# Original Article

# ASSESSMENT OF MANDIBULAR FRACTURE HEALING WITH RESORBABLE PLATES AND SCREWS; AN INTERVENTIONAL STUDY IN A TERTIARY CARE HOSPITAL

Quratul Ain<sup>\*</sup>, Arsalan Wahid <sup>\*\*</sup>, Tariq Javed<sup>\*\*</sup>, Suffiyan Saleem<sup>\*\*\*</sup>

<sup>\*</sup>Assistant Professor, Department of Oral & Maxillofacial Surgery, University Medical & Dental College, Faisalabad, Pakistan.

\*\*Senior Registrar, Department of Oral & Maxillofacial Surgery, University Medical & Dental College, Faisalabad, Pakistan.

\*\*\*PGR, Nishtar Institute of Dentistry Multan.

# **ABSTRACT:**

**OBJECTIVE:** To determine the outcome of fracture healing using resorbable plates and screws in case of mandibular fracture in adults.

**STUDY DESIGN:** Cohort Study

**SETTING:** Department of Oral and Maxillofacial Surgery, Nishtar Institute of Dentistry, Multan.

**STUDY DURATION:** Eight months (15<sup>th</sup> September 2010 to 14<sup>th</sup> May 2011)

**Subjects & Methods:** Total 73 cases presented in Outpatient Department of Nishtar Institute of Dentistry Multan were diagnosed clinically on the basis of step deformity, mobility at fracture site, disturbed occlusion and swelling. Radiographs (OPG, PA view of face) were taken wherever required to confirm step deformity and radiolucent or radiopaque line at fracture site.

A detailed history of all the patients was taken including the etiology, followed by a clinical and radiographic examination. Patients were then treated with resorbable plates and screws. After six weeks final assessment regarding infection, occlusion and mobility at the fracture site was made by consultant maxillofacial surgeon.

**RESULTS:** Sample size of the study was 73 patients (n=73) and male to female ratio was 6.3:1. The mean age of the patients was 21.1±2.9 years. The age range was 16–25 years. Majority of the patients 37(50.7%) were between 21–25 years of age.

Regarding the etiology, road traffic accident was the major cause which was evident in 62 patients (84.9%) followed by interpersonal violence in 8 patients (11%). Regarding the site of fracture, 32 patients (43.8%) had parasymphyseal and 10 (13.7%) had symphyseal fracture of mandible. 8 cases (11%) had fracture of mandible body and 23(31.5%) had mandible angle fracture.

The follow up visit after six weeks showed normal occlusion in 65 patients (89%), no infection in 71 patients (97.3%) and no mobility in 65 patients (89.0%). Outcome of treatment showed 64 patients (87.7%) with healed fracture while in 9 patients (12.3%) fracture did not heal.

**CONCLUSION:** Fixation of mandibular fracture with resorbable plates and screws seems to be a good technique for mandibular fractures except cost of treatment.

**KEY WORDS:** Maxillofacial trauma, mandible fracture, resorbable plate fixation

# **INTRODUCTION:**

The major cause of mortality and morbidity is maxillofacial trauma. Patients with maxillofacial

Corresponding Author: Dr. Arsalan Wahid Malik (Head, Dept. of Oral Medicine / Oral Diagnosis) University Medical & Dental College, Faisalabad Email: dr.arsalanmalik@gmail.com

\_\_\_\_\_

# ASSESSMENT OF MANDIBULAR FRACTURE

trauma are frequently reported in Pakistan and is associated with high incidence of mandibular fractures<sup>1,2</sup>. These fractures most commonly occur in 20 to 40 year old males as the result of personal assault, falls, or motorized vehicle accidents<sup>1</sup>.

The aim of fracture management is to obtain a bone function as close to the pre fracture state as possible. Absolute stability is the main criteria of fixation which aids in direct bone healing. Now a days titanium plates are widely used for rigid fixation due to advances in skeletal stabilization techniques. Although these devices are reliable because of their strength and skeletal stability<sup>2</sup>, they also have potential disadvantages. These include bone atrophy, palpability, loosening, temperature sensitivity, infections, and interference with radiation therapy and imaging<sup>7</sup>. Migration of metal particles to adjacent tissues and regional lymph nodes has also been shown<sup>1,2</sup>the disadvantage is that it might ultimately require reoperation for removal of metal plates and screws.

