

Locking plates and locking screws for management of mandibular fractures.

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Abstract:

Introduction: Assaults were common cause for mandibular and zygomatic complex fractures. When trauma is reported from large industry urban areas with high unemployment, lower facial trauma from alterations are more common. By and large the therapeutic goal of any fracture management is to restore original anatomic form and function as soon as possible without any morbidity. Ideally this should be accomplished at the earliest with the least patient discomfort.

Aim: To evaluate the usefulness of 2.0mm Locking plate/screw system on mandibular fracture patients, who reported to Department of Dental surgery, Government Dharmapuri Medical College, Dharmapuri, Tamilnadu, India.

Material and Methods: Thirty cases of fracture mandible of age group 20 to 56 years were taken up for study. They were treated by open reduction and internal fixation through an intraoral approach with 2.0mm Stainless steel locking plates and screw system for osteosynthesis of mandible. The screw holes in the bone plate were engineered to accept either screws that lock to it by a second thread under the head of the screw or standard non locking screws. Parameters such as ease of technique, occlusal stability, inter incisal opening, signs of infections and functional stability are evaluated.

Results: Thirty patients with 42 fracture mandible sites were treated with 54 locking plates and screws and observed for 12 weeks. All patients showed normal functions of jaws like mouth opening, chewing and speaking. Six patients complained of pain during mastication which was managed with analgesics. Only one patient needed intermaxillary fixation wiring.

Conclusion: Locking plates and screw system not only fulfilled the treatment goals of adequate immobilization, fixation & stabilization of mandible fractures, offer greater stability, easy to adapt, do not require intimate contact with bone there by reduces the disturbance to the cortical bone blood supply enhances the osteosynthesis at the fracture site.

Key words: Fracture mandible, locking plates, locking screws, fixation, miniplate

Date of Submission: 14-02-2018

Date of acceptance: 03-03-2018

I. Introduction:

Face is the index of your mind. Face being the most admired part, disfigurement due to trauma or otherwise would affect one's mind immensely. Any disfiguring trauma or defect to the maxillofacial region needs immediate and skillful management. So leave no stones unturned to improve, trauma management and aesthetic surgery.

Trauma to the facial skeleton results in injuries to soft tissues, teeth, mandible, maxilla, zygoma and nasal bone. Being the most prominent mobile bone of the facial skeleton, fracture of mandible occurs more frequently than any other fracture of facial skeleton.^(1,2) The treatment of mandibular fractures has been studied for the past 40 years. To treat facial trauma various systems for internal fixation were developed for the betterment of patient. The systems have become smaller, simpler and to avoid extraoral approach.

Hausmann (1886) was the first person to describe mandibular fracture management with screw-plate system. Luhr (1960) introduced titanium mandibular compression plate using the gliding screw principle. In early 1970, modification of orthopedic principles and armamentarium were introduced to maxillofacial trauma surgery by Spiessl through Association For Study of internal Fixation (AO/ASIF).^(3,4) The AO/ASIF principles were applied to maxillofacial skeleton with absolute stability resulting from rigid plates and screw. The drawbacks were its demanding technique, bicortical screw fixation and extraoral approach. In 1973 Michelet⁽⁵⁾ and in 1978 Champy⁽⁶⁾ introduced small, easily bendable, non-compression miniplates in the treatment of

mandibular fractures. Miniplate osteosynthesis has become the gold standard at the present time. A disadvantage of conventional bone plate and screw system is that the plate must be perfectly adapted to the underlying bone to prevent alterations in the alignment of the segments and changes in the occlusal relationship.⁽⁷⁾ To overcome this locking plates and screws were introduced.

Raveh and colleagues developed an improved reconstruction system in mid 1980's that incorporated the principle of an external device into a bone plate. These plates achieve stability by locking the screws to the plate and have been shown to enhance fixation stability.⁽⁸⁾ This study was done to evaluate the usefulness of 2.0 mm locking plate/screw systems on patients.

II. Aim :

To evaluate the usefulness of 2.0mm Locking plate/screw system on mandibular fracture patients, who reported to our department were selected. Following parameters were evaluated:

1. Ease of the technique.
2. Occlusal stability.
3. Interincisal opening.
4. Signs of infection.
5. Functional stability.

III. Materials and methods:

Thirty cases of fracture mandible of age group 20 to 56 years reported to our department were taken up for study. A complete and detailed history was taken from either the patient or his attendant in standardized manner. In this study, stainless steel locking plates and locking screws were used for osteosynthesis of fracture mandible. The plates were 4.9 mm wide, 25.8mm long and 1.5mm thick, with an isthmus of 5.1mm length and 2mm width (**Fig.1**). The screw holes in the bone plate were engineered to accept either screws that lock to it by a second thread under the head of the screw or standard nonlocking screw. The screws were slotted and were of the noncompression self-tapping type. The addition of a double lead thread beneath the screw head engages and locks into threads within the holes of the plate. Locking the screw to the plate does not generate additional compression. Therefore the periosteum will be protected and blood supply to bone preserved.

