Prospective study to assess the efficacy of IMF screws for maxillo-mandibular fixation
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Abstract

Purpose: The use of intermaxillary fixation (IMF) in the treatment of maxillofacial trauma represents the cornerstone of fracture reduction and immobilization. Many modalities of IMF have been described; recently IMF screws have been introduced into clinical practice. We performed prospective study to assess the efficacy of IMF screws for maxillo-mandibular fixation.

Material and Methods: 18 patients with mandibular fractures treated by using IMF screws, were evaluated by pre-op and post-op panoramic radiographs. Clinical examination was carried out for vitality and abnormal mobility of teeth adjacent to the site of screw insertion, to evaluate the efficacy of this method different factor such as iatrogenic dental injuries, loss, breakage or screw cover by oral mucosa, post-operative occlusion, injury to nerve and loosening of screw. Results: the most common complication was 10. 95% screws were covered by oral mucosa, 8. 2% screws were loosened at the time of removal, 1. 4% screw was distorted. Local inflammation of mucosa around the screw was present in 1 case. Injuries to dental roots caused by screws were found in 6 patients. The damage consisted of scratches of the roots of 8. 2%. All teeth having scratched roots remained vital and without abnormal mobility, throughout follow up. Iatrogenic injury to teeth was 2. 7%. Conclusion: self tapping IMF screws have been shown to be a useful modality to establish maxillo-mandibular fixation in the treatment of mandibular fractures. So use of IMF screws for MMF is a valid alternative to traditional arch bars. It is a safe, time-sparing technique, reduces the damage to periodontal tissues and offers less risk of needle stick injuries to the surgeon.

Keywords: Maxillo-Mandibular fixation, IMF screws, Mandibular fractures.

Introduction

Fracture of mandible occurs more frequently than any other fracture of facial skeleton. In maxillo-facial injuries, mandibular fractures used to be more common than middle third injuries. Successful treatment of maxillo-facial fractures depend on reduction and fixation using closed or open technique, and on restoration of normal occlusion. Mandibular fractures can be treated by intermaxillary fixation alone, or by osteosynthesis with or without intermaxillary fixation. Stable maxillo-mandibular fixation can be achieved by eyelets, arch bars, bonded brackets, cast metal splints, vacuum formed splints, pearl steel wires, self tapping IMF screws. The introduction of bone plating system has reduced the prolonged periods of intermaxillary fixation or sometime not required in patient with the mandibular fracture. However, there is often a need for temporary intermaxillary fixation intra-operatively to assist in reduction of fractures with the teeth in correct occlusion and to assist in fixation or post-operatively it also helps to correct minor occlusal discrepancies.

Conventional method like arch bars is the currently the most common methods of achieving maxillo-mandibular fixation, but they have their own disadvantages. They are time consuming, irritating to surgeon and patient, incidence of needle stick injury, injury to periodontium and difficult to maintain oral hygiene.

To overcome these problems, self tapping IMF screws has been introduced. These screws are quick and easy to use, and greatly shorten the operating time to achieve maxillo-mandibular fixation. The risk of needle stick injuries associated with using wires is also reduced, easy to maintain oral hygiene. This study is designed to evaluate the efficacy of self tapping IMF screws for maxillo-mandibular fixation in the management of mandibular fractures. In the present prospective study the effectiveness of this method was evaluated, looking also for postoperative iatrogenic complications.

Material and Methods

This study was an attempt to evaluate the efficacy of self tapping IMF screws as a mean of intermaxillary fixation in the treatment of mandibular fractures. The criteria for selection of cases were those who had sustained mandibular fractures and reported to the department of Oral and Maxillofacial Surgery, Pacific Dental College and Hospital, Debari, Udaipur. Patients were selected by random sampling.

Self tapping IMF screws are 2. 0 mm in diameter, 8/10/12 mm in length. The screw has pointed tip and its head has a slot where the wire can be passed for intermaxillary fixation. The selected cases were treated by open reduction and internal fixation under GA or LA. In these cases self-tapping IMF screws were used as a method of intermaxillary fixation. Intermaxillary fixation was achieved with 26 gauge stainless steel wire.