All the potential complications can be avoided by usingresorbable materials. They could provide sufficiently rigid fixation to allow for satisfactory bone healing, with the additional advantage of elimination by the body. Titanium or steel osteosynthesis was used routinely for treatment of mandibular fractures. However, material-related major disadvantages led to the search for biocompatible systems of osteosynthesis<sup>9</sup>. Resorbable materials were used in maxillofacial surgery, initially in craniofacial surgery and then in the treatment of mandibular fractures and orthognathic surgery<sup>3</sup>.

Although hundreds of techniques were advocated in the literature, most are variations of bandages and external appliances; extraoral and intraoral appliances; monomaxillary wiring, including bars, monomaxillary splints, and intermaxillary wiring and splints; guides or glides; and internal fixation, including wires, plates, and screws<sup>2</sup>.

Several studies presented disadvantages of titanium plates like delayed healing, infections and nonunion. Kelly and Harrigan<sup>10</sup> reported that most common site of a nonunion was in the body of the mandible. Melmed and Koonin<sup>15</sup> had 20 cases of nonunion resulting from 909

fractures of the mandible (2.2%). They believed that alcoholism, delay in seeking treatment, and carious teeth contributed to the problems of management and complications. The prospective study of James et al<sup>11</sup> showed delayed union (no clinically evident union after 8 weeks) in 9 of 253 patients (3.5%) and nonunion in 3 patients (1%). Of the delayed unions, four were in the angle, four were in the body, and one was in the symphysis. Moore et al<sup>12</sup> found a nonunion rate of 1.8% in 56 patients with 100 mandibular fractures. Bernstein and McClurg<sup>19</sup> reported delayed union in 5 of 156 patients with mandibular fractures. Chuong and Donoff<sup>14</sup> defined delayed union as mobility of the fracture site after 5 weeks of treatment with maxillo-mandibular fixation. Using this rather strict criterion, they found that delayed union occurred in 12 (3.1%) of 372 mandibular fractures. No cases of nonunion were reported. Haug and Schwimmer<sup>12</sup> reported 32 cases of fibrous union in 714 patients. These all studies used the traditional titanium plates for treatment of mandibular fractures.

This study was designed to assess the impact of resorbable plates in mandibular fractures in adults. If the resorbable materials have same stability and strength in mandibular fractures, then the disadvantages of titanium could be avoided by using resorbable plates and if proved beneficial, it would be used in future.

### **MATERIALS & METHODS:**

### Study subjects:

This is a longitudinal study conducted over a period of eight months (15<sup>th</sup> September 2012 to 14<sup>th</sup> May 2013) in Department of Oral & Maxillofacial Surgery, Nishtar Institute of Dentistry Multan. Inclusion criteria of the study was patients reporting to Nishtar Institute of Dentistry with only mandibular fracture having step deformity and radiolucent or radiopaque line at fracture site requiring open reduction and internal fixation. Patients from both genders were included with age range 16-25 years. Exclusion criteria of the study was patients having systemic conditions which increase the risk of potential complications with open reduction and internal fixation surgery like diabetes mellitus, patients whose age

contraindicates the open reduction and internal fixation i.e. 6–12 years, patients having gross comminution of mandible as a result of extensive facial injuries, primary bone disorders like rickets and pathological fracture of mandible. Study was approved bythe ethical review board of Nishtar Institute of Dentistry and informed consent was obtained from all participants.

# Study population & study protocol:

After evaluation on basis of inclusion / exclusion criteria, Seventy three patients (73) were enrolled for the current study from Department of Oral & Maxillofacial Surgery. These patients were evaluated according to standard guidelines of fracture examination and radiographs (OPG, PA view of face) were taken to confirm the diagnosis wherever indicated. Resorbable plates and screws were used for patient treatment and the follow up visit was scheduled after six (6) weeks. On follow up, patients were again evaluated in detail for signs of wound healing based on step deformity, infection or radiolucency.

# *Clinical evaluation & treatment:*

All fractures were treated with intraoral open reductions approach and internal fixation under general anesthesia. It the teeth in the line of fracture show mobility, tooth root fracture, apical pathology, were non-restorable, or interfere with the reduction of the fractures or occlusion, they were extracted.Before making incisions, intra-operative antibiotics were given intravenously.

