

SINGLE PLATE MANAGEMENT OF MANDIBULAR FRACTURES WITH IMMEDIATE POST OPERATIVE FUNCTIONAL RECOVERY

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ABSTRACT

Comparative study conducted on eighty dentate mandibular fracture patients at maxillofacial unit of de, Montmorency College of Dentistry / Punjab Dental Hospital Lahore, treated by open reduction and internal Fixation (ORIF) by mini plates and screws in two Groups. Group-A, treated by two plate fixation and Group-B, treated by one plate fixation with tension banding by an archbar in place of second plate to provide effective stabilization of fracture segments. Most of these patients were treated under local anesthesia during the period of 1996- 2000. Post operative complications were less in Group -B when compared to Group -A, so favoring the use of an archbar as tension band to overcome the torsional forces produced at anterior body region of mandible during function.

Aim was to evaluate of an archbar as tension band in comparison with tension band plate to reduce implant material and minimize implant related post operative complications, with provision of an alternative technique for mandibular osteosynthesis.

Infection was the common post operative complication (7.5%), it was 5% in Group -A and 2.5% in Group -B, other complications in Group A include 5% malocclusion and 10% plate removal and no such complications were found in Group-B.

Osteosynthesis by both techniques is effective in providing immediate post operative function but complications were minimum in Group-B.

Key words: Mandibular fractures, Archbar as tension band, double plate osteosynthesis, implanted material, post surgery complications.

INTRODUCTION

Man is exposed to trauma since the days of Adam but ever increasing vehicular traffic and interpersonal violence has compounded the problem. Increased awareness about esthetic and optimized need for earliest functional recovery to life has posed maxillofacial surgeons to innovate surgical techniques to provide better options in the treatment of mandibular fractures^{19,23,24}. Rigid internal fixation has challenged the traditional methods of treatment by intermaxillary fixation, use of splints and intraosseous wiring for maxillofacial fractures^{20,25,30,31}. Technique of internal fixation by plates and screws has provided precise

reduction, superior esthetic results, increased comfort and safety of patients and early restoration of functional life^{15,30,31}.

Use of compression plates and development of self tightening mandibular compression screws were included in the learning process to find a better system to provide required stabilization and compression of fractured segment to have early recovery to functional life without the need of post operative intermaxillary fixation²⁷. Need of tension band plate with a fixation plate was accepted by many surgeons to get masticatory function during healing period of mandibular bone^{4,24}. Eccentric dynamic compression plates were

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tried to overcome the need of tension band plate. Spiessl was able to overcome rotational forces at alveolar portion of fractures by addition of tension band as an archbar. This adaptation provided stabilization along the entire length of the fracture and eliminated separation previously encountered at the alveolar or tension site of the fractured bone. Need for tension banding is evident to get satisfactory stabilization during mastication regardless of the size and type of plates used^{4, 19, 27}.

Champy introduced a non compressive mini-plate system, plates were applied close to the tension zone of the mandible and monocortical screws were used for fixation of plates. Mini-plate system needs one plate in the posterior region of mandible and two plates in the parasymphylar region to provide sufficient support and stability to the bone fragments to allow immediate function^{4,12,15,27,31}. Studies comparing wire osteosynthesis and plating have proved the superiority of the latter^{2,8,12,13,15,25,29}. Compression plate and mini-plate systems are competing and successful results are claimed by both. Superiority of miniplates, due to ease of adaptation, unrestricted intraoral application, reduction in implant material, cost effectiveness and results obtained is evident^{7,20,25,30}.

The introduction of better biocompatible well-designed plates and screws, modifications in surgical techniques and better understanding of the biomechanics of bone repair have produced more acceptable results and these techniques are now practiced widely and routinely^{2,4,30}.

Susceptibility to corrosion of stainless steel and release of titanium into local tissues by phagocytosis and vascular transport to distant sites i.e; Lungs, are accepted facts^{11, 16,22}

Use of two miniplates recommended by many authors^{4,9,15,12} were compared to the use of an Archbar as tension band in place of second plate in dentate areas to achieve required optimal stability and effective neutralization of torsional stresses during function in mandibular osteosynthesis. Reduction in implanted material has made the procedure easy, reliable and cost effective.

MATERIAL AND METHODS

Present study was based on eighty dentate patients of mandibular fractures in body area, divided into two

equal groups 'A' and 'B'. These cases were selected randomly from maxillofacial unit of de'Montmorency College of Dentistry / Punjab Dental Hospital Lahore, after clinical and radiographic evaluation. Forty patients of group "A" were treated by open reduction and fixation of two plates on the bone in the area from below apices of teeth and lower border of the mandibular bone across the fracture line having two screws on either side of the fracture line separated by 5mm at least.

