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## Research Article

### IMF SCREWS AN ALTERNATIVE TO ARCHBAR

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#### ABSTRACT

Maxillomandibular fixation (MMF) is a basic and fundamental principle in the treatment of maxillofacial trauma. MMF serves as a cornerstone of maxillofacial reconstruction, providing a stable base from which facial form and function can be restored. It attempts to re-establish the patient's pre-morbid occlusion assisting in the reduction and fixation of simple and complex facial fractures.

##### Key Words:

IMF Screws, Archbars,  
Maxillomandibular Fixation

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## INTRODUCTION

Historically a plethora of techniques has been offered to fix the mandible and the maxilla. In essence more complex metallic framework was attached to the teeth to provide support and anchor points for fixation of the jaws with interconnecting elastics or wires between the dental arches. In dentate patients, tooth-borne devices such as chain linked interdental wires, wired arch bars, cast metal cap splints, pearl steel wires were used for many decades. In partially or completely edentulous jaws, individual partial or complete dentures or "gunning" type splints equipped with hooks were used. These methods have their own disadvantages that they are time consuming, risk of inadvertent skin puncture to the surgeon and difficulty to maintain oral hygiene with these methods.

To overcome the disadvantages these traditional techniques are challenged by cortical bone screws inserted into the alveolar process of the mandible and maxilla, providing anchor points for MMF. These Intermaxillary fixation (IMF) screws have the advantage of ease of application, safe placement and removal, and greatly shorten the operating time to achieve intermaxillary fixation. The risk of needle stick injuries associated with using wires is also reduced to a greater extent. There is no trauma to gingival margins and easy to maintain oral hygiene. The ability

to use intra operative wires and post operative elastic guidance is the other advantage in this technique.

This technique has some intrinsic disadvantages such as loosening of the screw, loosening of wire, root damage, injury to buccal mucosa, overgrowth of the mucosa over the screw and rarely ingestion of hardware. This study is done to evaluate the rationale for the use of IMF screws, indications, possible complications and efficacy of IMF screws over traditional arch bars to check the fracture segments stability postoperatively.

## MATERIALS AND METHODS

This prospective study was conducted in the Department of Oral and Maxillofacial Surgery, Sri Sai College of Dental Surgery, Vikarabad, Andhra Pradesh. Total of 40 patients who reported to our unit with clinical and radiological evidence of fracture of the mandible were included in the study. These patients were randomly allocated into two groups. Among them 20 patients were treated with IMF using arch bars and in 20 patients IMF screws were used.

Inclusion criteria included all patients who sustained fracture mandible and were in good health were included in the study. The following cases were selected. Unilateral/bilateral parasymphysis/body fractures of the mandible, Fractures of the

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symphysis of mandible. Unilateral fractures of condyle, ramus and angle of the mandible. Edentulous fractures of the mandible.

Exclusion criteria for the study were Patients unfit for surgery due to medically compromised conditions or respiratory disorders, epilepsy. Following enucleation of large cysts and resection of tumours where IMF is necessary. Orthognathic surgery for temporary intraoperative IMF. Malunited and nonunited fractures. Pediatric fractures in deciduous and early mixed dentition period. Dentoalveolar fractures. Bilateral condylar fractures. Comminuted fractures. Ethical clearance was obtained from institutional ethical committee.

**METHOD**

A detailed medical and dental history was recorded. A thorough general examination was done. The investigations carried out were surgical profile, photographs and radiographs OPG, PA mandible and IOPA in relation to the IMF screw site were taken. Fracture mandible was diagnosed clinically aided with radiographs. Impressions were taken and model surgery done. Patients randomly divided into two groups one was arch bar group (FIG 1) and the other IMF screws group (FIG 2). Intra operative IMF done.



Fig 1 Showing Archbar

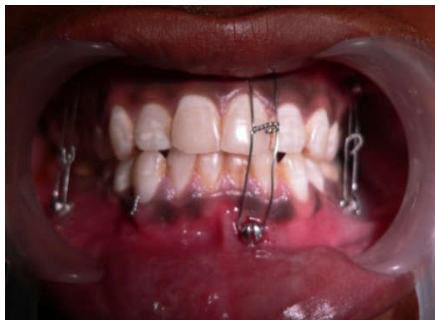


Fig 2 Showing IMF Screws

Open reduction and fixation done using miniplates/lag screws. Post operative IMF/elastics placed if necessary. Intra oral irrigation done twice daily with betadine and saline. Post operatively antibiotics were prescribed for all the patients. Plaque index (Sillness and Loe) was calculated and the patient’s oral hygiene was scored at the end of one week. IMF screws/arch bars removed after one week in cases where post operative IMF was not required and at the end of 4 weeks in patients with post operative IMF. All the details such as age, cause of injury type of fracture, operating time, screw site, use of elastic or wire fixation, duration of IMF, need for IMF postoperatively, post operative occlusion, intraoperative and postoperative sequel were recorded.