A 2.5-mm non compression resorbable plate was selected. After adequate plate adaptation, the plates were fixed with 2.5 mm resorbable screws with lengths ranging from 6 to 12 mm. After the screws were placed to secure the plate and the fracture(s) were adequately reduced, the occlusion was checked for discrepancies and stability. The mucosal incisions were closed with vicryl 3/0 sutures in a horizontal mattress fashion. The patient was placed into maximum intercuspation and intermaxillary fixation with elastics. There was no need of intraoral/ extraoral drains. After open reduction and internal fixation surgery, intermaxillary fixation

# SURGICALLY INDUCED ASTIGMATISM

### was removed 2 weeks.

Postoperative care included cefazolin 1 g intravenously every 8 hours or clindamycin 600 mg intravenously every 8 hours, and pain medication as necessary. Patients were advanced as tolerated to a full liquid diet that was continued after discharge for 8 weeks. After that, patients were given oral antibiotics for 7 days with chlorhexidine mouth rinse for 7 days. Final assessment was made after six weeks on the basis of occlusion, mobility at the fracture site and infection by Consultant Maxillofacial Surgeon having at least 3 years post fellowship experience. The fracture was considered as healed if the occlusion was normal and there was no mobility and infection at the fracture site.

# Statistical Analysis:

Descriptive statistics were applied to calculate mean and standard deviation for age of the patients. Frequencies and percentages were calculated for categorical variables like gender, type of fracture, healing (occlusion, mobility at the fracture site and infection). Effect modifiers like age, gender, etiology and type of fracture were controlled by stratification. P value less than 0.05 was considered significant. Data was entered and analyzed in statistical program SPSS version 20.0.

# **RESULTS:**

This study was conducted on 73 patients (n=73) having fracture of the mandible. The mean age of the patients was  $21.1\pm2.9$  years and age range was 16-25 years. Half of the patients 37(50.7%) were in age bracket of 21-25 years and rest half 36(49.3%) were in 16-20 years (Table 1).Regarding the gender of patients, 63 patients were males and the male: female ratio was 6.3: 1. (Table 2)

History of patients showed that road traffic accident was the major etiological factor in fracture of the mandible in 62 (84.9%) patients followed by interpersonal violence in 8 (11%) patients. Fracture due to falls 1 (1.4%) and sports injury 2 (2.7%) contribute a little in etiological factors. (Table 3)

Keeping in view the site of mandibular fracture, 32(43.8%) patients had parasymphyseal

fracture followed by 10(13.7%) having symphyseal fracture while 8(11%) patients were having fracture in body of the mandible and 23(31.5%) had fracture in angle. (Table 4)

After six weeks of treatment, follow up checkup showed normal occlusion in 65(89%) patients, no sign of infection in 71(97.3%) patients and no mobility in 65(89%) patients (Table 5). In 64 (87.7%) patients required healing was achieved but in 9 (12.3%) patients it was not healed. (Table 6)

Regarding the genders and age groups, fracture healing was comparatively good in age group of 16-20 years and in male gender as compared to females. (Table7)Keeping in view the etiology and sites of fracture, patients having sympheseal fracture showed good outcome (Tables8-9)

# Table 1: Age Distribution of the Patientswith Mandibular Fracture (n=73)

Age (in years)	No. of Patients	Percentage (%)
16 20	36	49.3
21 25	37	50.7
Total	73	100.0

# Table 2: Etiology in Patients withMandibular Fracture

Cause	No. of Patients	Percentage (%)
Road traffic accident	62	84.9
Falls	1	1.4
Sports	2	2.7
Interperson al violence	8	11.0
Total	73	100.0

# SURGICALLY INDUCED ASTIGMATISM

# Table 3: Final Assessment of Patients withMandibular Fracture

Parameter (at 6 weeks)	No. of Patients	Percentage (%)
Normal Occlusion	65	89.0
Negative Infection	71	97.3
Negative Mobility	65	89.0

# Table 4: Age Distribution in relation toOutcome of Treatment

Age (in years)	Total No. of Patients	No. of Patients Healed after Treatment
16 20	36	33
21 25	37	31

# Table 5: Gender Distribution in Relation toOutcome of Treatment

Gender	Total No. of Patients	No. of Patients Healed after Treatment	Percent age (%)
Male	63	56	88.9
Female	10	8	80.0

# 145

Males Efemales

Figure 1: Gender Distribution of the Patients with Mandibular Fracture



# Figure 2: Type of Fracture in Pakistan with Mandibular Fracture



# Figure 3: Outcome of Treatment in Pakistan with Mandibular Fracture

# **DISCUSSION:**

Healing of the fractured bone with restoration of form and function is the primary goal of fracture management. The overall management of fractures must include minimizing infection, malunion, soft tissue breakdown, and technical challenges.

