Efficacy of 2-mm locking miniplates in the management of mandibular fractures without maxillomandibular fixation

Chandan Prabhakar, Jayaprasad N. Shetty, Hemavathy O. R., Yadavalli Guruprasad

ABSTRACT

Background: The management of trauma has evolved greatly over the past many years. Various bone plating systems have been developed to provide stable fixation of mandibular fractures. The introduction of the locking plate/screw system has offered certain advantages over the conventional plating systems. This system does not require intimate adaptation of the miniplates to the underlying bone and has greater stability. This study evaluates the efficacy of locking miniplate/screw system in the treatment of mandibular fractures without maxillomandibular fixation. Materials and Methods: This was a prospective study analyzing 20 patients with undisplaced or minimally displaced mandibular fractures, who reported to Department of Oral and Maxillofacial Surgery, Government Dental College and Research Institute, Bangalore. The selected cases were treated by open reduction and internal fixation using the 2.0 mm locking plate/screw system. Results: Open reduction and internal fixation with the 2.0 mm locking plate/screw system were achieved in all the 20 cases with satisfactory stability of the fracture fragments. The system was found to be reliable and effective intraoperatively. Only two complications were noted in the study. Conclusion: The locking miniplate system was found to be reliable and effective in management of mandibular fractures without postoperative intermaxillary fixation, however further studies with more sample size is required.

Key words: Locking plate/screw system, locking miniplates, mandibular fractures
The purpose of this study was to evaluate the efficacy of a new locking bone plate or screw system without post surgical maxillomandibular rigidity. The introduction of locking plate/screw system and reconstruction plating systems for the treatment of mandibular fractures and continuity defects has offered certain advantages over other plating systems. The techniques for application of the 2.0-mm locking miniplate system is that it becomes unnecessary for the plate to have intimate contact with the underlying bone, making plate adaptation easier leading to lesser alterations in the alignment of the segments and changes in the occlusal relationship. Another advantage is that one should use a drill guide to “center” the drill hole within the center of bone plate to facilitate proper screw locking with the plate [Figures 5 and 6].

Materials and Methods

This was a prospective study analyzing 20 patients with undisplaced or minimally displaced mandibular fractures, having insignificant medical history. The data were randomly collected from the patients visiting the Department of Oral and Maxillofacial Surgery, Government Dental College and Research Institute, Bangalore. The selected cases were treated by open reduction and internal fixation with 2.0 mm titanium locking miniplates. Inclusion criteria were undisplaced or minimally displaced fractures of the mandible requiring open reduction and internal fixation in any one of the following regions: symphysis, parasymphysis and body or angle region. Exclusion criteria were fractures infected prior to treatment, comminuted fractures or mandibular fractures with associated condylar and coronoid fractures and patients with compromised medical conditions.

Surgical procedure

After the routine clinical and radiological examination protocol, the fracture site was exposed by intraoral approach except in some inaccessible angle fractures, where transbuccal trocar was used with osteosynthesis using locking miniplates without maxillomandibular fixation. In symphysis and parasymphysis region, two miniplates were used, one at inferior and one at superior border; in body and angular region, only one plate was used. The patients were evaluated for the location, type and number of fractures, presence of tooth in fracture line, time elapsed between the presentation of the patient after trauma, complications during surgery, pre and post surgical occlusal relationship, adequacy of reduction on postoperative radiograph and any post surgical complications requiring a secondary surgical intervention. Antibiotics and analgesics were administered for 7 days following surgery. The patients were followed up for a period of 6 weeks initially for every week and a period of 6 months later to assess radiographic evidence of healing [Figures 1-4].

The 2.0-mm locking miniplate system

The thickness of the plate was 2 mm, and the lengths of the plates and screws were variable depending on the fracture site and other clinical considerations. The screws were 2 mm longer from the conventional screws wherein the first 2 mm of the screws locks the miniplate. The locking plate/screw system obviously has the advantage of less screw loosening, greater stability, less precision required for plate adaptation, less alteration in postoperative occlusal relationship and more importantly they do not disrupt the underlying cortical bone perfusion.

