Use of Dynamic Compression Plates in Rigid Internal Fixation for Mandibular Fractures

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Abstract

Vehicular accidents and Urban violence continues to be a major source of faciomaxillary injuries, Mandible being more commonly injured than other facial bones. A series of seventy five patients surgically treated for facial fractures between Jan '92 and Dec '94 was reviewed. Of these, 51 had mandibular fractures at different sites like Angle and Body, Body and/or Symphysis and Ascending Ramus. All these patients were treated with rigid internal fixation using Dynamic Compression Plate on A. O principle. It provided complete anatomical reduction and stimulated bone healing and full range of movement. It decreases morbidity and allows better control of patient's nutritional status. Patients can return to normal routine work after 8 to 10 days.

Despite current advances in public education and automobile safety requirements trauma continues to be the major cause of hospitalization. Urban violence continues to escalate and account for another major source of traumatic injuries. Mandible is more commonly fractured than any other facial bones because of the prominence of jaws. According to research and experience of AO group (Arbeitsgemeinschaft fur ostiosynthesefragen), primary (direct) bone healing without the formation of callous will occur when a fracture has been reduced accurately and stabilized rigidly. This is brought about by inter fragmentary compression and/or dynamic compression using a Dynamic Compression Plate (D.C.P.). (Fig.1)

In this review, the technique, utility and advantages of D.C.P. will be discussed. Our experience using D.C.P. in mandibular fractures will be reviewed and complications discussed.

Materials and Methods

A Series of seventy five patients surgically treated for facial fractures between Jan '92 and Dec '94 were reviewed. Of these fifty one patients of mandibular fractures were treated by Dynamic Compression Plates for Rigid Internal Fixation. 22 patients had double fractures. Fractures were situated at sites mentioned in Table I.

Table I Showing site of fracture		
Site	Number	Percent
Angle & Body	14	27.45
Body &/or Symphysis	10	19.60
Ascending Ramus	13	25.49
Midline	14	27.45

Instrumentation and Surgical Technique

Although the system appears to require an imposing array of equipment most of the equipments are already a part of system used by orthopaedic surgeons in our hospital. These include Drill, Drill bits, Tap, Plate benders and Pliers, Screws and Plates, Bone holding Forceps.

Procedure

After the patient is fully evaluated for other possible injuries a complete understanding of the patient's mandibular fractures is obtained by clinical evaluation

Table II
Showing Age and Sex Distribution
of patients with various faciomaxillary Injuries

Age In Yrs	Mandibular Fractures				Other Facio. Fractures				Total	
	Males		Females		Males		Females			
	No.	%	No.	%	No.	%	No.	%	No.	%
0-10	2	3.92	1	1.96	-	-	1	4.16	4	5.33
10-20	6	11.76	2	3.92	3	12.50	1	4.16	12	16.00
20-40	24	47.05	6	11.76	14	58.33	4	16.66	48	64.00
40 and above	8	15.68	2	3.92	1	4.16	-	-	11	14.66
Total	40	78.41	11	21.56	18	74.99	6	24.98	75	99.99

and mandibular radiographs. (Fig. 2). The patient is anaesthetized preferably by Nasotracheal Intubation.

Dental extraction with meticulous mucosal closure is carried out on non viable teeth or teeth of questionable viability or sever caries to prevent them from acting as nidus of infection.

Fig. 1 : Dynamic Compression plate with special ovally Configured Screw holes.

Premorbid occlusion is reestablished via bimannual manipulation. This is secured by either IMF, classic arch bar fixation or ivy loops. (Fig. 3).

A standard external submandibular or submental approach is performed sparing the marginal mandibular nerve or mental nerve. Longer incision may be employed depending on the need for exposure. With the fracture exposed and periosteum incised and elevated for an area around the fracture large enough to accomodate the plate, a four or six hole DCP is chosen. The inferior border of mandible is stabilized by the application of reduction forceps.

The chosen plate is then bent with the plate bending irons to a slightly greater curvature than that of the lateral cortex of the involved segments. This will prevent the lingual gapping of the inner cortex fracture. The plate is secured with the plate holding forceps and the screws fixed.

Ensure that the screws engage both lateral and medial cortex. (fig. 4). All the screws are tested for tightness, the wound irrigated, haemostases checked and the wound closed in standard fashion with active or passive drain.

Fig. 2. Radiograph of Mandible Postero-Anterior view showing fracture angle mandible.

Fig. 3. Reduction and Occlusion after inter maxillary fixation.

Fig. 4. Intraoperative Plate in position with screws fixed.

The patient is placed on a 5-7 days course of perioperative and postoperative antibiotics and liquid diet immediately. Soft diet is started as soon as tolerated.

A post reduction radiograph is obtained (Fig. 5a & 5b) and following drain removal patient is discharged from the hospital to be followed weekly for 6-8 weeks.

