

## USE OF MINIPLATES WITH BICORTICAL SCREWS FOR INITIAL STABILIZATION AND LATER BRIDGING BY BONE GRAFT FOR CONTINUITY DEFECTS OF MANDIBLE DUE TO BLAST INJURIES

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### ABSTRACT

**Objective:** Mandibular continuity defects reconstruction using miniplates is advantageous in many respects viz-a-viz convenience, contour & free from many of the donor site morbidities. This study evaluated the role of miniplates in continuity defect reconstruction of mandible due to blast injuries followed by bone graft.

**Methodology:** The study was conducted in the Department of Oral and Maxillofacial Surgery at Sardar Begum Dental College, Gandhara University, Peshawar from Jan 2011 to Jan 2014. Through a descriptive case series a total of 44 patients of blast injuries having mandibular continuity defects were recruited in the study. Miniplates with bicortical screws were used for functionally stable fixation of continuity defect fracture. One week and one month follow up was done. The decision to graft the site was taken at one month and grafting was done. Patients were put on follow up for upto 3 months post- surgery after grafting.

**Results:** Mean age of the sample was 27.02 + 5.2 years. 95.5% of patients presented were below the age of 35 years. There were 86.4% males and 13.6% females. 68.2% patients presented with fracture of the body of mandible. 13.6% of patients developed surgical site infections that were further put on antibiotics after culture and sensitivity test for recovery for another three weeks. Bone graft was applied on all patients and another follow up was done for 3 months out of which 13.6% patients developed surgical site infection.

**Conclusions:** Functionally stable fixation of mandibular continuity defects using miniplates with bicortical screws and MMF not only provides good stability but is also safe method for initial management of mandibular continuity defects. This can safely be followed up by bone grafting without the need for removal of hardware used in the initial surgery.

**Key words:** Mandibular Fractures, Miniplates, surgical site infection, bone graft, blast injuries.

### INTRODUCTION

Injuries to the face represent a complex set of challenges to the surgeon. They can result from assault, suicide attempts, falls, RTA's, accidents, or bomb blasts<sup>1</sup>. Bomb blast injuries are common in our part of the world. Fire arm injuries can be high-energy and low energy. High-velocity projectiles can result in devastating functional and esthetic consequences shattering

the hard tissues<sup>2</sup>. Timing of surgical intervention is still controversial<sup>3</sup>. Standard treatment modalities include aggressive early primary reconstruction versus delayed staged reconstruction. Fire arm injuries frequently involve mandible<sup>4</sup>.

Surgical management of facial fire arm wounds is basically divided into three stages: (1) debridement, fracture stabilization, and primary closure; (2) reconstruction of hard tissues, provided soft tissue coverage is adequate; and (3) rehabilitation of the oral vestibule, alveolar ridge, and secondary correction of residual deformities and dental implants<sup>1</sup>. After initial wound debridement and removal of the comminuted and crushed parts of the osseous tissue, the reconstruction plates are usually applied that rigidly stabilize the

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mandible. Mandibular plate reconstruction offers the advantages of (1) lack of donor site morbidity, (2) expediency, (3) excellent mandibular contour<sup>5</sup>. However it is expensive and soft tissue perforation are the disadvantages for reconstruction plate. Furthermore they are required to be replaced if hard tissue reconstruction has to be done at 2nd stage, necessitating graft fixation with miniplates, thereby increasing the costs. Reconstruction plates provide rigid fixation to the mandible that can be alternatively achieved using miniplates with bicortical screws<sup>7</sup>. Later the segmental defect can be replaced with non vascularized iliac bone graft or rib graft<sup>8</sup>. This can be done without the need of application of new hardware at the stage. Our aim in this study is to evaluate the role of miniplates and bicortical screws in the treatment of mandibular fractures due to blast injuries before the bone graft can be applied.

## METHODS AND MATERIALS

This was a descriptive case series study and was conducted in the department of Oral & Maxillofacial Surgery of Sardar Begum Dental College, Gandhara University, Peshawar from Jan 2011 to Jan 2014. All patients presenting with history of bomb blast and fire arm injuries and having continuity defect of the mandible at any site were enrolled in the study. The diagnostic criteria set for inclusion was continuity defect of the mandible (on X ray) and with adequate soft tissue and skin to provide primary closure were included in the study. Patients with soft and hard tissue defect requiring composite grafts, patients with comorbidities like diabetes mellitus, heart failure, hepatic failure, mandibular symphysis fracture of more than 50mm and patients who were immunocompromised were not included in the study. After cleaning and debriding the wound and minimizing loss of vascular intact tissue, miniplates were applied with bicortical screws initially (FIGURE 2). The surgery was done under general anesthesia and patient was kept under observation for another 3 days in the ward. Once stabilized, all the patients were sent home on standard antibiotic therapy for 10 days. Follow up was advised at one week and one month post op. At 1 month post op, decision to graft was taken in absence of infection and in presence of good occlusion grafting was done. The surgical site infection was detected on the basis of redness at surgical site, pain, fever and purulent

discharge from the site and confirmed by culture of microbes in the laboratory. Those patients who didn't develop the surgical site infection were further subjected to bone graft and those patients who developed surgical site infection underwent Culture & sensitivity test & appropriate antibiotics advised, which in most cases were third generation cephalosporins. All patients were put into MMF for six weeks. The grafts were either costochondral or taken from the iliac crest. All the patients were advised for follow up at 2 weeks, 4 weeks, 6 weeks and at 03 months post grafting. At 6 weeks MMF was removed. Graft uptake was confirmed by lack of infection & serial radiographs and in some cases bone scintigraphy.

