A Comparative Study of Three Dimensional Stainless Steel Plate Versus Two Dimensional Stainless Steel Miniplate In The Management of Mandibular Symphysis And Parasymphysis Fracture

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Abstract: Background and Aim: Maxillofacial trauma is very common in all unforeseen events and the unique position of the mandible on the face makes it vulnerable. It is therefore, one of the most commonly fractured facial bones. The aim of this study is to compare 3-Dimensional versus 2-Dimensional Stainless steel miniplates for open reduction and fixation of mandibular symphysis and parasymphysis fracture. Methods: Patients with symphysis and parasymphysis fractures of mandible (unilateral /bilateral) were selected. All patients were treated and observed by the same surgeon. Routine investigations were carried out. Results: There is no statistically significant difference between three dimensional miniplate and twodimensional miniplate osteosynthesis in the open reduction and internal fixation of mandibular symphysis and parasymphysis fractures. Clinically, three-dimensional miniplates were found to be better than two-dimensional miniplates in terms of cost, ease of surgery and operative time. Conclusion: Three-dimensional miniplates were unfavorable for cases where fracture line was oblique and in close proximity to the mental foramen, where they were difficult to adapt and there were more chances for tooth-root damage and inadvertent traction of the mental nerve. Studies with larger sample size are recommended to correlate the findings of the present study for their wider use in clinical practice. [J Doshi, Natl J Integr Res Med, 2018; 9(3):14-20]

Key Words: Three Dimensional, Stainless Steel Plate, Mandibular Symphysis, Parasymphysis

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Introduction: Maxillofacial trauma is very common in all unforeseen events and the unique position of the mandible on the face makes it vulnerable. It is therefore, one of the most commonly fractured facial bones. Only a few studies have previously reported clinical experiences with these plates in the treatment of mandibular fractures. The aims of the study are to evaluate and compare the clinical effectiveness of three dimensional (3D) and two dimensional (2D) stainless steel miniplate for open reduction and internal fixation of mandibular symphysis and parasymphysis fractures and to assess the versatility of 3D-plates in mandibular symphysis and parasymphysis fractures in comparison with conventional miniplates by evaluating the incidence of complications like Pain, Edema, Occlusion derangement, Mobility, Infection, Paresthesia by follow up for 3 months.

Method: A randomized prospective study was conducted on with mandibular symphysis and parasymphysis fractures.

Inclusion Criteria:

- Non-comminuted, non-infected mandibular symphysis and parasymphysis fracture with associated maxillomandibular fractures.
- Fractures indicated for open reduction.
- A dentition complete enough to apply stable Erich arch bar was present.

Exclusion Criteria:

- Patients having periodontally weak teeth.
- Preoperatively infected fracture cases.
- Grossly communited fracture cases.
- Medically compromised patient.

Method of Study: With the prior approval of local ethical committee, informed consent was obtained from the patients before they were included in the study. Patients with symphysis and parasymphysis fractures of mandible (unilateral /bilateral) were selected. All patients were treated and observed by the same surgeon. Routine investigations were carried out.

Patients were randomly divided into two equal groups:

Group A

- Number of patients – 10
- Patients underwent osteosynthesis using three-dimensional stainless steel miniplates (2.0 mm system).

Group B:

- Number of patients – 10
- Patients underwent osteosynthesis using two-dimensional stainless steel miniplates (2.0 mm system).

Follow up:

- At 1st week, 2nd week, 3rd week, 6th week, 3rd month.
- Postoperative OPG was taken in all the cases as early as possible after surgery.

Statistical Analysis: Data were analyzed using SPSS version.15. Descriptive statistics were done to find out the Mean and SD of the socio-demographic variable among the groups. Student's t test was used to compare 3-D and 2-D stainless steel miniplate in mandibular symphysis and parasymphysis fractures. A value of P less than 0.05 was considered statistically significant.