Forty patients of second group were treated by open reduction and single plate fixation at smooth bone in the area from below apices of teeth and lower border of the mandibular bone across the fracture line having two screws on either side of the fracture line. Stainless steel half round wire was adapted to the buccal side of teeth across the fracture line along the dental arch involving at least two teeth on either side and fixed by soft stainless steel wire of 0.5 mm diameter to act as tension band. High torque drill machine having speed less than 1000 rpm (revolution per minute) with continuous copious irrigation was used to avoid over heating during drilling hole into bone for insertion of screws^{4,15}.

PROCEDURE

The face and operating site was prepared and the patient was draped with sterile towels. Anesthetic solution, 2% lignocaine with 1; 100,000 adrenaline was administered for getting local as well as regional block. Infiltration of anesthetic solution was given at proposed surgery site for reduction of bleeding. While some uncooperative or opting few cases were operated under general anesthesia.

Prior to surgical proceedings temporary inter-maxillary fixation was carefully established to get accurate pre traumatic occlusion.

Mucoperiosteal incision was made in the buccal or labial sulcus across the fracture line and flap was reflected to get access to the fractured site.

Monocortical screws were inserted into the bone on either side of fractured line and soft stainless steel wire of 0.5 mm was twisted around the screws by making figure of 8 to approximate and stabilize the fractured segments fig-1¹⁰.

Plates were accurately adapted and fixed with at least two screws on either side of the fracture line.

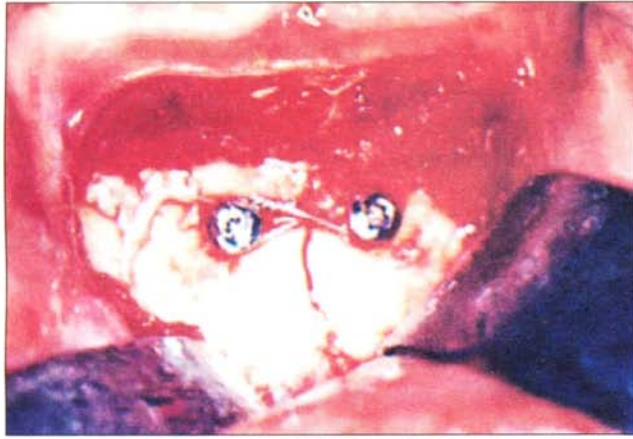


Fig 1



Fig 2

Continuous and copious irrigation with normal saline, of drill bit and surrounding area was maintained during drilling. Second plate in group A was fixed similarly at a distance of 5mm at least fig-2.

Temporary intermaxillary fixation and figure 8 wiring was removed. Functional occlusion was re evaluated and wound was closed with 3/0 vicryl in layers.

In group- B second plate was omitted and halfround wire was adapted and fixed across the fracture line as in fig -4.

POST OPERATIVE COMPLICATION CRITERIAS AND STATISTICAL ANALYSIS

Post operative morbidity for both groups 'A' and 'B' was assessed by given criteria. Infection was recorded when it was manifested by abscess formation. Malocclusion was based on evaluation of occlusion, checked for maximum interdigitation, Midline relationship,

Molar relationship, Canine relationship, Attrition wear facet relationship. Patient's feelings regarding any abnormality during mastication, when present were sorted by using articulation paper clinically. Patients were asked about the presence of a subjective sensation of hypoesthesia or numbness of lips and mental region, for difference in the nature of sensation when compared with non-injured side and with the skin of the cheek. Sensory testing was performed using light touch with cotton wool and sharp/blunt differentiation with a dental probe on the skin of the chin and lower lip. Plate was removed when exposed or when infection persisted with consistent medication or if any other complaint related to plate was observed. Persistent mobility of fractured segments if observed after 4-8 weeks of the treatment was included as non union in complications.

The data was subjected to statistical analysis, test of proportion was applied to check the significance of difference between the two groups at $p < 0.05$.