After recording the detailed history, patients were thoroughly examined, radiographs and photographs were also taken for each patient. With the aid of Orthopantomograph, the exact site of placement of screws is selected based on clinical and/or radiographic information. Screws are positioned interdentally at mucogingival junction or in edentulous spaces. Further care is also taken so that screw is not placed too far below the root apex as the screw is then covered by vestibule and making it difficult to put wires. Screws were inserted, at least one in each quadrant, under general anesthesia or local anesthesia. The sites of placement of screws in maxilla includes the zygomatic buttress region and in between canines and first premolar.
In the mandible care is taken not to place the screw too far inferiorly as it may endanger the inferior dental nerve and vessels. Prior to placement of screws, 2% lignocaine with adrenaline is infiltrated. Once the position of screw placement is determined the guiding hole is drilled using a straight surgical hand piece and a straight fissure bur of 1.5 mm diameter. The holes are drilled through the mucosa without a gingival incision. Care is taken that the bur enters the alveolar bone at right angles between roots of the teeth so as to avoid injuries to roots.

The screw is secured in a screw holder and inserted into previously drilled hole in a clockwise direction. The screw is passed through the buccal cortices and inserted until the flat surface of the head fits snugly against the buccal mucosa (Fig 1) and IMF is achieved with the help of 26 gauge wire (Fig 2). Care is taken that the screw does not penetrate the palatal or lingual mucosa where it could cause soft tissue irritation. The screws were left in place for 2-3 weeks to enable postoperative elastic traction to correct small discrepancies in occlusion. Antibiotic therapy is maintained for five postoperative days. The screw removal is done after achieving satisfactory fixation. The screws were removed without anesthesia except screws which had been covered by oral mucosa in postoperative period. All patients were checked by using orthopantomogram, immediately within 24 hrs after surgery and second radiograph after screw removal, to evaluate any possible iatrogenic injury to the teeth (Fig 3). At removal, the vitality of the teeth adjacent to the hole was monitored. All patients had a clinical follow-up of at least 6 months.

Result

Of the eighteen patients in this study, 16 (88.9%) were male and 2 (11.1%) were female. The average age of the study population was 28.94 ± 9.502 yrs. Among these, 6 (33.3%) were undisplaced, 9 (50%) were minimally displaced and 3 (16.7%) were moderately displaced. Out of 18 cases 6 (33.3%) had fracture of parasymphysis, 3 (16.7%) had symphysis fracture, 1 (5.6%) had body fracture, 2 (11.1%) had angle fracture, 4 (22.2%) had subcondylar fracture, 1 (5.6%) case had symphysis and subcondylar fracture and 1 (5.6%) case reported with symphysis and angle fracture.

Etiology of mandibular fracture was also evaluated. 15 (83.3%) fractures were caused by road traffic accident and 3 (16.7%) fractures were result of fall injury. Preoperative occlusion was not dearranged in 6 (33.3%) patients and dearranged occlusion in 12 (66.7%) patients. In all the cases there was achievement of satisfactory occlusion intraoperatively. On first postoperative day only 1 (5.6%) case had mild occlusal discrepancy. Over a period of two week none of the patients had malocclusion.

Changes in the pain status were noted over a period of two week. On first postoperative day 11 (61.1%) patients had moderate pain, 1 (5.6%) patient had severe pain and 6 (33.3%) patients had mild or no pain. On third postoperative day only 3 (16.7%) patients had moderate pain, whereas on 7th and 14th postoperative day none of the patients had pain. Over all, oral hygiene was good and improved after educating the patients to maintain the oral hygiene.

Four screws each were placed in 17 (94.4%) patients, while in 1 (5.6%) case five screws inserted. Total 73 screws used. They were inserted under local anaesthesia in 16 patients and under general anaesthesia in other 2 patients. 8 (10.95%) screws were covered by oral mucosa and 6 (8.2%) screws were loosened at the time of removal. 1 (1.4%) screw was distorted. Local inflammation of mucosa around the screw was present in 1 case. Injuries to dental roots caused by screws were found in 6 patients. The damage consisted of scratches of the roots of 6 (8.2%) teeth and 2 (2.7%) root canal were perforated. Among this, 1 (1.4%) tooth became devitalized by insertion of screw. All teeth having scratched roots remained vital and without abnormal mobility, throughout follow-up. Iatrogenic injury to teeth was 2.7%.

During the surgical procedures, no needlestick injury to the surgeon was reported. None of the patients had injury to inferior alveolar nerve. Average time taken for maxillo-mandibular fixation with help of IMF screws was 17+2.8 minutes with range of 13-23 minutes.