Specification for screws: (**Fig.2**)

External diameter	- 2.1mm
Head diameter	- 3.1mm
Head length	-1.5mm
Head type	-Slotted
Tapping	-Self tapping.

Surgical technique :

All cases were treated according to the principles outlined by Champy. All patients were treated under local anesthesia with 2% Lignocaine with 1: 80,000 adrenaline. All patients were treated by intraoral approach under aseptic condition. Using Ehrlich arch bar and 26 G stainless steel wire, arch bar wiring done in upper and lower jaws.

In case of angle fractures, one four hole noncompression stainless steel locking plate with isthmus was adapted along the medial side of external oblique ridge and screwed to the bone using 2mm self threading locking screws with isthmus in the fracture line 2*6mm screws were used for angle fractures.

In case of symphysis and parasymphysis fractures between the mental foramina two four hole plates were used according to Champy's line of osteosynthesis (**Fig.3**). Care should be taken not to injure the mental nerve. The occlusion was checked and the screws were tightened finally. Maxilomandibular fixation was released. The site was irrigated and closed with 3-0 braided silk.

All patients were kept under antibiotic care for one week. They were advised to take liquid diet for 2 days and thereafter on a soft diet for 4 weeks. They were advised warm saline gargle and to keep the mouth clean. Sutures were removed on the 7th to 10th postoperative day.

The long term follow up were recorded for the following:

1. Resolution of facial edema.
2. Healing of surgical sites.
3. Alteration in occlusal pattern.
4. Neurosensory disturbances.
5. Post operative mouth opening.

Follow up was performed weekly during first 6 weeks and thereafter monthly from 3 months to 6 months (**Fig.4-10**).

IV. Results:

30 patients with fracture mandible were chosen. 42 fractures were treated. 54 plates were used. All patients were males. Age ranged from 20 to 56 years. The time from injury to treatment ranged from 4th day to 20th day. Patients were postoperatively evaluated for 3-6 months by clinical examination and radiograph.

The following parameters were evaluated

1. Ease of technique: No intraoperative difficulties associated with their application except that one should “center” the drill hole with center of bone plate to facilitate screw locking with the plate
2. Occlusal stability: all fractures appeared to be well reduced and stable. Post operative radiographs taken with the first 2 days showed excellent reduction in all cases except one angle fracture which needed Intermaxillary fixation.
3. Interincisal opening width: Interincisal opening increased in all cases gradually from an average of 15mm to 45mm
4. Signs of infection: All fractures healed with no signs of infection except one mandible right body fracture which was treated 20 days after injury due to multiple trauma. The infection was treated as outpatient by intraoral incision and drainage, irrigation with saline and with oral antibiotics.
5. Functional stability: All of our cases demonstrated a good functional stability in the immediate postoperative period without any inter fragmentary mobility or occlusal disturbance or tenderness. Six patients complained of pain during mastication which was managed with analgesics.

V. Discussion:

The treatment of mandible fractures has evolved significantly in the past few decades as rigid internal fixation has become increasingly popular with both patients and surgeons. Surgeons have been influenced to abandon transosseous wires for plating in the region of jaw fractures because of dissatisfaction with the need for maxillomandibular fixation, the potential for better fixation and stabilization, the reports of enhanced primary bone healing associated with rigid fixation and the purported advantage of mandibular osteosynthesis by miniature screwed plates.⁽⁹⁾

Two general treatment philosophies emerged for plate and screw fixation in 1970's and 1980's. The Association for the Study of Internal Fixation (AO/ASIF) philosophy³, which promotes sufficient rigidity at the fracture site to prevent inter fragmentary mobility during mandibular function, has traditionally been accomplished using large rigid plates and bicortical screws placed through an extraoral approach.

A second philosophy popularized by Champy et al⁶ emphasized the ideal line of osteosynthesis in the mandible. Consideration was given by them to anatomy and biomechanics of the mandible in developing the ideal osteosynthesis line. This technique uses non-compression monocortical miniplates placed through transoral incisions in the region of optimal stresses to neutralize torsion.

The rigid system with their possible disadvantages is being replaced more and more by functionally oriented miniplating system since

1. It resists forces depending on the location.
2. More biocompatible
3. Easily adaptable
4. No shield protection
5. Minimal tissue dissection
6. Stability

Raveh et al developed an improved reconstruction system in the mid 1980's that incorporated the principles of an external fixation device into a bone plate. These plates achieve stability by locking the screws to the plate and have been shown to enhance fixation stability. Other reported advantage of this design includes fewer fixation screws per osseous segment and allowance for a less precise adaptation of the plate to the underlying bone. Raveh et al showed the effective transoral use of these devices for mandible fracture management in 1987.