Figure 1: Pre-operative OPG showing symphysis and b/l condylar fracture of mandible

Figure 2: Post-operative OPG showing 3 D miniplate in position

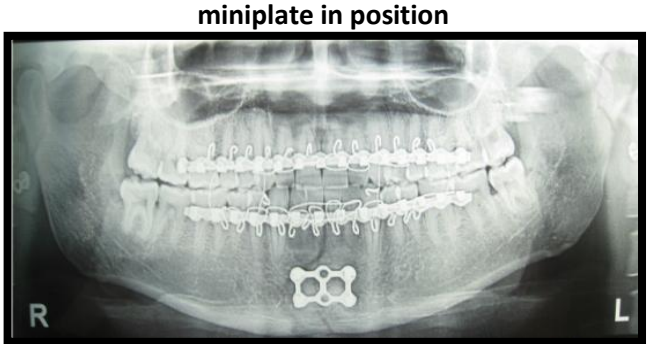


Figure 3 Pre-operative OPG showing Rtn parasymphysis fracture ofmandible

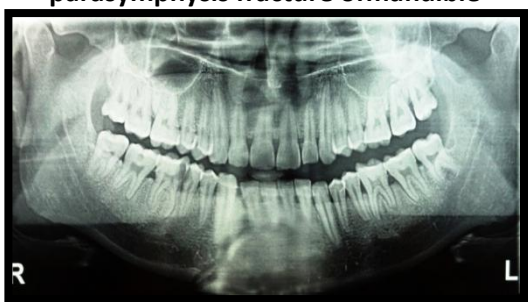


Figure 4: Post-operative OPG showing 2 D miniplate in position

Results: Graph 1 show the distribution of patients in two groups, Group A and Group B according to severity of the pain at 5 different follow-ups. There was no statistical significance in both the groups, at all the follow-ups (p >0 .05).

Graph 2 show that 70% patients had post-operative edema in Group A and 60% in Group B at the 1st week of follow-up. At 2nd week of follow-up, 10% of patients had edema in group A and group B. At 3rd week of follow-up, none of the patients had post-operative edema in group A and group B. At 6th week of follow-up, none of the patients had edema in group A while 2 patients devloped post-operative edema in Group B. None of the patients had edema in both groups at 3rd month. There was no statistical significance in both the groups at all the follow-ups (p>0.05).

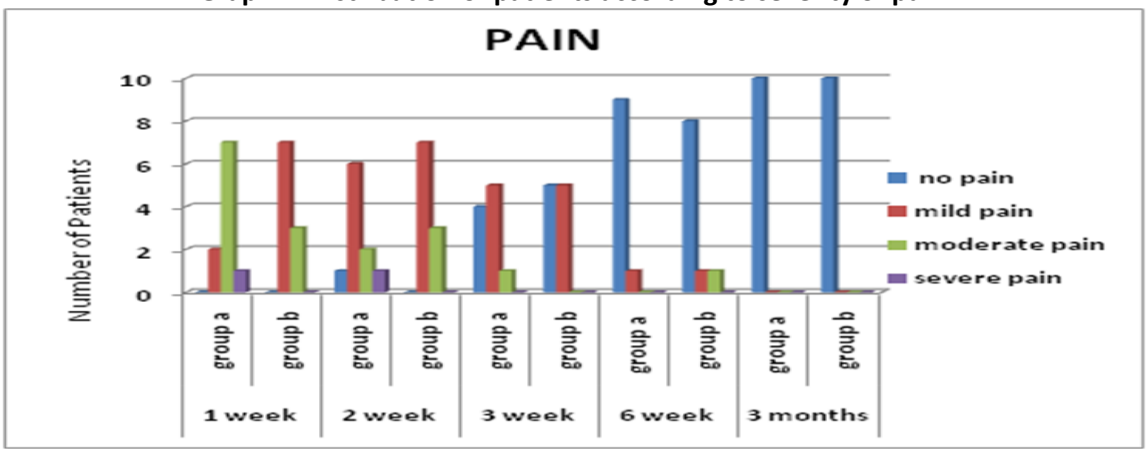
Graph 3 show that only one patient had post-operative occlusion derangement at 1stand 2nd weeks of follow-up in group A &group B. At 3rd week of follow-up, four patients in Group A and two patients in Group B had occlusion derangement. 6th week of follow-up 3 patients in Group A and one patient in Group B had occlusal derangement. At the end of 3rd month one patient had occlusal derangement in both the Groups There was no statistical significance in both the groups at all the follow-ups (p>0.05).