**RESULTS**

Total of 40 patients with mandibular fractures were treated with open reduction and internal fixation utilizing Intermaxillary fixation screws/arch bars for Intermaxillary fixation as an intra operative occlusal stabilizing modality. Mean age of patients was 43.5 years (range 16-55 years) comprising of 36 male and 4 female (n=40) patients.(TABLE 1)

Table 1

Sex	Group			
	IMF screw		Arch bar	
	N	%	N	%
Female	3	15.0%	1	5.0%
Male	17	85.0%	19	95.0%
Age	17-55		16-53	

The most common etiology was road traffic accident (28 cases) followed by interpersonal violence (10cases) and falls (2cases). (Table 2)

Table 2

S.no	Site of Fracture	Road Traffic Accidents	Inter Personal Violence	FALL
1.	Symphysis fracture	7	-	-
2.	Symphysis and Subcondyle	4	2	1
3.	Parasymphysis fracture	4	1	-
4.	Bilateral parasymphysis	2	-	-
5.	Parasymphysis and Angle	1	2	-
6.	Parasymphysis and Subcondyle	5	3	1
7.	Body fracture	4	-	-
8.	Body and Subcondyle	1	2	-

The common sites of fracture were symphysis (7); parasymphysis (total 22), isolated parasymphysis (5), bilateral parasymphysis (2), angle with parasymphysis (3), body with subcondylar fracture (3), subcondylar with parasymphysis fracture (9); sub condylar with symphysis (7), body fractures (4). Total 64 mandibular fractures in 20 patients were treated. 96 IMF screws were placed in maxilla and mandible of size 2.5x8mm in 20 patients and arch bars were placed in 20 patients. Intermaxillary fixation was achieved by using 26 gauge wire.(Table 3)

Table 3

S.No	Diagnosis	ARCH Bar Group (Number of patients)		IMF Screw Group (Number of patients)	
1.	Symphysis fracture	4	20.0%	3	15.0%
2.	Symphysis and Subcondyle	5	25.0%	2	10.0%
3.	Parasymphysis fracture	1	5.0%	4	20.0%
4.	Bilateral parasymphysis	1	5.0%	1	5.0%
5.	Parasymphysis and Angle	2	10.0%	1	5.0%
6.	Parasymphysis and Subcondyle	4	20.0%	5	25.0%
7.	Body fracture	2	10.0%	2	10.0%
8.	Body and Subcondyle	1	5.0%	2	10.0%

The mean working time for IMF screw fixation was 15.15 minutes and time for removal of the screws was 5.11 minutes. Whereas the application of arch bars required a mean duration of 84.23 minutes and removal of 20.80 minutes.

Out of the 40 patients, 9 patients were placed on IMF for 2 weeks followed by guiding elastics that were associated with condylar fractures. These screws/arch bars were removed after a period of 4 weeks in cases where post operative IMF was

intended. In the rest 31 cases, IMF was placed intra operatively and released after surgery. The screws were removed 1 week postoperatively.

Satisfactory occlusion was achieved in 37 patients with good fracture stability of the fracture fragments. 2 patients in IMF screw group and 1 patient in arch bar group developed malocclusion. None of the patients showed malunion, nonunion, sensory disturbances, oro-antral communication or ingestion of the hardware. There was damage to the root with minor contact in 3 patients, mucosal hyperplasia at the screw site in 4 patients, loosening of 6 screws in 4 patients, and pain at screw site in 2 patients.

## **DISCUSSION**

Management of fractured facial bones presents some unique challenges of its own, need to restore a pre-morbid occlusion, maintenance of facial symmetry and balance, and complex movements of temporomandibular joint. Recognition of existing problem is essential, followed by reduction of fracture, retention of the bony segment in reduced position, and rehabilitation during and after bone healing.