Fracturesmust be managed carefully not only to maintain the function of the mandible but also to re-establish proper occlusion, and minimize

### SURGICALLY INDUCED ASTIGMATISM

secondary complications. Normally, surgeons attempt to achieve four main outcomes while treating mandibular fractures: anatomic reduction, immobilization, prevention of infection and rehabilitation of function<sup>20</sup>.

The most effective method of rigid fixation which is associated with minimal morbidity and early mobilization and return to work is open reduction and internal fixation with plate and screws. Usually titanium plates and screws have been used for fixation<sup>12</sup>. Between 18-35% of these plates are subsequently removed due to complications such as loosening.

Bioabsorbable plates are now available as an alternative to metal plates. The potential advantage of using resorbable plates is that the reoperation rate to remove titanium plates that develop complications would be greatly reduced. Pattern of fracture, technical errors, lack of prophylactic antibiotics, mobility at fracture site and non compliance of patient are considered the predisposing factors for infection<sup>13</sup>.

In present study, majority of the patients 37(50.7%) were between 21-25 years of age. Mean age of the patients was  $21.1\pm2.9$  years. Male to female ratio was 6.3:1. Road traffic accident was the major cause of fracture of mandible evident in 62 patients (84.9%) followed by interpersonal violence in 8 patients patients (11%).32 (43.8%) had parasymphyseal and 10 patients (13.7%) had symphyseal fracture of mandible. Six week follow up showed normal occlusion in 65 patients (89%), no infection in 71 patients (97.3%) and no mobility in 65 patients (89.0%). Outcome of treatment showed 64 patients (87.7%) with healed fracture while in 9 patients (12.3%) fracture did not heal. These results are comparable with national and international literature.

Regarding the gender, the most affected was the male in many studies<sup>11,12</sup>. but according to Ueeck et al<sup>18</sup> it is the female gender. The high ratio of males in our country might because less participation of females in the outdoor and social life, driving and sport activities. According to a study showed the complication rate of using resorbable fixation was approximately 22.5 %. While the average complication rate of titanium plateranges from 13.7% to 43%<sup>22</sup>. These statistics advocate the use of bioresorbable

# SURGICALLY INDUCED ASTIGMATISM

polymers as a secure replacement to titanium fixation.

Bryan Bell and Craig Kindsfater<sup>26</sup> andBayat M et al<sup>36</sup> conducted studies where patients received biodegradable plates and screws. Satisfactory healing was observed in almost all patients withfavorable restoration of form and function. Ylikontiola L et al<sup>31</sup> and José Lacet de Lima et al experienced that SR-P(L/DL)LA 70/30 plates and screws are reliable for internal fixation of anterior mandibular fractures in adults. During the follow-up, no problems were encountered except for 1 case where a plate became exposed intraorally and infected requiring debridement and later excision of the exposed part of the plate.

Takahiro Suzuki et al<sup>28</sup> and Cox T et al<sup>29</sup> found all patients with fractured mandibular condyles with anatomic good reduction and better stability because of resorbable miniplates and screws in their study. They concluded that the PLLA miniplate system provides reliable stability when used for the fixation of mandibular condylar process fractures.

Krach et al<sup>30</sup> suggested that bioresorbable fixation plates can be used in mandibular fractures in circumstances where a perfect alignment of repositioning is a guaranteed result. Previous studies that used poly-Llactic/polyglycolic acid copolymer fixation in orthognathicsurgery provided uncomplicated bone and overlying soft tissue healing<sup>29,30</sup>.

Authors comparing resorbable plates and screws with titanium plates found it equally good for treatment of mandibular fractures. Yu-SeokAhn et al<sup>18</sup> Turvey TA et al<sup>19</sup>. andHyo-Bin Lee et al<sup>11</sup>. had the same opinion about the efficacy of resorbables.

While Bayram B et al,<sup>36</sup>.Esen A et al,<sup>37</sup> andDorri M et al<sup>38</sup> favoured using titanium plates instead of resorbables for fixation of mandibular fractures. Although resorbable plates are new in routine usage, they continue to improve in quality, flexibility, and ease of application.