Discussion

Management of fractured facial bones presents some challenges of its own: a need to restore normal occlusion, maintenance of facial symmetry and balance, complex movement of temporomandibular joint. Recognition of existing problem is essential, followed by reduction of fractures, retention of the bony segment in reduced position, and rehabilitation during and after bone healing.4,27

Successful treatment of mandible fractures depends on reduction and fixation using a closed or open technique, on restoration of normal occlusion and bony union. Before fracture reduction, temporary intermaxillary fixation with correct registration of occlusion is usually necessary.24,27 The goal of intermaxillary fixation is to provide indirect stabilization of fractures of the maxilla, the mandible, or both.21 Intermaxillary fixation can be achieved by eyelets, arch bars, bonded brackets, cast metal splint, vacuum formed splint, self-tapping IMF screws and self-drilling IMF screws.21,22 The introduction of bone plating system has reduced the prolonged periods of intermaxillary fixation or sometimes not required in a patient with the fracture of the mandible. However, there is often 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 by elastic traction.6 The most common technique is to use arch bars or eyelet wires. These techniques take a relatively long time to place and to remove, can lead to perforation of the surgeon’s gloves and consequent “needle-stick” injury of fingers caused by the sharp-ended wires, with disease transmission risk. Moreover they are not easy to apply when the teeth carry extensive crown and bridgework. Finally, wires tightened during the application of arch bars around
the teeth may cause an ischaemic necrosis of the mucosa, and make it difficult to maintain gingival health. The disadvantage of eyelet wiring is that, as the eyelet is drawn into the interden tal space and the wire is tightened, it proves difficult to insert other wires through the eyelet. 4,17,19

To get around these problems, Dal pont presented a solution for intermaxillary fixation, using S-shaped hook inserted under general anaesthesia lateral to the piriform aperture and at the inferior border of the mandible. 24,27 Otten improved this method using AO miniscrews inserted into the nasal spine and into the symphysis region of the mandible. These screws were used to attach elastic bands, or wires for intermaxillary fixation. 27 The self-tapping intermaxillary screws were first introduced by Arthur and Berardo in 1989 and later modified by Carl Jones with a capstan head design. 17 The authors used self-tapping titanium screws 8mm long and 2mm in diameter. In our study we used self-tapping stainless steel screws 8mm, 10mm or 12mm long and 2mm in diameter. While author used 24 gauge stainless steel wires for IMF, we used 26 gauge wires for IMF. We also came across the advantages mentioned by the author.

There are many advantages to this procedure, with respect to the use of arch bars. First, insertion is quick, easy and safe; no discomfort to the patient; takes about 10min, with significant intraoperative saving in time and cost; they are equally easy to remove without anaesthesia. There is practically no damage to the dental papillae and oral mucosa are considerably reduced; the teeth and dental prosthesis are not subjected to traction, and it is easier to maintain dental hygiene. Finally, the method is compatible with rigid fixation using any plating system. 3,18,19,21

The main risk of using screws is the possibility of damaging dental roots while drilling the hole, especially in patients with dental crowding. There are also reports of other complications such as breakage, or loss of screws, or the screws being covered by oral mucosa, infections associated with their placement, loss of teeth, and anaesthesia due to injury to the mental or inferior alveolar nerves. 3,6,18,20 Finally, some authors stated that intermaxillary fixation with screws does not permit postoperative directional traction and cannot provide the “tension band” effect that can be achieved by means of arch bars. 27

For self-tapping screw insertion, a pilot drill is used, passed directly through mucosa into the bone of selected site, and a hole is prepared. However, several problems have been encountered. The roots of adjacent teeth may be damaged by the drill when screw holes are being prepared. Drill-tips may break off in bone. If the speed of the drill is too fast then surrounding mucosa and bone may be burnt, resulting in painful ulceration. If the screws are left in place postoperatively, this overheating can cause thermal necrosis of bone around the screw and can lead to its loosening. IMF screw can also shear at bone level during insertion, as bone particles may collect in the pitch of the screw and cause binding. To overcome these problems a self-drilling IMF screw has been developed. 11

A careful procedure during the drilling of the bur hole is essential, with slow drill speed and copious irrigation with sterile saline. 3 If resistance is felt to drilling, one must stop and prepare another hole, because this could indicate that the bur is partly or fully within a tooth root. 27 The screw should be inserted at an even speed and should not be forced if resistance is felt. 3 It is certainly important to evaluate a dental panoramic radiograph prior to drilling and inserting the screws in order to accurately visualize the position of the roots, especially in cases of dental crowding. 3,28 In many instances the IMF screw can be used in edentulous spaces in the arch, in particular, the mandible, while the pneumatized sinus often limits this application in the maxilla. 4