Graph 4 shows that none of the patient had post-operative infection in post operative follow-up in group A , whereas in Group B 2 patients reported with infection at the end of 6th week follow up. There was no statistical significance in both the groups at all the follow-ups (p>0.05).

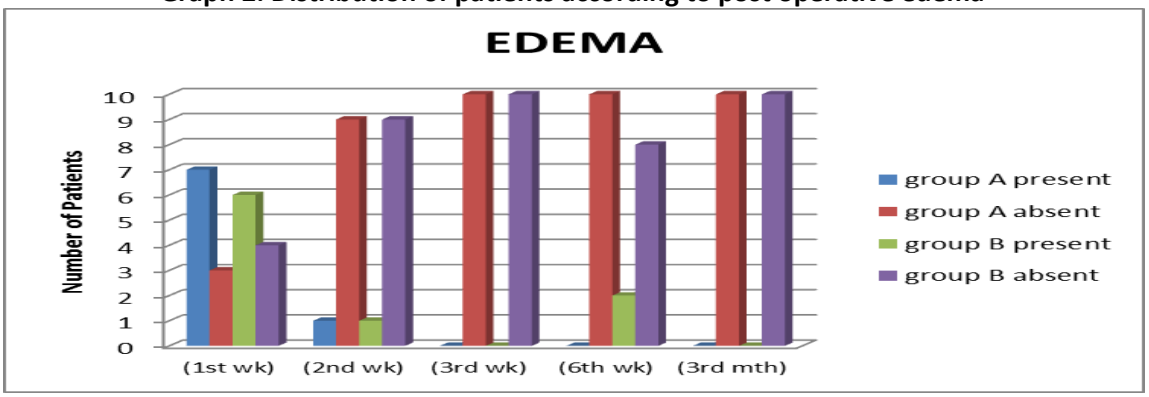
Graph 5 shows that only one patient had post-operative fracture segment mobility from 1st week of follow-up till 6th week in both group A and group B. At the end of 3rd month none of the patient had mobility at the fracture site in both the groups. There was no statistical significance in both the groups at all the follow-ups (p>0.05)

Graph 6 show that one patient in group A and two patients group B reported with paresthesia of lower lip and chin region at all follow-ups. At the end of 3rd month only one patient in Group A and Group B had mental nerve paresthesia. There was no statistical significance in both the groups at all the follow-ups (p >0.05).

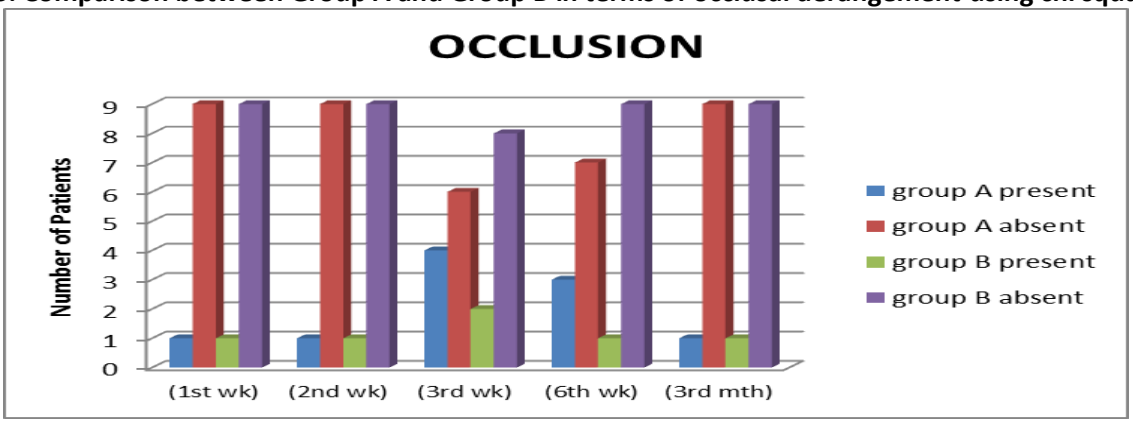
Graph 1: Distribution of patients according to severity of pain



