Novel Use of Orbita Plates in Mandibular Body Fractures

Sonal Anchlia¹ · Jigar M. Dhuvad¹ · Dhruvi Shukla¹ · Rohit Kumar¹ ·
Nisarg Patel¹ · Vipul Nagavadiya¹

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Abstract

Background Isolated fractures of the mandibular body separate the dentate border and compress lower border when subjected to masticatory forces. This study aims at evaluating the efficacy of two Orbita plates in Champy's osteosynthesis lines along with achieving 3D configuration and preventing trauma to mental foramen.

Aims (1) To achieve a near 3D configuration by fixing the terminal parts of both plates in contact with each other; (2) to preserve the mental nerve within the ellipse created by two Orbita plates; and (3) to prevent damage to the root apices from the upper plate.

Materials and Methods This study was performed on 20 patients with mandible body fracture through the mental foramina. With the intraoral vestibular approach, two Orbita miniplates were fixed in Champy's osteosynthesis lines. A geometrically closed quadrangular relationship was achieved in the shape of an ellipse, with the mental nerve emerging from it.

Results Fracture healing was optimum in all the cases along with satisfactory occlusion. Postoperative intermaxillary fixation was not required. Mental nerve function impairment was insignificant.

Conclusion This served to achieve satisfactory functional outcomes in patients with mandible body fracture without injury to roots and along with achieving a geometrically close quadrangular relationship even where 3D miniplates cannot be placed.

Keywords Orbita plate · 3D · Quadrangular · Paresthesia · Mandible body fracture

Introduction

In the past decade, techniques for the treatment of mandibular fractures have evolved significantly. From the time of Hippocrates, many different techniques for treating mandibular fractures have been described based on the principle of repositioning and immobilization of the bony fragments. However, during the past 50 years, advances in biomaterials, their profile and specially designed instruments have allowed maxillofacial surgeons to improve the outcomes of treatment of mandibular fracture while reducing morbidity.

Over the years, the management of trauma has evolved from various forms of splinting to circum mandibular wiring, extra oral pins and semirigid fixation with transosseous wiring followed by rigid fixation technique, which then gave way to semirigid fixation with miniplates [1]. The conventionally used miniplate techniques require maxillomandibular fixation for a short period and are unable to render 3D stability at the fracture site. Farmand presented the "3D plating system" consisting of 2×4 hole miniplates joined by four interconnecting cross struts, which had quadrangular geometry to assure good stability in three dimensions [2]. Easy use, good resistance against torque and compact form of the plate were some of the advantages. 3D miniplates is a misnomer as the plates are not three dimensional but hold the fracture fragments rigidly by resisting the forces in three dimensions, namely shearing, bending, and torsional forces, with a geometrically closed quadrangular plate secured with bone screws.

✉ Dhruvi Shukla
dhruviraval4191@gmail.com; dhruvi_shukla@ymail.com

¹ Department of Oral and Maxillofacial Surgery, Government Dental College and Hospital, Asarwa, Ahmedabad, India

If two parallel miniplates placed are on either side of the mental foramen in Champy's lines of osteosynthesis, the upper one may damage the roots of the teeth. Similarly, 3D plate would sacrifice the mental nerve if placed over the mental foramen region. This prompted the use of two Orbita plates for the treatment of mandibular body fracture in such a way that geometrically closed quadrangular nearly 3D configuration could be achieved (Fig. 1) even in mandible fractures through the mental foramina. The authors state that till date, to the best of our knowledge, no such literature exists about this novel technique.

Materials and Methods

This study was conducted for isolated mandible body fractures with the fracture line passing through the mental foramina in 20 patients (fourteen males and six females with average age group of 30 years) from August 2014 to March 2017 in the Department of Oral and Maxillofacial Surgery, Government Dental College and Hospital, Ahmedabad. Unilateral isolated mandibular body fractures passing through the mental foramen were treated with two Orbita plates, one above and one below the mental foramina by a single operating surgeon.

After obtaining informed consent from patients, under local anesthesia lignocaine with adrenaline 1:200,000 an intraoral vestibular incision was placed, directed more toward the lip to avoid future seepage and for pooling of saliva and debris through the suture line. The mentalis muscle was incised near the alveolar bone ridge, thus creating a stepwise approach to the bone. A musculoperiosteal flap was elevated. Branches of the mental nerve were dissected and retracted. The presence of mental nerve loop was clinically judged with curved probe [3].

After achieving occlusion with maxillomandibular fixation, one 2 mm, C shape, 4 hole with gap Orbita miniplate

was placed above the mental foramen in Champy's osteosynthesis line. Keeping the concavity of the plate facing downwards it was fixed with monocortical drilling with four, 2 mm × 6 mm stainless-steel screws. Orbita plate has two arms curved at 15 degree to its own long axis. The first two screws were fixed close to fracture line followed by the remaining two taking care of the roots of teeth in the same area. The second Orbita plate was placed with concavity directed upwards and both the ends touching the previous plate so that geometrically close quadrangular relationship is achieved with a shape of ellipse. The second Orbita plate was fixed with four, 2 mm × 8 mm stainless-steel screws. The mental nerve emerged out through the ellipse (Fig. 2). Water tight closure of the incision was performed.