The technique for application of the 2.0-mm locking plate is not different than the application of any other non compression type of miniplate. The only exception is that one should use a drill guide to “center” the drill hole within the center of bone plate to facilitate proper screw locking with the plate [Figures 5 and 6].

Results

Among the study population, the majority of cases were...
in the age group of 21–30 years (65%) with a mean age of 28.8 years. There were 19 (95%) male and 1 (5%) female patient of Asian origin, with road traffic accident (RTA) being the most common etiological cause 11 (55%), followed by assault 5 (25%), and work-related or self-fall 4 (20%) [Table 1].

Fracture distribution consisted of 14 parasymphysis (43.75%), 2 symphysis (6.25%), 8 body (25%) and 8 angle (25%) fractures, with a total of 32 fracture sites in the 20 cases selected, with 15 fractures distributed on both left and right sides of the mandible [Graph 1]. There were 13 undisplaced and 7 minimally displaced fractures observed. Teeth in fracture line were retained in 15 (75%) cases and extracted in 5 (25%) cases. Teeth were extracted only when there was an absolute indication, with the most common reason being fractured teeth.

The fractures were treated ranging from 1 to 5 days with a mean of 1.8 days from the time of injury. The fractures were approached intraorally in 15 (75%) cases, a combination of both intraoral and extraoral approach was used when extraoral lacerations were present in 4 (20%) of the cases and 1 (5%) fracture was approached through an external laceration. All the patients were followed up for postoperative complications initially on a weekly basis for 6 weeks and later monthly till 6 months. A minor complication (3.125%) of
wound dehiscence was noted which was treated with wound irrigation and local measures. There was one major complication with infection (3.125%) at fracture site, requiring incision and drainage and subsequent miniplate removal after 5 weeks of fracture treatment. This patient was placed on an 8-day period of Maxillomandibular fixation. The infection resolved after hardware removal and the fracture showed delayed healing during the follow-up period. The other fracture sites healed without any complications. Primary bone healing was noted in the 93.75% of fracture sites with overall postoperative complications of 6.25% in the study [Graph 2].

**DISCUSSION**

The objective in the treatment of mandibular fracture is to re-establish normal occlusion and masticatory function. Conservative treatment to achieve this is performed by immobilizing the mandible for the healing period by intermaxillary fixation which is achieved by dental wiring, arch bars, cap splints, and gunning splints.[11,12] Operative treatment of mandibular fractures involves intraoral or extraoral opening of the fracture site and direct osteosynthesis with transosseous wires (Schwenzes 1982), lag screws (Niederfellmann 1982), or bone plates (Schilli 1975, Spiessel 1976).[13-15]

A number of fixation methods have been advocated for the treatment of mandibular fractures. A new type of plating system is “the locking plate/screw system”, which was initially developed by Raveh et al.[16] In the mid 1980s, the principles of external fixation device were incorporated into a bone plate. These plates achieve stability by locking the screw into the plate and have been shown to enhance fixation stability. A unique advantage to the locking plate/screw system is that it becomes unnecessary for the plate to have intimate contact with the underlying bone, making plate adaptation easier leading to lesser alterations in the alignment of the segments and changes in the occlusal relationship upon screw tightening.[17,18]

Another theoretical advantage in the locking plate/screw system is that these plates do not disrupt the underlying cortical bone perfusion as much as the conventional plates which compress the undersurface of the bone plate to the cortical bone (Edward Ellis III and John Graham 2002).[19,20] A third advantage of the locking plate/screw system is that the screws are unlikely to loosen from the plate. This means that even if the screw is inserted into the fracture line, loosening of the screw will not occur. The possible advantage to this property of the locking plate/screw system is decreased incidence of inflammatory complications from loosening of hardware (Reza Bolourian 2002).[21] It is also proposed that this system provides greater stability that provided by the standard conventional miniplate (Edward Ellis III and John Graham 2002).[22]