Edward Ellis and Graham have used 2mm locking plates and screws in noncomminuted mandible fractures and found it to be simple and stable after fixation.⁽¹⁰⁾

Locking plates/ screw systems offer certain advantages over other plates in this regard.

1. It is unnecessary for the locking plate to intimately contact the underlying bone in all areas. As the screws are tightened, they lock to the plate, thus stabilizing the segment without the need to compress bone to the plate. This eliminates the possibility of alteration of the reduced fragment while insertion of screw.^(10,11)
2. the screws are unlikely to loosen from the bone plate, this in turn leads to a decreased incidence of inflammation due to loosening of the hardware.⁽¹²⁾
3. The amount of stability provided across the fracture/ osteotomy gap is greater than when standard non locking screws are used. An invitro study by Gutwald et al⁽¹³⁾ has shown that a 2mm locking plate/screw

system provides stability to simulated mandibular fracture than does a standard 2mm miniplate for which the screws do not lock to the plate. It may therefore be possible to use smaller plates for a given fracture with a locking system than might be required if the screws do not lock to the plate.

- 4 The locking bone plate/screw systems do not disrupt the underlying cortical bone perfusion as much as conventional plates which compress the undersurface of the bone plate to the cortical bone.⁽¹⁴⁾
- 5 A final advantage of locking systems is that the patient has early use of the jaws by eliminating the need for postoperative MaxilloMandibular Fixation and allows the patient to speak, masticate and improve his state of nutrition.^(15,7)

Locking plates and screws are little costlier than miniplates. Bending of the plate may result in distortion of the threaded screw holes and dysfunction of the locking mechanism So plates must be precontoured and bent only with caution⁽¹⁶⁾

VI. Conclusion:

The results we obtained suggested that Locking bone plate and screw system fulfilled the treatment goals of adequate immobilization, fixation and stabilization of mandible fractures. This system is easy to adapt and reduces operating time and we encounter fewer complications. It minimizes the disturbance of vascular supply and provided superior stability. Being an intraoral approach it prevents the morbidities associated with extraoral approach, also maxillomandibular fixation can be avoided. The ease of application makes it a useful technique to follow in day to day treatment of mandible fractures.

VII. Figures:

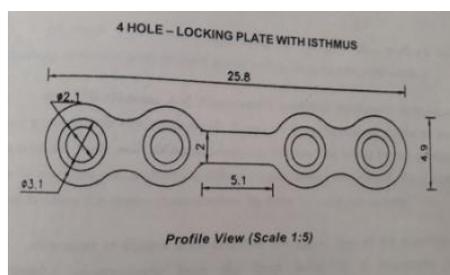


Fig.1 Locking plate.

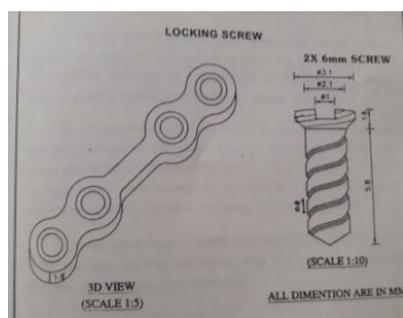


Fig.2 Locking screw.

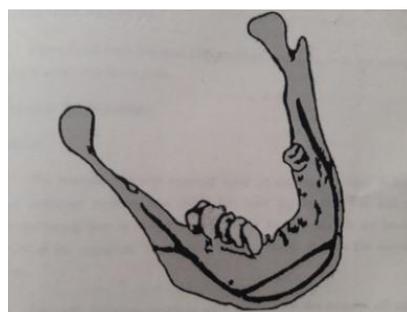


Fig.3 Champhy's line of osteosynthesis.



Fig. 4 & 5 Pre & postoperative extraoral photographs.

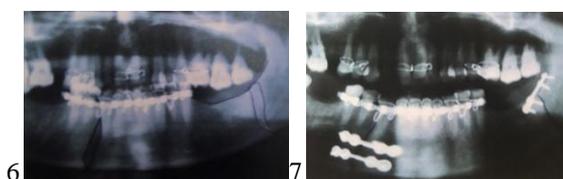


Fig. 6 & 7 Pre & postoperative orthopantamogram.



Fig.8 Preoperative intraoral photograph. **Fig.9** fracture site exposure. **Fig.10**. Locking plate and screws fixed at the fracture site.

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Dr .R. Balasundaram "Locking plates and locking screws for management of mandibular fractures..".
 "IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), Volume 17, Issue 2 (2018), PP 38-42.