# REFERENCES

 Yeluri R, Baliga S, Munshi AK. Malunited fracture of the body and condyle of the mandible : A Case Report. Contemp Clin Dent. 2010 Jul;1(3):186-9.

- Arvind RJ, Narendar R, Kumar PD, Venkataraman S, Gokulanathan S. Maxillofacial trauma in Tamil Nadu children and adolescents: A retrospective study. J Pharm Bioallied Sci. 2013 Jun;5(Suppl 1):S33-5.
- 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 Jan;2(1):28-32.
- Proffit WR, Turvey TA, Phillips C. The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension. Head Face Med. 2007;3:21.
- Alpert B, Seligson D. Removal of asymptomatic bone plates used for orthognathic surgery and facial fractures. J Oral Maxillofac Surg. 1996 May;54(5):618-21.
- Jorgenson DS, Mayer MH, Ellenbogen RG, Centeno JA, Johnson FB, Mullick FG, et al. Detection of titanium in human tissues after craniofacial surgery. Plast Reconstr Surg. 1997 Apr;99(4):976-9; discussion 80-1.
- Meningaud JP, Poupon J, Bertrand JC, Chenevier C, Galliot-Guilley M, Guilbert F. Dynamic study about metal release from titanium miniplates in maxillofacial surgery. Int J Oral Maxillofac Surg. 2001 Jun;30 (3):185-8.
- Matthews NS, Khambay BS, Ayoub AF, Koppel D, Wood G. Preliminary assessment of skeletal stability after sagittal split mandibular advancement using a bioresorbable fixation system. Br J Oral Maxillofac Surg. 2003 Jun;41(3):179-84.
- Bhatt K, Roychoudhury A, Bhutia O, Trikha A, Seith A, Pandey RM. Equivalence randomized controlled trial of bioresorbable versus titanium miniplates in treatment of mandibular fracture: a pilot study. J Oral Maxillofac Surg. 2010 Aug;68(8):1842-8.

SURGICALLY INDUCED ASTIGMATISM

- 10.Kelly DE, Harrigan WF. A survey of facial fractures: Bellevue Hospital, 1948-1974. J Oral Surg. 1975 Feb;33(2):146-9.
- 11.Singh JK, Lateef M, Khan MA, Khan T. Clinical study of maxillofacial trauma in Kashmir. Indian J Otolaryngol Head Neck Surg. 2005 Jan; 57(1):24-7.
- 12.Zweig BE. Complications of mandibular fractures. Atlas Oral Maxillofac Surg Clin North Am. 2009 Mar;17(1):93-101.
- Terris DJ, Lalakea ML, Tuffo KM, Shinn JB. Mandible fracture repair: specific indications for newer techniques. Otolaryngol Head Neck Surg. 1994 Dec;111(6):751-7.
- 14.Chuong R, Donoff RB, Guralnick WC. A retrospective analysis of 327 mandibular fractures. J Oral Maxillofac Surg. 1983 May;41(5):305-9.
- 15.Haug RH, Schwimmer A. Fibrous union of the mandible: a review of 27 patients. J Oral Maxillofac Surg. 1994 Aug; 52(8):832-9.
- 16.Oikarinen K, Korpi J. [Management of facial bone fractures]. Duodecim. 2010;126(6): 703-11.
- 17.Agarwal S, Gupta A, Grevious M, Reid RR. Use of resorbable implants for mandibular fixation: a systematic review. J Craniofac Surg. 2009 Mar;20(2):331-9.
- 18.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.
- 19.Fordyce AM, Lalani Z, Songra AK, Hildreth AJ, Carton AT, Hawkesford JE. Intermaxillary fixation is not usually necessary to reduce mandibular fractures. Br J Oral Maxillofac Surg. 1999 Feb;37(1):52-7.
- 20.Kuhlefelt M, Laine P, Suominen-Taipale L, Ingman T, Lindqvist C, Thoren H. Risk factors contributing to symptomatic miniplate removal: a retrospective study of 153 bilateral sagittal split osteotomy patients. Int J Oral Maxillofac Surg. 2010

May;39(5):430-5.