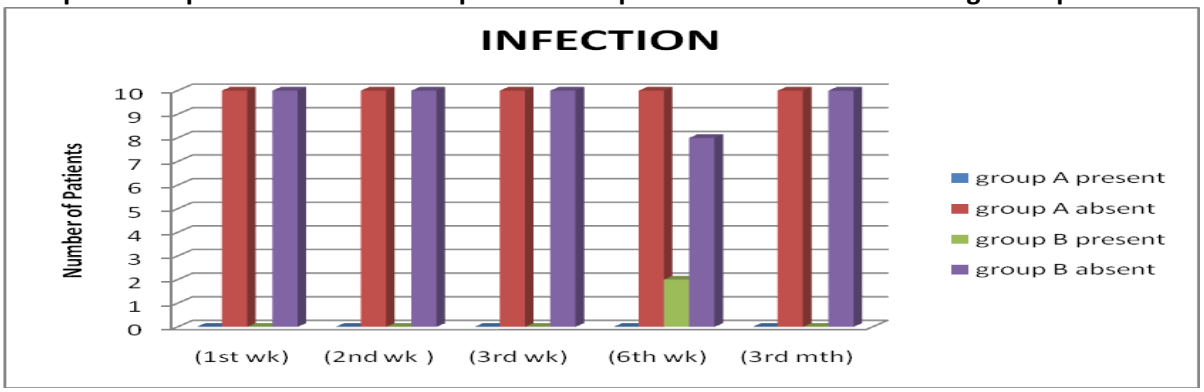
Graph 2: Distribution of patients according to post operative edema



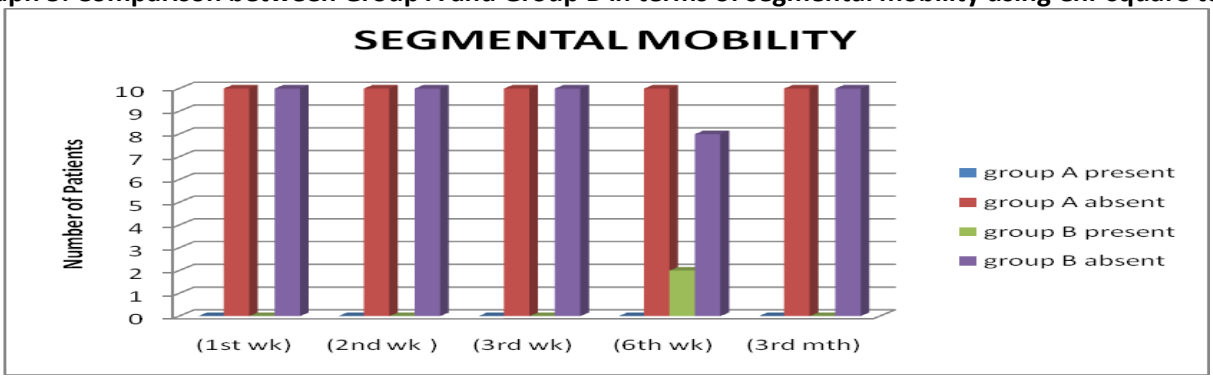
Graph 3: Comparison between Group A and Group B in terms of occlusal derangement using chi square test