Win KKS et al used self-tapping screws of 3.5mm diameter and 12mm/16mm in length. They used horizontal stab incision before using drill to make the pilot hole. 14 In our study we have not placed any incision before the placement of screw. Henderson DK and Gerberdins JL found that the health care worker are at risk of acquiring HIV infection subsequently to accidental sticks with needle contaminated with blood from infected patient. 14 Avery and Johnson reported a 50.5% incidence of glove penetration with wires for intermaxillary fixation; 11.4% of perforations resulted in a skin-penetrating injury. 23 In our prospective study we used less amount of stainless steel wires i.e. only 3-4 wires for intermaxillary fixation as compared to arch bars and we have not encountered any cases of needle stick injuries.

Main risk of using screws is the possibility of damaging dental roots. Farr DR suggested that operator must be confident that they have felt the bur drop into the medullary bone, after having perforated the buccal cortex. If this change in resistance to the bur is not felt, the possibility that the bur partly or fully within a tooth root should be considered. 4 Total 73 screws were used in our study. Postoperative dental panoramic radiographs revealed that injury to dental roots caused by screws were found in 6 patients. The damage consisted of scratches of the roots of 6 (8.22%) teeth, and in 2 (2.74%) root canal was perforated. Among this 1 (1.37%) tooth was devitalized by insertion of screw. All teeth having scratched roots remained vital and without abnormal mobility, throughout follow-up. The low percentage (2.74%) of iatrogenic injury to teeth was experienced in our study. Asscherickx et al stated that histological examination of 3 teeth damaged by screws showed an almost complete repair of the periodontal structure (eg, cementum, periodontal ligament, and bone). 33

Farr DR reported a case of fracture of screw at the junction of screw head and threaded portion, where as no such case of screw fracture was encountered in the present study. 8 Roccia F found that screws were covered with oral mucosa. They were positioned either in the mobile mucosa or close to a sur-
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gical incision used to expose the mandibular fracture. In our study also 8 (10. 96%) screws were covered with oral mucosa and only in these cases were the screws removed under local anaesthesia. Coletti DP reported that screws loosening were the most common complication. In our study, screw loosening was noted in 6 screws (8. 22%) out of all screws placed, but it did not affect the intermaxillary fixation and occlusion. Holmes S reported a case of screw fracture and screw bent. They suggested the technique of two forward turns accompanied by one backward turn to exclude the swarm from the pitch of the screw. In the present study, fracture of the screw was not noted but only 1 (1. 37%) screw was distorted. There was no damage to the inferior alveolar nerve or anaesthesia of the lower lip following placement of screws reported in present study.

Gordon KF observed complication like; canine space abscess, submental cellulitis, malocclusion. Coburn DG observed screw fracture, tooth mobility adjacent to screw site and interproximally bone resorption. In present study, local inflammation of mucosa around the screw was present in 1 case. No abnormal tooth mobility was observed. Laurentjoye M and Coletti DP noted postoperative malocclusion but in our study there was no case of postoperative malocclusion.

According to the data, it is evident that the maximum time taken for arch bar fixation is approximately 1 hour and difficult to maintain oral hygiene. In the present study, average time taken for IMF with use of IMF screw was found to be 17 minutes and maintenance of oral hygiene was good. Pain was not noted at the end of 3rd post-operative day in all the cases and needle stick injury was not noted in any of the cases.

Contraindications to screws include paediatric patients with unerupted teeth, patient with severe osteoporosis, multiple comminuted mandibular fractures. Use of these screws is not indicated where the function of a tension band and postoperative directional traction are required, as in multiple comminuted mandibular fractures, alveolar bone fracture or gunshot fractures. Thus the use of this method is mainly indicated in single or double mandibular fracture with minimal displacement, compound condylar fracture, and fracture in edentulous patients if the proper dentures are available.

Conclusion

The present study was concluded that self tapping IMF screws have been shown to be a useful modality to establish maxillo-mandibular fixation in the treatment of mandibular fractures. So use of IMF screws for MMF is a valid alternative to traditional arch bars. IMF screws are useful in mandibular fractures which are not grossly displaced or comminuted. It is a safe, time-sparing technique, reduces the damage to periodontal tissues and offers less risk of needle stick injuries to the surgeon. This study revealed a low percentage (2. 7%) of iatrogenic injuries to teeth and 0% of post-operative malocclusion. The most common complication was noted in present study is, screws covered by oral mucosa (10. 95%).

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