to teeth and bony sequestrum around the area of screw placement. If the speed of the drill is too fast surrounding mucosa and bone may be burnt, resulting in painful ulcerations and even drill tip may break off in bone. If the screws are left in place postoperatively this overheating can cause thermal necrosis of bone around the screw and loosening of head. Self tapping intermaxillary fixation screws may shear at bone level during insertion.

Coburn DG (2002) [6] reported a case of fracture of screw at the junction of screw head and threaded portion. He recommended a careful drilling of bur hole, with slow bur speed and copious irrigation with sterile saline. He further suggested that the screw should be inserted at an even speed and should not be forced if resistance is encountered.

A similar complication was also reported by Simon Holmes (2002) [8]. He advocated caution with use of bi-cortical screws and suggested the technique of two forward turns followed by one backward turn to exclude the shaft from the pitch of the screw during insertion and removal, where as no such case of screw fracture was encountered in the present study.

Next commonly encountered complication mentioned with self tapping screws was the injury to the roots of the teeth adjacent to the screw fixation site. Majumdar (2002) [12] reported one case of root damage using self tapping screws. The operator must be confident that he/she has felt the bur drop in the medullary bone after having perforated the buccal cortex, before lingual/palatal cortex is encountered. If this change in resistance is not felt, the possibility of bur being partly or fully in a tooth root should be considered. Majumdar mentioned his system include easy placement and removal with minimal hardware, significant

reduction in operating time from 45 to 10 min and equal ease of application in dentate and non dentate patients. The above mentioned advantages were experienced in the present study.

Steven Key (2000) [13] recommended a thorough clinical and radiographic assessment of the adjacent teeth at the site of screw placement. The alignment of the teeth in three dimensions should be fully appreciated. They recommended placing self tapping screws between the canine and first premolar region at the mucogingival junction or placing it below the root apices of the mandibular teeth or above the root apices of the maxillary teeth.

The loosening of the screws is another complication associated with this method. Busch RF [4] also reported a similar complication in his study. He recommended use of greater diameter screws placed away from root apices. A similar complication was encountered in our study also.

In the present study, the time taken to achieve intermaxillary fixation with self tapping IMF screws and Erich arch bar was noted. According to the results, it is evident that the maximum time taken was for arch bar fixation 100 min and the average time taken for IMF with the self tapping IMF screw was found to be 8.5 min. The results of the present study are in agreement with the data from various studies [7, 10].

Win et al. (1991) [15] used self tapping screws of diameter 3.5 mm and 12 mm/16 mm in length. They used horizontal stab incision before using drill to make the pilot hole. They used self tapping IMF screws in three partially edentulous patients with dentures. In the present study the screws were placed transmucosally.

Bush and Prunes (1991) [4] used 2.7 mm diameter self tapping IMF screws of length 16/20 mm. They mentioned that this technique had less infections, reduced operating time, minimal hardware and superior stabilization than other techniques.

Bush (1994) [5] used self tapping IMF screws in 67 patients. He reported periodontal abscess distant from screw site in one patient, one case of cellulitis around screw and one screw was displaced into the maxillary sinus. In the present study no such complications were encountered. Bush reported loss of fixation occurred in 6 patients. In our study there was one case of loss of fixation. He mentioned the advantages of self tapping IMF screws, which includes a reduced risk of percutaneous contamination, the technique was simple to learn and use and operating time was reduced from 90 to 15 min. In our study, we found 30% percutaneous contamination compared to Erich arch bar 100%. The IMF screws technique is simple as well as easy to use. Another complication associated with self tapping IMF screws is that, they become embedded in the soft tissue over a period of time and during their removal necessitate use of stab incision under

local anesthesia. The self tapping IMF screws sometimes pose problem for the plate positioning during immobilization of the fractured segments.

In our study, self tapping intermaxillary screws and Erich arch bar fixation were used for open reduction and internal fixation. In the present study all cases of mandibular fractures were treated with open reduction and internal fixation under GA, except or one case of angle fracture which was treated only with the intermaxillary fixation using self tapping IMF screws with acceptable occlusion and bone healing. Mean time taken for intermaxillary fixation was 8.52 min and for Erich arch bar was 100 min. Time taken for IMF with screws was tremendously reduced when compared with arch bar.

Self tapping IMF screws provided good intra operative fixation in all the 10 cases in the present study. Post-operatively, there was no incidence of infection, trauma to the surrounding tissues and nerve injury. There were no signs and symptoms of pain and edema at the screw site in all the cases at the end of 1st and 6th postoperative week in the present study. Oral hygiene of all the patients was good and infact it had improved postoperatively after meticulous oral hygiene instructions with screws but it was fair with Erich arch bars. It was easier to maintain oral hygiene with IMF screws compared to arch bar.

The present study indicates that IMF screws technique is good alternative to Erich arch bars for temporary intermaxillary fixation.

Conclusion

Intermaxillary fixation with self tapping IMF screws is more efficacious method as compared to the conventional Erich arch bars in the treatment of mandibular fractures. Although both the techniques offer—*good temporary intermaxillary fixation* to check occlusion and postoperatively for intermaxillary fixation, Self tapping IMF screws reduces the operating time, the risk of needle stick injuries (30%). Maintenance of *oral hygiene and patient acceptance* was good with IMF screws as compared to arch bar. *Considering the results of the study it would be advantageous to use self tapping IMF screws for treatment of*

mandibular fractures and extend it to the treatment of other facial fractures.

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