Fig 3



Fig 4

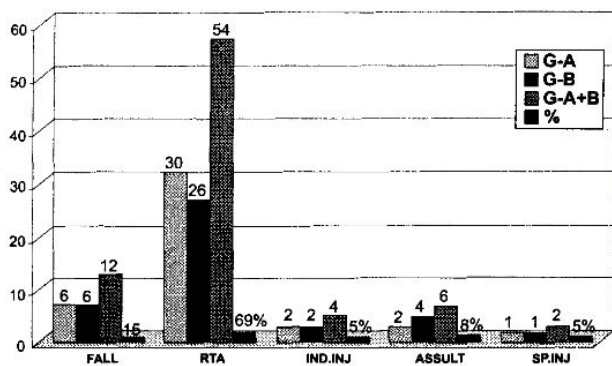


Fig 5. Etiology of fractures in Group-A and Group-B

RESULTS

Majority of patients belong to age group (16y to 25y) 55.5% and 22.5% belong to (26y to 35 y) age group, 95% of patients were male. Maximum patients treated in this study had fracture in canine region of the mandible 72.5%, symphysis region 15% and premolar region 12.5%. Road traffic accidents 70% being the major cause of mandibular fractures, fall 15% being the second common cause, details on fig-5.

Delay in trauma and treatment was divided in three groups, the first groups comprises of patients treated within first week and were 62% while 28% were treated in second week and only 10% were delayed for more than two weeks.

Infection being the common complication in both groups, in total it was 7.5%, 10% in double plated group and 5% in single plated group. Occlusal disturbances were nominal only two patients 2.5%, needed selective occlusal grinding in double plated group, while intercuspal relationships were undisturbed in second

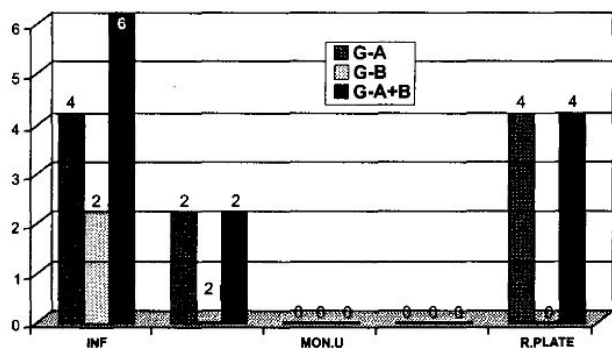


Fig 6. Complications in Group-A and Group-B

group. Plate removal was needed in four patients 5% and all of them belonged to group A. Details of complications given in fig-6.

DISCUSSION

Restoration of physical integrity and earliest possible functional life with minimal morbidity is the ultimate goal of maxillofacial surgeons for management of maxillofacial trauma. During present study the maximum patients were result of road traffic accidents, 70% and minimum in the sports injury group, 2.5%,. Most of the RTA was related to motor cycle than motor cars

Infection rate of 3% to 27% has been reported in previous studies with the use of metal plates and screws for the treatment of mandibular fractures^{12,14,15,18,21,23,25,26,30} Mobility of fractured segments have been the most common technical cause of infection^{21,23,24,28,5} Technical errors, like inadvertent placement of screws in the line of fracture, poor plate adaptation or contouring, in adequate cooling during preparation of holes for insertion of screws, increase the risk of post operative infection^{21, 23, 28}. Technique failure was proved to be a frequent event in the application of rigid internal fixation devices to mandible fractures^{4,21}. Lack of antibiotics used is considered as a predisposing factor for infection, so the use of antibiotics, as prophylaxis as well as after surgery has been advocated in routine^{2, 5, 12, 18}. Many authors have accepted tooth in the line of fracture as a major risk factor for infection^{18,21}.

During this study there was 7.5% infection in total, 5% belong to group 'A', and 2.5% in group 'B'. Infection in group B respondent to removal of infected tooth while in group 'A', 2.5% were treated by using antibiotics and other 2.5% responded to removal of plate. Non compliance in the use of antibiotics was noticed in 5% . One patient in group 'B' having alveolar fracture involving multiple teeth, got apical infection in one tooth and responded well to root canal treatment.

Overall the infection rate of 7.5% was comparable to previous studies. Incidence of infection was double in group 'A' when compared to group 'B'. It favors the assumption that reduction of implanted material has minimized procedural errors and has facilitated easy adaptation of one plate at selected smooth mandibular

bone hence reduced the post operative complication. Lesser infection rate in group 'B' reflects that stability provided by fixation of labial archbar was superior to tension band plate. Treatment modality was found to be the major factor associated with an increased risk of infection.

Malocclusion up to 18.2% has been reported in previous studies while during this study it was 2.5% . Inappropriate bending and adaptation of plates is said to be the cause of it^{12,16,18,21,25} . These malocclusion cases were belonging to group 'A', and were corrected by occlusal grinding. They were result of an error in counteracting of plates or insufficient reduction and stabilization during the procedure of osteosynthesis. Later these plates were exposed into the buccal sulcus and were removed. Palpability of plate, hot and cold sensation or thermal sensitivity felt post operatively and stress shielding effects of plate on underlying bone are reported reasons for removal of plates^{15,17,18}. Potential complications related to the presence of plates were loosening of hardware, related tenderness, swelling, pain, and infection. Metal toxicity, hypersensitivity, carcinogenicity, radiation, and X-ray effects related to metallic implants are rare reasons for implant removal^{2,5,15,18}.