It is observed that the degree of plate adaptation affected the mechanical behavior of nonlocking plates but did not affect the locking plate/screw system. The only exception is that one should use a drill guide to “center” the drill hole within the center of bone plate to facilitate proper screw locking to the plate (Brain Alpert, Rolf Gutwald, and Rainer Schmelzeisen 2003).[23,24]

The screws, plate and bone form a solid framework with higher stability than the traditional miniplate system.
The locking plate/screw system has demonstrated higher stability across a fracture/osteotomy gap compared with the conventional nonlocking 2.0 mm miniplate in *in vitro* studies.²²

Our study reviews the efficacy of 2.0-mm locking plate/screw system in 20 patients requiring open reduction and internal fixation without maxillomandibular fixation. The patients were evaluated for the location, type and number of fractures; presence of tooth in line, time elapsed between the presentation of the patient after trauma, pre and post surgical occlusal relationship, adequacy of reduction on postoperative radiograph, and any post surgical complications requiring a secondary surgical intervention.

In this study, 32 fractures were observed in the 20 patients selected. Open reduction and internal fixation was carried out in standard operating protocol using either an intraoral or an extraoral approach. The system was found to be reliable and effective treatment modality of mandibular fractures. Our observations do correlate with those of the study conducted by Ayman Chritah, Stewart K Lazow, and Julius R Berger (2005).²⁶,²⁷

Postoperative complications were noted in two patients. One developed an intraoral wound dehiscence which was treated with antibiotics and local measures. There was one major complication (3.125%) with infection at fracture site requiring incision and drainage and subsequent miniplate removal after 5 weeks of fracture treatment. Primary bone healing was noted in 93.75% of fracture sites with an overall postoperative complication of 6.25% in the study. Our study observations do correlate with those of the study conducted by Edward Ellis III and John Graham (2002).²⁸

In this study, a sincere attempt was made to clinically evaluate the efficacy of 2.0 mm locking plate/screw system in treatment of mandibular fractures without maxillomandibular fixation and the results of this study are in accordance with the study conducted by different authors.