Arch bars and IMF screws are currently the most common methods of achieving intermaxillary fixation. Arthur and Berardo<sup>1</sup> are acknowledged to be among the first to propose the use of conventional 2.0 mm self tapping titanium bone screws directly linked by wire loops to establish mandibulo-maxillary fixation. Specially designed hooks made of 0.8 mm Cr-Ni steel wire with a ring bent at their base for passing through the bone screw were introduced 1981 by Otten and are referred to as Otten hooks.<sup>2</sup>

From the very beginning the domain for IMF screw utilization has been seen unanimously in the treatment of simple (i.e., singular, one line, nondisplaced) fractures in the mandible and maxilla or both. The indication in closed treatment has been expanded with the progressive use of internal fixation devices. In the present study the following cases were selected, unilateral/bilateral parasymphysis /body fractures of the mandible, fractures of the symphysis of mandible, unilateral fractures of condyle, ramus and angle of the mandible.

Whenever a satisfactory three-dimensional relationship of the bony bases and jaws can be restored using dentures or bite blocks as a platform, IMF screws may anchor fragments until rigid plate fixation is accomplished. Unerrupted tooth buds in the deciduous or mixed dentition of pediatric patients presents a compelling contraindication to their use because of the potential injury to the tooth buds by IMF screws.<sup>3</sup>

The number of screws or fixation points (2, 4, 6, and 8), the diameter (2.0, 2.5, 3.0, and 3.5 mm) and the screw length (8 to 24 mm) varied widely across the studies as well as the mono or bicortical insertion mode<sup>4</sup>. In the present study, 2.5mm diameter self tapping screws of 8mm length were used and the screws were monocortical.

In the present study the site of screw placement was pre-determined clinically and radiologically. IOPA radiographs were used in relation to the intended screw site to assess the inter-radicular space. It was observed in this study that the placement of IMF screws into the inter-radicular spaces of the anterior maxilla turns out to be unfavorable as the space

between the central and lateral incisors and the lateral incisors and the canines is too narrow.

The preferences for screw placement confirming to the original description of Arthur and Berardo<sup>1</sup> the anterolateral surface of the maxilla in the piriform rim and at the zygomatico-maxillary crest and the anterolateral mandibular region below the root apices and between the mental foramina.<sup>4</sup> The alternate choice for screw placement were at the lateral surfaces was the spaces between the first and second premolars in each quadrant.<sup>5</sup> In accordance with all these factors we chose the sites for placement of screws distal to canines between the canines and the premolars.<sup>6</sup> However it is pertinent to mention that the pre operative IOPA radiograph is essential pre-requisite for screw placement. In cases of parasymphysis fractures where the fracture site interferes with the placement of IMF screws the site was modified depending upon the inter-radicular spaces.

The dental root lesions are responsible for the greatest criticism of IMF screws a rationale for a precautionary screw site selection clinically and radiographically is preferred.<sup>7</sup> The iatrogenic injury to the adjacent teeth with minor contact was seen in 4 patients in our study. This is to re-emphasise the value of radiographs to avoid iatrogenic injury. There is no absolute safety technique to prevent iatrogenic damage of dental roots, but the hazard can be diminished. Anatomic danger zones like the mental foramina, the neurovascular bundles within the areas of nerve exit, and the mandibular canal or the maxillary antral wall are the first constraint for IMF screw placement.<sup>8</sup>

The clinical studies are supplemented by letters and replies further elucidating the IMF screw technique and its adverse sequelae. In regard to the danger to dental root injuries skepticism and caution against the use of IMF screws was notoriously prominent<sup>9</sup>

Self-drilling IMF screws offer an improved tactile feedback as soon as tooth roots are encountered, limiting the possibility of root damage<sup>10</sup>. This feature permits a prophylactic screw removal, redirection of the entry path or repositioning to another site. To prevent fracture of the screw it should be inserted at even speed and should not be forced if resistance is encountered.<sup>11</sup> Fracture of screw at the junction of screw head and threaded portion were noticed in some studies<sup>12</sup> where as no such case of screw fracture was encountered in our study.

Soft tissue burying or mucosal overgrowth of IMF screws is encountered in studies with screw placement within the mobile mucosa or close to the surgical incision used to expose the mandibular fracture.<sup>13</sup> Mucosal overgrowth was encountered in 4 patients at 7 screw sites and only in patients with post-operative IMF. In cases where the IMF screw site was in the line of incision, the incision was placed prior to screw placement. In such cases the IMF screw was intentionally buried during closure. IMF screws were removed 7 days post-operatively which coincided with the suture removal.