Upon discharge, all patients were prescribed a 5- to 7-day course of oral antibiotics. All patients were instructed to continue on soft diet for 4 weeks. Patients were observed for postoperative complications like malocclusion, tooth hypersensitivity, paresthesia, masticatory difficulty, infection, nonunion and malunion. Patients were clinically evaluated postoperatively in the first, fourth and 12th weeks following surgery, and clinical and radiographic details were recorded at 12th week of follow-up.

Postoperative Evaluation

Clinical Assessment

- A. Occlusal stability: The occlusion achieved after fixation of mandibular fracture was evaluated for stability during the first, fourth and 12th weeks following surgery. Occlusal score proforma was given as follows:

- 1—Loss of molar relationship
- + 1—No loss of molar relationship

Fig. 1 Two Orbita plates with geometrically closed quadrangular nearly 3D configuration

Fig. 2 Intraoperative picture of two Orbita miniplates

- B. Paresthesia/anesthesia and dysesthesia on lip chin were recorded by questioning the patient. This was confirmed by neurosensory tests like pin prick, light touch and two-point discrimination. Measurement was taken on dry skin after cleaning with 70% alcohol. At postoperative visits, patients were asked the difference in sensations of lower lip or chin, burning, tingling, pain, biting of lips, food running down from the mouth. Findings were compared with the opposite unaffected side.

Radiographic Assessment

Preoperative panoramic view and immediate postoperative panoramic view were taken to evaluate fracture reduction and placements of plates and their relationship with the mental foramen.

Follow-up panoramic view was taken at first week, fourth week and 12th week postoperatively.

Results

This study consisted of twenty patients who had sustained mandibular fractures through mental foramina and were treated by open reduction and internal fixation using two Orbita miniplates.

The clinical evaluation of the postoperative complications was encountered in the present study at the end of first, fourth and 12th weeks. None of the patients complained of difficulty in mouth opening or mastication, and none developed infection. Only three patients developed

transient paresthesia of lower lip, which resolved within 10 days (Table 1).

Occlusion was stable with no or minimal loss of molar relationship in 17 out of 20 patients (85%). Three patients (15%) showed ipsilateral loss of molar relationship, which was corrected with elastics for 7 days postoperatively (Table 2). No cases of nonunion/malunion were found.

Discussion

The most common cause of fractures was road traffic accidents accounting for 61.1% of their fractures. The next common etiology was interpersonal violence accounting for the remaining 38.8%. Similar findings were described by Fridrich et al. [4], where the anatomical distribution of fracture was as follows: parasymphysis fracture (38.8%), symphysis (11.1%), angle (27.7%), body (11.1%) and angle with parasymphysis (11.1%).

Mostafa Farmand stated that the stability of the 3D plate is achieved by its configuration, not by thickness or length. These plates are composed of linear, square or rectangular units and may provide increased torsional stability [5].

Occlusion was evaluated for stability in immediate postoperative, first, fourth and 12th weeks following surgery. Stable occlusion was achieved in 17 (85%) with no or minimal loss of molar relationship. Three patients (15%) had ipsilateral loss of molar relationship, which was, however, corrected after 7 days of elastics. We also observed paresthesia of lip in three (15%) patients, which was resolved within 10 days. The common complications of semirigid fixation as stated by Winstanley et al. [6] were paresthesia of lip, infection, malunion, nonunion, occlusal deformity.

According to a study using cone-beam computed tomography images from 250 patients (500 hemi-mandibles), a high prevalence of the anterior loop of the mandibular canal was found, although its length varied greatly, in 41.6% of the cases, and its length ranged from 0.25 to 4.00 mm (mean 1.1 ± 0.8 mm) [7]. To avoid nerve injury during surgery in the foramina area, guidelines were developed based on the literature with respect to verifying the position of the mental foramen and validating the presence of an anterior loop of the mental nerve. These guidelines included leaving a 2-mm zone of safety between an implant and the coronal aspect of the nerve; the foramen must be probed to exclude the possibility that an anterior loop is present. This 2-mm distance can be easily covered in the ellipse formed by two Orbita plates (Fig. 3).

It seems that the fixation technique, which greatly affects the stabilization of fracture parts and efficacy of recruitment of a blood supply and healing process, plays the most important role in the development of postsurgical

Table 1 Clinical evaluation of the postoperative complications encountered at the end of fourth week

Case no.	Paresthesia	Infection	Masticatory difficulty	Mouth opening
1.	A	A	A	Ad
2.	A	A	A	Ad
3.	A	A	A	Ad
4.	A	A	A	Ad
5.	A	A	A	Ad
6.	A	A	A	Ad
7.	A	A	A	Ad
8.	A	A	A	Ad
9.	A	A	A	Ad
10.	A	A	A	Ad
11.	A	A	A	Ad
12.	A	A	A	Ad
13.	A	A	A	Ad
14.	A	A	A	Ad
15.	A	A	A	Ad
16.	A	A	A	Ad
17.	A	A	A	Ad
18.	A	A	A	Ad
19.	A	A	A	Ad
20.	A	A	A	Ad