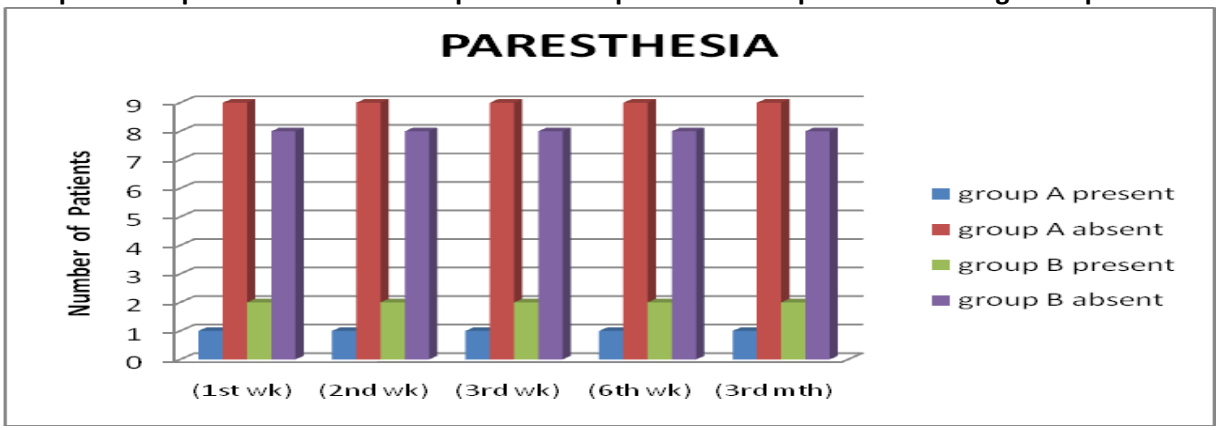
Graph 4: Comparison between Group A and Group B in terms of infection using Chi-square test.



Graph 5: Comparison between Group A and Group B in terms of segmental mobility using Chi-square test



Graph 6: Comparison between Group A and Group B in terms of paresthesia using Chi-square test



Discussion: The strategic position of the mandible on the facial skeleton and its unique role in mastication, deglutition, phonation and esthetics compels the clinician to give immediate attention whenever it is fractured.[17] The objectives in the treatment of mandibular fractures are to re-establish anatomical reduction and fixation of fracture segment with normal occlusion and masticatory function with minimal disability and complications.[9]

Operative treatment of mandibular fractures involves intraoral or extraoral opening of the fracture site and direct osteosynthesis with transosseous wires (Schwenzes 1982), lag screws (Niederdellmann 1982), or bone plates (Schilli 1975; Spiessel 1976). A number of fixation methods have been advocated for the treatment of mandibular fractures.[9]

The 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.[9, 2] The basic concept of 3D fixation as explained by Farmand M (1995)[4] is that a geometrically closed quadrangular plate secured with bone screws creates stability in three dimensions. The stability is gained over a

defined surface area and is achieved by its configuration and not by thickness or length. The large free areas between the plate arms and minimal dissection permit good blood supply to the bone.[9] The 3D plating uses lesser foreign material, reduces the operation time and overall cost of the treatment as described by Zix J et al in 2007[29] and Farmand M in 1995.[4]

In the present study, 3D miniplates and 2D miniplates were compared in terms of post-operative complications at six different follow-ups and there was statistically no significant difference between the two groups. At 1st week of follow-up, all the patients had mild to moderate pain in the group A & B. After this, at routine follow-ups, pain intensity further decreased and at 3rd month of follow-up none of the patients complained of pain in both the groups.

At 1st week of follow-up, 7 patients in Group A and 6 patients in Group B had post-operative edema. The edema reduced in intensity in both the groups at routine follow-ups and there was statistically no significant difference between the two groups at all the follow-ups.

One patient (6.7%) in Group A and Group B had post-operative occlusion derangement up to the 1st and 2nd week of follow-up respectively. This was because of the associated condylar fracture .At the end of 3rd week of follow up additional 3 patients in Group A and 1 patient in Group B had post-operative occlusion derangement after IMF removal. They were managed by guiding elastics and intermaxillary fixation. At the end of 3rd month 2 out 20 patients had occlusal derangement which was managed by selective occlusal adjustment. However, there was statistically no significant difference between the groups at all the follow-ups. Occlusal derangement in the present study was found to be within the result of the previous clinical study by Manoj Goyal et al 6.6% (2 out of 30) which was managed by selective occlusal adjustment.