### References

1. Lindqvist C, Kontio R, Pihakari A, Santavirta S. Rigid internal fixation of mandibular fractures - an analysis of 45 patients treated according to the ASIF method. Int J Oral Max Fac Surg 1986;15:657-64.
2. Ellis E 3rd. Rigid skeletal fixation of fractures. J Oral Maxillofacial Surg 1993;51:163-73.
3. Iizuka T, Lindqvist C, Hallikainen D, Paukku P. Infection after rigid internal fixation of mandibular fractures: A clinical and radiologic study. J Oral Max Fac Surg 1991;49:585-93.
4. Ellis E 3rd, Walker L. Treatment of mandibular angle fractures using two noncompression miniplates. J Oral Maxillofacial Surg 1994;52:1032-6.
5. Ellis E 3rd, Graham J. Use of 2.0 mm locking plate/screw system for mandibular fracture surgery. J Oral Max Fac Surg 2002;60:642-5.
6. Herford AS, Ellis E 3rd. Use of locking reconstruction bone plate/screw system for mandibular surgery. J Oral Max Fac Surg 1998;56:1261-5.
7. Frigg R. Development of the locking compression plate. Injury 2003;34:B6-10.
8. Alpert B, Gutwald R, Schmelzeisen R. New innovations in craniomaxillofacial fixation: The 2.0 lock system. Keio J Med 2003;52:1207-7.
9. Gutwald R, Alpert B, Schmelzeisen R. Principle and stability of locking plates. Keio J Med 2003;52:21-4.
10. Collins CP, Pirinjian-Leonard G, Tolas A, Alcalde R. A prospective randomized clinical trial comparing 2.0-mm locking plates to 2.0-mm standard plates in treatment of mandible fractures. J Oral Maxillofac Surg 2004;62:1392-5.
11. Mukerji R, Mukerji G, McGurk M. Mandibular fractures: Historical perspective. Br J Oral Maxillofac Surg 2006;44:222-8.
12. Chong R, Donoff RB, Guralnick WC. A Retrospective analysis of 327 mandibular fractures. J Oral Max Fac Surg 1983;41:305-9.
13. Dodson TB, Perrott DH, Kaban LB, Gordon NC. Fixation of mandibular fractures: A comparative analysis of rigid internal fixation and standard fixation techniques. J Oral Max Fac Surg 1990;48:362-6.
14. Valentino J, Marentere IJ. Supplemental maxillomandibular fixation with miniplate osteosynthesis. Otolaryngol Head Neck Surg 1995;112:215-20.
15. Herford AS, Ellis E 3rd. Use of a locking reconstruction bone plate/screw system for mandibular surgery. J Oral Maxillofac Surg 1998;56:1261-5.
16. Potter J, Ellis E 3rd. Treatment of mandibular angle fractures with a mealleable noncompression miniplate. J Oral Maxillofac Surg 1999;57:288-92.
17. Feller KU, Schneider M, Hlawitschka M, Pfeifer G, Lauer G, Eckelt U. Analysis of complications in fractures of the mandibular angle – a study with finite element computation and evaluation of data of 277 patients. J Cranio-maxillofac Surg 2003;31:290-5.
18. Ardekian I, Rosen D, Klein Y, Peled M, Michaelson M, Laufer D. Life-threatening complications and irreversible damage following maxillofacial trauma. Injury 1998;29:253-6.
19. Sikes JW Jr, Smith BR, Mukherjee DP, Coward KA. Comparison of fixation strengths of locking head and conventional screws, in fracture and reconstruction models. J Oral Maxillofac Surg 1998;56:468-73.
20. Villarreal PM, Junquaera LM, Martinez A, Garcia-Consuegra L. Study of mandibular fracture repair using quantitative radiodensitometry: A comparison between maxillomandibular and rigid internal fixation. J Oral Maxillofac Surg 2000;58:776-81.
21. Schmidt BL, Kearns G, Gordon N, Kaban LB. A financial analysis of maxillomandibular fixation versus rigid internal fixation for treatment of mandibular fractures. J Oral Maxillofac Surg 2000;58:1206-10.
22. Hirai H, Okumura A, Goto M, Katsuki T. Histologic study of the bone adjacent to titanium bone screws used for mandibular fracture treatment. J Oral Maxillofac Surg 2001;59:531-7.
23. Aframian-Farnard F, Savadkoohi F, Soleimani M, Shahrokhi B. Effect of maxillomandibular fixation on the incidence of postoperative pulmonary atelectasis. J Oral Maxillofac Surg 2002;60:988-90.
24. Haug RH, Street CC, Goltz M. Does plate adaptation affect stability? A biomechanical comparison of locking and nonlocking plates’ J Oral Maxillofac Surg 2002;60:1319-26.
25. Cabrini Gabrielli MA, Real Gabrielli MF, Marcantonio E, Hochuli-Vieira E. Fixation of mandibular fractures with 2.0-mm miniplates: Review of 191 cases. J Oral Maxillofac Surg 2003;61:430-6.
26. Kirkpatrick D, Gandhi R, Van Sickels JE. Infections associated with locking reconstruction plates: A retrospective review. J Oral Maxillofac Surg 2003;61:462-6.
27. Bolourian R, Lazow S, Berger J. Transoral 2.0-mm miniplate fixation of mandibular fractures plus 1 week of maxillomandibular fixation: A prospective study. J Oral Maxillofac Surg 2002;60:167-70.
28. Chritah A, Lazow SK, Berger JR. Transoral 2.0-mm locking miniplate fixation of mandibular fractures plus 1 week of maxillomandibular fixation: A prospective study. J Oral Maxillofac Surg 2005;63:1737-41.

How to cite this article: Prabhakar C, Shetty JN, Hemavathy OR, Guruprasad Y. Efficacy of 2-mm locking miniplates in the management of mandibular fractures without maxillomandibular fixation. Natl J Maxillofac Surg 2011;2:28-32.

Source of Support: Nil. Conflict of Interest: None declared.