Complications : As shown in Table III

Table - III Complication		
Complications	Number	Percentage
Malocclusion	3	5.85
Wound Infection	1	1.9
Damage to Marginal Mandibular Nerve	1	1.9

Observations and Results

The male/female ratio was 4 : 1, the average age 30-35 yrs. The cause of fracture was most commonly the motor vehicle accident; 68% had mandibular fractures, 56.8% had unilateral fractures and 43.1% had bilateral or multiple fractures. Average length of jaw immobilization was 4-6 days. The average follow up was 1 year.

Operative complications are given in Table III. Reoperation was necessary in 3 patients with persistent malocclusion. (Fig. 6). These were initial cases wherein Rigid Internal Fixation was done without prior Intermaxillary fixation. Two of them were edentulous. Only patient who had post operative infection was treated with incision and drainage and it occurred as the drain was not kept. Patient with marginal mandibular nerve injury had a compound fracture with bad skin injury. (Fig. 7).

All patients had early active pain free movements. Patients returned to normal diet after removal of intermaxillary fixation and resumed their routine work after 1 week.

Average weight loss (secondary to inter maxillary fixation eliminated) was 5-7 kgs. Complete bone union was demonstrated radiologically in all patients after 6-8 weeks. (Fig. 8).

DCP were removed in ten patients after three months by second surgery.

Discussion

The main advantages of rigid internal fixation are :

- * Early active pain free movement.

Fig. 5a Preoperative X-ray showing fracture (L) Ramus.

- * Avoidance of long term inter maxillary fixation.
- * Safe secured airways without tracheostomies particularly in polytraumatized patients.
- * Shorter periods of hospitalization and incapacitation from work.

DCP is so designed that the compression can be achieved by appropriate positioning of screw relative to plate. The first hole is drilled into the bone eccentrically and the screw is inserted only until the head of the screw engages the plate. The first hole in the fellow fragment is then drilled again positioning the drill in the plate hole so that it is away from fracture. After measuring and tapping the hole this screw is now placed. Both the screws are tightened alternatively so that there is relative motion between screw head and plate until the screws are fully tightened and heads set flush within the plate hole. This relative motion will force the screws and therefore the bone fragments to move towards the fracture site thereby resulting in dynamic compression. (Fig. 9a & 9b).

Fig. 5b mandible and post reduction radiograph showing reduced fracture, inter maxillary wiring and plate in position.

Additional screws are generally placed neutrally. Any motion between the fragments of gliding between the metal implants and the bone surface must be prevented. In order to achieve stability it is necessary not only to apply a DCP properly but it is also important to apply the plate in appropriate location.

Fig. 6. Postoperative malocclusion due to improper fixation without inter maxillary fixation.

Fig. 7. Patient with marginal mandibular nerve injury but good dental occlusion.

Fig. 8. Orthopantomogram showing complete bone union radiologically 6 weeks after surgery.

Fig. 9a. Function of D. C. P. : The special configuration of the screw holes and screw heads and the eccentric placement of the screw make interfragmentary compression possible when the screws are driven home.

Fig. 9b. Function of D. C. P. : The special configuration of the screw holes and screw heads and the eccentric placement of the screw make interfragmentary compression possible when the screws are driven home.

Fig. 10a. The tension side above and the pressure side below the mandible are determined by the arrangement of muscles and conditions of function.

Fig. 10b. Direction of muscular forces exerted on a mandible fracture, causing compression of the fracture along the base and separation at the alveolus.

Fig. 11. Dynamic Compression Plate alone at pressure side causing a gap at superior side of mandible biomechanically, a mistake, because this means instability.

For the mandible the side under tension, which is determined by the arrangement of muscles and condition of function is the oral (alveolar) side while compression forces are acting along the inferior border. (Fig. 10a & 10b)

Fig. 12. Tension band principle : Fracture within the row of teeth needs tension band splint and stabilization plate.

Therefore to achieve absolute stability a compression plate used in mandibular fractures should be placed in the region of alveolar process. Owing to anatomical constraints provided by the dentition and the location of the inferior alveolar nerves the DCP should be at the inferior border of mandible. However DCP alone at the base of mandible is insufficient to stabilize but even can cause distraction at the alveolar side and lead to infection, pseudoarthrosis and malocclusion. (Fig 11) To overcome these problems an inter maxillary fixation or arch bar is applied on the alveolar side of the fractures as per tension band principle and then DCP is applied at the basal or compression side. (Fig. 12).

Two edentulous patients had malocclusion due to improper occlusion alignment and inadequate stabilization.

Conclusions

With distinct advantages over other methods, like

complete anatomic reduction and thereby stimulating bone healing and early return to normal diet and routine work, this method although may not be panacea for mandibular fractures, is an important technique that skillful maxillofacial surgeons should maintain in their armamentarium so that each new clinical situation may be dealt in best possible way.

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