During this study there has been no need for removal of plate in group 'B' while 10% removal of plates was needed in group 'A'. Some imbalance in torque was left during the adaptation and fixation of plate, it initially lead to minor occlusal discrepancies and later ended with loosening of the screws and exposure of the plate. Patients became free of any complaint after removal of infected and exposed plates. Chances of all complications were reduced due to less implant material being used in group 'B'.

Postoperative removal of archbar after six weeks had increased the stresses going to the bone hence had reduced the stress shielding to minimum when compared with double plate fixation system. Utilization of an Archbar as a tension band has reduced chances of complications related to technical errors during fixation of second plate and screws. It has decreased possibilities of potential complications like stress shielding, Palpability, thermal sensitivity, and others (discussed above). Double fold benefit by reduction

second surgery for removal of plate. These advantages increased the reliability of the technique and reduced the cost and fear of the patient.

Removal of plate as a complication was 10% in group 'A' and 0% in group 'B' thereby the difference between two groups was significant statistically at $p < 0.05$. Other complications like altered sensation / damage to nerve and non union of fractures were not present in both groups.

CONCLUSION

Osteosynthesis provided by both techniques offered optimal stability for healing of the fractures and allowed immediate function of mastication. Superiority of second technique is evident. Rigid fixation by this technique proved to be faster, cost effective, requires less amount of implanted material, fewer problems when compared to double plate fixation. Results were improved by this modality due to easy and better adaptability of single plate and less number of screws. Archbar fixation provided better control on occlusal stability and made minor occlusal corrections possible post operatively without attempting second surgery.

REFERENCES

- 1 Abbas I, Ali K, Mirza YB. Spectrum of mandibular fractures at a tertiary care dental hospital in Lahore. J Ayub Med Coll Abbottabad, 2003 Apr-Jun; 15(2): 12-4.
- 2 Atanasov DT. A retrospective study of 3326 mandibular fractures in 2252 patients. Folia Med (Plovdiv). 2003;45(2): 38-42
- 3 Buckley Michael J., Banes Albert J. and Jordan Richard D. The Effects of Mechanical Strain on Osteoblasts In Vitro J. Oral Maxillofac Surg ; 48 (1990) 276-282
- 4 Champy Maxime, Pape Hans-Dieter, Gerlach Klaus Louis and Lodde. Mandibular Fractures The Strasbourg Miniplate. Osteosynthesis. Oral and Maxillofacial Traumatology Vol.2 Chicago, quintessence publishing (1986) 19-43.
- 5 Chaushu G, Manor Y, Shoshani Y, Taicher S. Risk factors contributing to symptomatic plate removal in maxillofacial trauma patients. Plast Reconstr Surg. 2000 Feb;105(2):521-5.
- 6 Dechow Paul C, Ellis III Edward and Throckmorton Gaylord S. Structural Properties of Mandibular Bone Following Application of a Bone Plate. J. Oral Maxillofac Surg ; 53 (1995) 1044-1051
- 7 Edwards, Timothy J. C. M.B.B.S.; David, David A Comparative Study of Miniplates Used in the Treatment of Mandibular Fractures. Plastic & Reconstructive Surgery. 97(6):1150-1157, May 1996.
- 8 Ellis E 3rd, Muniz O, Anand K Treatment considerations for comminuted mandibular fractures. J Oral Maxillofac Surg. 2004 Jan;62(1):115-6.