A absent, Ad adequate

Table 2 Occlusal stability scores at preoperative, immediate postoperative, first, fourth and 12th weeks

Case no.	Preoperative	Immediate postoperative	First week	Fourth week	12th week
1.	− 1	+ 1	+ 1	+ 1	+ 1
2.	− 1	+ 1	+ 1	+ 1	+ 1
3.	− 1	+ 1	+ 1	+ 1	+ 1
4.	− 1	+ 1	+ 1	+ 1	+ 1
5.	− 1	+ 1	+ 1	+ 1	+ 1
6.	− 1	+ 1	+ 1	+ 1	+ 1
7.	− 1	+ 1	+ 1	+ 1	+ 1
8.	− 1	− 1	+ 1	+ 1	+ 1
9.	− 1	− 1	+ 1	+ 1	+ 1
10.	− 1	+ 1	+ 1	+ 1	+ 1
11.	− 1	+ 1	+ 18	+ 1	+ 1
12.	− 1	+ 1	+ 1	+ 1	+ 1
13.	− 1	+ 1	+ 1	+ 1	+ 1
14.	− 1	+ 1	+ 1	+ 1	+ 1
15.	− 1	+ 1	+ 1	+ 1	+ 1
16.	− 1	+ 1	+ 1	+ 1	+ 1
17.	− 1	+ 1	+ 1	+ 1	+ 1
18.	− 1	− 1	+ 1	+ 1	+ 1
19.	− 1	+ 1	+ 1	+ 1	+ 1
20.	− 1	+ 1	+ 1	+ 1	+ 1

infection. The risk of infection was 7.5% by reconstruction plates, 32% by dynamic compression plates and 25% by miniplates in mandibular fractures [8–10].

The two Orbita plates technique can three-dimensionally control the fracture lines. This technique has an equal cost

Fig. 3 “Safe zone” for anterior loop of mental nerve

as two miniplates, low stress shielding, but more plate profile.

Lower lip sensory changes after internal fixation of mandibular fractures are a concern to surgeons, especially when fracture line passes through mental foramen. In postoperative OPGs, there was no case of inferior dental canal penetration by first plate screws. Lip sensation 10 days after the procedure was normal in 17 patients, while three patients had paresthesia of the lower lip on the fracture side. This can be attributed to presurgery displacement of bony fragments after trauma and is not related to this technique.

Dentin hypersensitivity was not observed postoperatively, which could be demonstrated by postoperative OPG with none of the screw penetration into the roots of teeth.

The authors justify that till date, to the best of their knowledge, no literature exists about this technique, which may hence be considered novel. Till date, a single Orbita plate has been used successfully for the fixation of superior, inferior and lateral borders of the orbit only. The same two

Orbita plates with 3D configuration were used in our study in the mandible, and we have successfully operated 20 patients with this technique without postoperative paresthesia or dentin hypersensitivity with an average of 1-year follow-up. We did not encounter inadvertent penetration of screws in the anterior loop of mental nerve either (Fig. 4).

The curved Orbita plates do not pose any operative difficulty as the internal fixation of the two Orbita plates to the body of the mandible is performed in the same manner as in the case of two straight 4 hole miniplates on Champy’s osteosynthesis lines with two screws each on either side of the mental foramina. Moreover, using these plates, it becomes relatively easier to cover the mental foramen and the loop in the ellipse () is formed by joining the two Orbita plates in such a manner that there are no chances of nerve damage.

If the fracture line passing through the mental foramina is fixed with two parallel miniplates following conventional methods, these miniplates, which are situated above the mental foramina, are closer to roots of teeth and thus definitely pose higher chances of root damage. If the same miniplates are placed closer to the mental foramen, there are more chances of nerve compression as well as chances of penetrating the screw into the anterior loop. However, if curved Orbita plates are used for the same, both the roots and the anterior loop of the mental nerve will be avoided.

The main advantages of use of two Orbita plates over 3D plate or two straight plates are threefold:

1. A near 3D configuration is achieved as the anterior and posterior parts of both upper and lower plates are kept in contact with each other
2. Mental nerve is preserved
3. Root apices are preserved as the distal screw holes of the upper Orbita plates are placed lower than those of straight plates.

Fig. 4 Postoperative occlusal radiograph and OPG

Conclusion

The surgical technique applied in this study, using two Orbita miniplates for the treatment of fracture of the mandible body through mental foramina, seems to be acceptable as no cases of dentin hypersensitivity, surgical infection, masticatory difficulty and with clinically insignificant chances of paresthesia and occlusal discrepancy were found. It seems that this method can be assumed to be an appropriate alternative to treatment with two parallel miniplates because it does not damage the roots of adjacent teeth, and geometrically near three-dimensional configuration can be achieved.

Compliance with Ethical Standards

Conflict of interest No conflict of interest.

Ethical Standard All procedures performed in this study involving human participants were in accordance with the ethical standards of the institution.

Informed Consent Informed consent was obtained from all individuals who are involved in this study.

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