- 21.Qudah MA, Bataineh AB. A retrospective study of selected oral and maxillofacial fractures in a group of Jordanian children. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002 Sep;94(3):310-4.
- 22.Ba X, Wang H, Tian W, Liu L, Li S. [Analysis of 413 cases of mandibular fractures]. Hua Xi Kou Qiang Yi Xue Za Zhi. 1999 Feb;17(1): 46-8.
- 23.Ueeck BA, Dierks EJ, Homer LD, Potter B. Patterns of maxillofacial injuries related to interaction with horses. J Oral Maxillofac Surg. 2004 Jun;62(6):693-6.
- 24.Ferretti C. A prospective trial of poly-Llactic/polyglycolic acid co-polymer plates and screws for internal fixation of mandibular fractures. Int J Oral Maxillofac Surg. 2008 Mar;37(3):242-8.
- 25.Bell RB, Kindsfater CS. The use of biodegradable plates and screws to stabilize facial fractures. J Oral Maxillofac Surg. 2006 Jan;64(1):31-9.
- 26.Bayat M, Garajei A, Ghorbani K, Motamedi MH. Treatment of mandibular angle fractures using a single bioresorbable miniplate. J Oral Maxillofac Surg. 2010 Jul;68(7):1573-7.
- 27.Ylikontiola L, Sundqvuist K, Sandor GK, Tormala P, Ashammakhi N. Self-reinforced bioresorbable poly-L/DL-lactide [SR-P(L/DL)LA] 70/30 miniplates and miniscrews are reliable for fixation of anterior mandibular fractures: a pilot study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2004 Mar;97(3):312-7.
- 28.Suzuki T, Kawamura H, Kasahara T, Nagasaka H. Resorbable poly-L-lactide plates and screws for the treatment of mandibular condylar process fractures: a clinical and radiologic follow-up study. J Oral Maxillofac Surg. 2004 Aug;62(8):919-24.
- 29.Cox T, Kohn MW, Impelluso T. Computerized analysis of resorbable polymer plates and screws for the rigid fixation of mandibular

# SURGICALLY INDUCED ASTIGMATISM

angle fractures. J Oral Maxillofac Surg. 2003 Apr;61(4):481-7; discussion 7-8.

- 30.Ahmed W, Ali Bukhari SG, Janjua OS, Luqman U, Shah I. Bioresorbable versus titanium plates for mandibular fractures. J Coll Physicians Surg Pak. 2013 Jul;23(7): 480-3.
- 31.Edwards RC, Kiely KD, Eppley BL. Resorbable fixation techniques for genioplasty. J Oral Maxillofac Surg. 2000 Mar;58(3):269-72.
- 32.Edwards RC, Kiely KD, Eppley BL. Fixation of bimaxillary osteotomies with resorbable plates and screws: experience in 20 consecutive cases. J Oral Maxillofac Surg. 2001 Mar;59(3):271-6.
- 33.Ahn YS, Kim SG, Baik SM, Kim BO, Kim HK, Moon SY, et al. Comparative study between resorbable and nonresorbable plates in orthognathic surgery. J Oral Maxillofac Surg. 2010 Feb;68(2):287-92.
- 34.Turvey TA, Bell RB, Phillips C, Proffit WR. Self-reinforced biodegradable screw fixation compared with titanium screw fixation in mandibular advancement. J Oral Maxillofac Surg. 2006 Jan;64(1):40-6.

35.Lee HB, Oh JS, Kim SG, Kim HK, Moon SY,

Kim YK, et al. Comparison of titanium and biodegradable miniplates for fixation of mandibular fractures. J Oral Maxillofac Surg. 2010 Sep;68(9):2065-9.

- 36.Bayram B, Araz K, Uckan S, Balcik C. Comparison of fixation stability of resorbable versus titanium plate and screws in mandibular angle fractures. J Oral Maxillofac Surg. 2009 Aug;67(8):1644-8.
- 37.Esen A, Ataoglu H, Gemi L. Comparison of stability of titanium and absorbable plate and screw fixation for mandibular angle fractures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Dec;106(6):806-11.
- 38.Dorri M, Nasser M, Oliver R. Resorbable versus titanium plates for facial fractures. Cochrane Database Syst Rev. 2009(1): CD007158.

25.02.2015
30.09.2015

When this world favors somebody, it lends him the attributes, and surpassing merits of others and when it turns its face away from him it snatches away even his own excellences and fame.

Live amongst people in such a manner that if you die they weep over you and if you are alive they crave for your company.

# Hazrat Ali (Karmulha Wajhay)