- 9 Fernandez JR, Gallas M, Burguera M, Viano JM. A three-dimensional numerical simulation of mandible fracture reduction with screwed miniplates. *J Biomech.* 2003 Mar;36(3):329-37
- 10 Halling Frank, Mertan Hans-Albert and Luhr Georg. Auxillary Devices for open reduction and fixation of displaced mandibular angle fractures. *Oral Surg Oral Med Oral Pathol* ; Aug (1991)124-125
- 11 Jorgenson, Daniel S. M.D.; Mayer, Michael H. M.D.; Ellenbogen, Richard G. Detection of Titanium in Human Tissues after Craniofacial Surgery. *Plastic & Reconstructive Surgery.* 99(4):976-979, April 1997.
- 12 Kuriakose-MA; Fardy-M; Sirikumara-M; Patton-DW; Sugar-AW. A comparative review of 266 mandibular fractures with internal fixation using rigid (AO/ASIF) plates or mini-plates. *Br-J-Oral-Maxillofac-Surg.* 1996 Aug; 34(4): 315-21
- 13 Lamphier J, Ziccardi V, Ruvo A, Janel M. Complications of mandibular fractures in an urban teaching center. *J Oral Maxillofac Surg.* 2003 Jul;61(7):745-9; discussion 749-50.
- 14 Leach J, Truelson J. Traditional methods vs rigid internal fixation of mandible fractures. *Arch Otolaryngol Head Neck Surg.* 1995 Jul;121(7):750-3.
- 15 Luhr-HG, Gausmann-DF. Results of compression osteosynthesis with intraoral approach in 922 mandibular fractures. *Fortschr-Kiefer-Gesichtschir.* 1996; 41: 77-80
- 16 Matthew IR, Frame JW. Release of metal in vivo from stressed and nonstressed maxillofacial fracture plates and screws. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2000 Jul;90(1):33-8.
- 17 Mathog RH, Toma V, Clayman L, Wolf S. Nonunion of the mandible: an analysis of contributing factors. *J Oral Maxillofac Surg.* 2000 Jul; 58(7):746-52; discussion 752-3.
- 18 Manor Y, Chaushu G, Taicher S. Risk factors contributing to symptomatic plate removal in orthognathic surgery patients. : *J Oral Maxillofac Surg.* 1999 Jun;57(6):679-82
- 19 Moreno JC, Fernandez A, Ortiz JA, Montalvo JJ. Complication rates associated with different treatments for mandibular fractures. : *J Oral Maxillofac Surg.* 2000 Mar;58(3):273-80; discussion 280-1.
- 20 Oikarinen Kyosti, Altonen Mikko, Kaupoi Heini. A Retrospective Analysis of 279 Patients with Isolated Mandibular Fractures Treated With Titanium Miniplates. *J. Oral Maxillofac Surg* ; 52 (1994) 931-935
- 21 Orringer JS, Barcelona V, Buchman SR.. Reasons for removal of rigid internal fixation devices in craniofacial surgery. *J Craniofac Surg.* 1998 Jan;9(1):40-4.
- 22 Onodera Ken, Ooya Kiyoshi and Kawamura Hiroshi, Japan Sendai. Titanium lymph node pigmentation in the reconstruction plate system of a mandibular bone defect. *Oral Surg, Oral Med, Oral Pathol*; April 75 (1993) 495-497
- 23 Peled M, Ardekian L, Abu-el-Naaj I, Rahmiel A, Laufer D. Complications of miniplate osteosynthesis in the treatment of mandibular fractures. *J Craniomaxillofac Trauma.* 1997 Fall;3(2):14-7.
- 24 Piffko J, Homann Ch, Schuon R, Joos U, Meyer U. [Experimental study on the biomechanical stability of different internal fixators for use in the mandible] *Mund Kiefer Gesichtschir.* 2003 Jan;7(1):1-6. Epub 2002 Oct 11.
- 25 Renton TF, Wiesenfeld D. Mandibular fracture osteosynthesis: a comparison of three techniques: *Br J Oral Maxillofac Surg.* 1996 Apr;34(2):166-73.
- 26 Schortinghuis J, Bos RR, Vissink A. Complications of internal fixation of maxillofacial fractures with microplates. *J Oral Maxillofac Surg.* 1999 Feb;57(2):130-4; discussion 135.
- 27 Shetty V, Atchison K, Der-Martirosian C, Wang J, Belin TR. Determinants of surgical decisions about mandible fractures. *J Oral Maxillofac Surg.* 2003 Jul;61(7):808-13.
- 28 Stone Ira E., Dodson Thomas B. and Bays Robert A. Risk Factors for Infection Following Operative Treatment of Mandibular Fractures: A Multivariate Analysis. *Infection Risk After Mandibular Fracture* ; Vol 91 No.1 Jan (1993) 64-68
- 29 Toma VS, Mathog RH, Toma RS, Meleca RJ. Transoral versus extraoral reduction of mandible fractures: a comparison of complication rates and other factors. *Otolaryngol Head Neck Surg.* 2003 Feb;128(2):215-9.
- 30 Tuovinen V, Norholt SE, Sindet-Pedersen S, Jensen J. A retrospective analysis of 279 patients with isolated mandibular fractures treated with titanium miniplates: *J Oral Maxillofac Surg.* 1994 Sep;52(9):931-5; discussion 935-6.
- 31 Zachariades N., Mezitis M. and Rallis G. An audit of Mandibular fractures treated by intermaxillary fixation, intraosseous wiring and compression plating. *British Journal of Oral and Maxillofacial Surgery.* 34 (1996) 315-321.