Two patiens in Group B had post-operative infection at 6th week of follow-up owing to the poor oral hygiene. Infection rate in the present study was found to be within the result of the previous clinical studies by Feledy J et al i.e. 9% (2 out of 22)[5] , Claude Guimond et al i.e. 5.4% (2 out of 37).[10] and Manoj Jain et al i.e. 10%(2out of 20).[12]

In addition to infection, sensory deficit is a problem frequently seen in connection with mandibular fractures. One patient (6.7%) in Group A and two patients (13.4%) in Group B reported with paresthesia of lower lip and chin region at all the follow-ups. This agrees with another study on 3D plates by Claude Guimond et al (8.1%) who found that the main cause of sensory deficit in mandibular angle fractures was the trauma itself. In a previous study by Juergen Zix,[29] the sensory deficit was related to the injury in 75% of the observed cases, whereas only 25% were caused by the treatment while using 3-D miniplates. The most probable reason for intraoperative damage to the nerve is fracture manipulation, rather than drilling and screw placement close to the nerve. In terms of implant failure, both three-dimensional and two-dimensional miniplates were equally efficient and none of the patients had implant failure at all the follow-ups. This is in accordance with the previous studies by Feledy J et al [5] and Guimond et al [10] and Manoj Jain et al.[12]

Although results obtained in our study do not show a major difference in clinical outcome between the two-dimensional miniplate system and three-dimensional miniplate system, yet three-dimensional miniplate was found to be better than two-dimensional miniplates in terms of ease of surgical technique, minimal tissue dissection near the fracture site and also in terms of cost because of fewer number of plates and screws used in this technique. However, three-dimensional miniplates were difficult to adapt in cases where the fracture line was oblique and in close proximity to the mental foramen.

Conclusion: Within the limitations of the study, it can be concluded that there is statistically no significant difference between three dimensional miniplate and two-dimensional miniplate osteosynthesis in the open reduction and internal fixation of mandibular symphysis and parasymphysis fractures. Clinically, three-dimensional miniplates were found to be better than two-dimensional miniplates in terms of cost, ease of surgery and operative time. However, three-dimensional miniplates were unfavorable for cases where fracture line was oblique and in close proximity to the mental foramen, where they were difficult to adapt and there were more chances for tooth-root damage and inadvertent traction of the mental nerve. Studies with larger sample size are recommended to

correlate the findings of the present study for their wider use in clinical practice.

References:

1. Champy M, Lodde J P, Schmitt R: Mandibular osteosynthesis by miniature screwed plates via a Buccal Approach; J max-fac Surg 6, 1978.
2. Ebenezer V and Ram lingam B: Three dimensional miniplates in Mandibular Angle fractures, Indian Journal of Multidisciplinary Dentistry, Vol. 1, Issue 2, (Jan-Feb 2011):89-92
3. Farmand M, Dupoireux L : The value of 3-dimensional plates in maxillofacial surgery 1992;93(6);353-7
4. Farmand M: The 3-dimensional plate fixation of fractures and osteotomies. Facial Plast Surg 3:39,1995
5. Feledy J: Treatment of mandibular angle fractures with a matrix miniplate: A preliminary report. Plastic and Reconstructive Surgery. 114: 1711-1718,2004
6. Feller K U, Richter G, Schneider M: Combination of microplate and miniplate for osteosynthesis of mandibular fractures: an experimental study Int. J. Oral Maxillofac. Surg. 2002; 31: 78–83
7. Gabrielli M A C, Gabrielli M F R, Marcantonio E, et al: Fixation of Mandibular Fractures With 2.0-mm Miniplates: Review of 191 Cases; J Oral Maxillofac Surg 61:430-436, 2003
8. Gandi L, Kattimani V S: Three dimensional bone plating system in the management of mandibular fractures-a clinical study; Annals and Essences of Dentistry; Vol. IV Issue 2 Apr - Jun (2012), 104-110
9. Gokkulakrishnan S, Singh S, Sharma A: An analysis of postoperative complications and efficacy of 3-D miniplates in fixation of mandibular fractures; Dental Research Journal 2013
10. Guimond C: Fixation of mandibular angle fractures with a 2.0-mm 3-dimensional curved angle strut plate. Journal of Oral Maxillofac. Surg. 63:209-214,2005
11. Iatrou I, Samaras C, Lygidakis N T: Miniplate osteosynthesis for fractures of the edentulous mandible: a clinical study 1989-96 Journal of Cranio-Maxillofacial Surgery (1998) 26, 400404
12. Jain M K, B K Bhagwan B K and shah D K: Comparison of 3dimensional and standard miniplate fixation in the mandibular fracture, American association of oral & maxillofacial surgeon, 2010, 0278-2391/01, 1568-1572.
13. Joshi U , Kurakar M: Comparison of Stability of Fracture Segments in Mandible Fracture Treated with Different Designs of Mini-Plates Using FEM Analysis; J. Maxillofac. Oral surg
14. Khalifa M E, El-Hawary H E, Hussein M M: Titanium Three Dimensional Miniplate versus Conventional Titanium Miniplate in Fixation of AnteriorMandibular Fractures Life Science Journal 2012;9(2)
15. Kim Y K, Nam K W: Treatment of mandibular fractures using Low- profile Titanium miniplates: preliminary study , Journal of plastic and Reconstructive surgery July 2001
16. Kimura A, Nagasao T, Kaneko T : A comparative study of most suitable miniplate fixation for mandibular symphysis fracture using a finite element model; Keio J Med 2006; 55 (1): 1–8
17. Kumar B P, Kumar J ,Mohan A P: A Comparative study of three dimensional stainless steel plate versus stainless steel miniplate in the management of mandibular parasymphysis fracture J.Bio.Innov 1(2), pp: 19-32, 2012
18. Kuriakose M A, Fardy M, Sirikumara M: comparative review of 266 mandibular fractures with internal fixation using rigid (AO/ASIF) plates or mini-plates; British Journal of Oral and Maxillofacial Surgery (1996)34,315-321
19. Michelet FX, Deymes: J. Osteosynthesis with miniaturized screwed plates in Maxillofacial surgery. Journal of Oral Surg. 1:79-84,1973
20. Malhotra K, Sharma A, Giraddi G : Versatility of Titanium 3D Plate in Comparison with Conventional Titanium Miniplate Fixationfor the Management of Mandibular Fracture; J. Maxillofac. Oral Surg. (July-Sept 2012) 11(3):284–290
21. Mittal G , Dubbudu R R, Cariappa K M: Three Dimensional Titanium Mini Plates in Oral & Maxillofacial Surgery: A Prospective Clinical Trial; J. Maxillofac. Oral Surg. (Apr-June 2012) 11(2):152–159
22. Moreno J C, Ferncindez A, Ortiz J A: Complication Rates Associated with Different Treatments for Mandibular Fractures; J Oral Maxillofac Surg 58 273-280 2000
23. Nathan B, Jan D W, Scott L: Clinical and FEA of Low Profile 3D and Parallel Miniplates in Fixation of Mandibular Symphysis and Parasymphysis Fractures; Journal of maxillofacial and Oral Surgery 2008 Vol.7

24. Prasad R, Thangavelu K, John R: The role of 3D plating system in mandibular fractures: a prospective study. Journal of Pharmacy and Bioallied sciences June 2013 Vol 5 Supplement 1
25. Renton T F, Wiesenfeld D : Mandibular fracture osteosynthesisa: comparision f three techniques; ; British Journal of Oral and Maxillofacial Surgery (1996)34,166-173
26. Rix L, Stevenson A R L, Moorthy A P: An analysis of 80 cases of mandibular fractures treated with miniplate osteosynthesis ; Int. J. Oral Maxillofac.Surg. 1991; 20. 337 341.
27. Schmelzeisen R, McIff T , Rahn B: Further development of titanium miniplate fixation for mandibular fractures. Experience gained and questions raised from a prospective clinical pilot study with 2.0 mm fixation plates; Journal of Cranio- Maxillo-Facial Surgery (1992)20,251-256
28. Tuovinen V, Norholt S E, Pedersen S S: A Retrospective Analysis of 279 Patients With Isolated Mandibular Fractures Treated With Titanium Miniplates, J Oral Maxillofac Surg,52;931-935,1994
29. Zix J, Lieger O, Iizukac T: Use of straight and curved 3- Dimensional Titanium miniplates for fracture fixation at the mandibular angle;J Oral Maxillofac Surg 65:1758-1763,2007.

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