Rare incidents were also noticed, namely bone infection and interdental sequestration, root fractures, pressure ulcers of the mucosa overlying the screw heads and cerclages, sensory disturbances or deficit in the innervation of the inferior or mental nerves, breakage of drill bits, deflection or shearing of screw shafts, screw ingestion periodontal abscess distant from



screw site, cellulitis around screw and screw displacement into the maxillary sinus was seen.<sup>14</sup> None of these complications were seen in our study.

In contrast to IMF screws arch bars serve for tension banding and provide an extra line of resistance to the overall hardware construct. However, the function of converting tensile into compressive forces can also be efficiently performed by a superior border osteosynthesis plate.

Arch bars are wired around the tooth necks so that their hooks lie at or closely below the level of the interdental papillae. This hook position reduces the magnitude of the eccentric forces, which are responsible for the tilting of the bone fragments to the lingual side upon wire or rubber band anchorage

Arch bars provide a contiguous but flexible connection along the teeth, which was helpful in the spatial re approximation of fragments. The interdental metal bar is capable of bridging edentulous spaces in the mandibular or maxillary arch and of capturing loose teeth, tooth-bearing alveolar processes, or segmental mandibular or maxillary fragments. It also allows for manipulation (sideward/upward/downward bending, torque) for occlusal readjustment and bone reduction.

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Injuries of the periodontal tissues with mobile teeth, intra-alveolar root fractures, or dento-alveolar trauma in addition to fractures of the mandible or maxilla necessitate tooth splinting besides IMF. In such cases arch bars play dual role of rigid tooth splinting by way of circumdental wiring is an integral feature.

In the present study the mean working time was 15.15 min as compared to 84.23 min in that of the arch bars. The initial working time was about 25 minutes, later the working time decreased to about 14 minutes. Mastering the technique of placement of IMF screws decreased the working time in further cases. This significantly saves the intra operative time and cost.

There was difficulty in maintaining oral hygiene and compliance in patients with arch bars. The particulate matter accumulates beneath the arch bar and results in higher caries rate. IMF screws uses only two wires to provide fixation and therefore allowed for enhanced dental care. The plaque index of the arch bar group was 2.4 as compared to 1.6 in IMF group indicating poor and fair oral hygiene respectively. In addition to this the bacteremia associated with arch bars may be decreased with IMF screws by reducing repeated trauma to the gingival mucosa.<sup>5</sup>

IMF screws are claimed to improve the safety of the procedure, since only a few wire ligatures are used as jaw linking cerclages unlike in arch bars.<sup>15</sup> Minimizing intraoral manipulation with sharp stainless steel wire tips diminishes the

rate of glove perforations and puncture injuries as risk factors for blood borne virus transmission (hepatitis B, hepatitis C, HIV). An incidence of glove perforations up to 50% due to wire stick trauma was reported, when intermaxillary wire fixation was employed as the single treatment modality in a series of mandible fractures.<sup>16</sup>

A lowered incidence of glove perforations using IMF screws has been confirmed in a pilot clinical study with a 9:1 ratio of glove penetrations in arch bars compared with no penetrations in MMF screws.<sup>17</sup> In our study the incidence of glove perforations in arch bars is 7 compared to that of 2 in IMF screws. Similar results were noted in the studies done by various authors.<sup>18</sup>

Brown JS, Grew N (1991)<sup>19</sup> compared the cost effectiveness of intermaxillary fixation as compared to mini-plate osteosynthesis. They concluded that the use of mini plates is no more expensive than the use of IMF in the management of fractured mandible.

A pragmatic answer to the pros and cons of IMF screws versus arch bars is to accept that these methods represent two divergent anchorage principles, skeletal versus tooth borne, and will coexist with each other. Both methods have a decade-long history and the time-honored versions should undergo and eventually profit from refinements and diversification in design and application

## CONCLUSION

The two basic modalities of MMF after craniofacial trauma: tooth-borne devices or bone screws acting as skeletal fixation points. Though each method has received positive ratings, neither represents a perfect solution for MMF, and each has problems and drawbacks. Self tapping IMF screws offer good temporary fixation for intraoperative occlusion for open reduction. The self tapping IMF screws are useful in fractures of mandible which are not grossly displaced or comminuted.

The current cases demonstrate a good postoperative fracture stability and occlusion in symphysis, parasymphysis, body, angle of mandible and even in unilateral subcondylar fractures. This study reveals a low percentage of iotrogenic injury to teeth, lesser damage to the periodontal tissues, reduces the operating time, minimizes risk of needle stick injuries and also it is easier to maintain dental hygiene. The morbidity of the procedure is low with the advantage that the patient returns to normal function within days of treatment.

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