## RESULTS

The study was conducted on a total of 44 patients presenting with mandibular fractures due to blast injuries. The mean age group in this study was 27.02 + 5.25 years with 95.5% patients in the age group less than 35 years and 4.5% above 35 years as shown in Table-1. Of the sample, 86.4% were males and 13.6% were females. The details of the site distribution are given in Table-2. According to the site distribution 68.2% of patients presented with fracture body of the mandible, 22.7% with fracture angle of the mandible and 9% with symphysis fracture. On follow up, surgical site infection was observed in 13.6% patients (Table-3). Those patients who developed surgical site infection were subjected to antibiotic therapy after culture and sensitivity for another three weeks before bone graft was applied. Out of 44 patients subjected to miniplate fixation 15.9% failed to produce successful occlusion and were subjected to maxillomandibular fixation for 4 weeks to produce occlusion (Table-4). After successful recovery, bone graft was applied to those patients as well as patients who did not develop any infection at the surgical site. The common sites chosen for bone graft were iliac crest in 77.3% of patients and costochondral rib graft in 22.7% of patients (Table-5). After applying the graft, all the patients were sent back home on standard medication and another follow up was advised after 03 months. After 03 months, surgical site infection was observed in 6 (13.6%) of patients (Table-6).

The surgical site infection after miniplates and after bone graft were stratified among age groups where no statistically significant difference was found ( $p=0.124$  for infection after miniplate fixation and

p=0.168 after bone graft) (Table-7). Stratification was also done for infection after miniplates with regards to gender and site of fracture and infection after bone graft with regards to gender, site of fracture and type of graft used. No statistical difference was found for those variables with regards to infection. (Table-8 and

**Table-1: Age wise distribution**

Age group in years	Frequency	Percent
Up to 25	21	47.7
25 to 35	21	47.7
35 and above	2	4.5
<b>Total</b>	<b>44</b>	<b>100.0</b>

**Table-2: Site of fracture wise distribution**

Site of fracture	Frequency	Percent
Body of Mandible	30	68.2
Angle of the Mandible	10	22.7
Symphysis of mandible	4	9.1
<b>Total</b>	<b>44</b>	<b>100.0</b>

**Table-3: Surgical Site Infection after Rigid fixation with Miniplates**

	Frequency	Percent
Yes	6	13.6
No	38	86.4
<b>Total</b>	<b>44</b>	<b>100.0</b>

**Table-4: frequency of Malocclusion after miniplate fixation**

	Frequency	Percent
Yes	37	84.1
No	7	15.9
<b>Total</b>	<b>44</b>	<b>100.0</b>

**Table-5: Type of Bone Graft Used**

	Frequency	Percent
Iliac Crest	34	77.3
Costochondral rib graft	10	22.7
<b>Total</b>	<b>44</b>	<b>100.0</b>

**Table-6: Surgical Site Infection after Bone Graft**

	Frequency	Percent
Yes	6	13.6
No	38	86.4
<b>Total</b>	<b>44</b>	<b>100.0</b>

**Table-7: Age wise stratification of surgical site infection after miniplate fixation**

		Infection after 1st surgery		Total
		Yes	No	
Age Groups	Upto 25 years	1	20	21
	25 to 35 years	4	17	21
	35 years and above	1	1	2
<b>Total</b>		<b>6</b>	<b>38</b>	<b>44</b>
Chi-Square Tests				
	value	df	asymptotic sig. 2 sided	
Pearson	4.172 <sup>a</sup>	2	.124	

**Table-8: Gender and type of graft used wise stratification of surgical site infection after miniplate fixation**

Background Variables	Pearson Chi Square		
	Value	df	Asymp Sig. 2-sided
Gender	.054 <sup>a</sup>	1	.816
Site of Fracture	3.242 <sup>a</sup>	2	.198

**Table-9: Gender, Site of fracture and type of graft used wise stratification of surgical site infection after Bone Graft**

Background Variables	Pearson Chi Square		
	Value	df	Asymp Sig. 2-sided
Gender	.054 <sup>a</sup>	1	.816
Site of Fracture	.978 <sup>a</sup>	2	.613
Type of Graft Used	.445 <sup>a</sup>	1	.505

Table-9 respectively).

## DISCUSSION

Internal fixation of the fractures means the application of hardware (e.g plates, wires) directly to the bone surface for stabilization of fracture fragments. It can be rigid and non-rigid depending upon various factors<sup>9</sup>. Miniplates mostly used with monocortical screws for fixation of fractures in craniomaxillofacial region provide functionally stable fixation, a fixation neither rigid nor non rigid but stable enough to provide mandible function without MMF<sup>9,10,11</sup>. Continuity defects however require more rigid forms of fixation for stability and function. Mandible defects resulting from pathology or trauma are stabilized by reconstruction plate as a standard treatment<sup>12,13</sup>. Large plate and screw size, fracture, plate exposure, screw loosening, infection, bulky mandible contours, wider periosteal

stripping/ exposure and difficulty in adaptation to the mandible are the disadvantages of the reconstruction plate<sup>12</sup>. In a study conducted by Shaw RJ et al<sup>14</sup> in 2004 comparison of miniplate with reconstruction plate was done for reconstructing mandibular defects showing no significant difference in rate of complication by miniplates or reconstruction plates. In a study conducted on animals, two miniplates with bicortical screws for mandible defect reconstruction provided sufficient amount of rigidity comparable to reconstruction plates and did not have the potential problems associated with the reconstruction plate<sup>12</sup>.

This study was carried out in view of increasing local conflicts, more influence of terrorism in our area and high influx of patients with facial trauma today as compared to the past. As mentioned earlier, the rate of infection after miniplate fixation and after the bone graft was observed in 13.6% of patients. In our study, a preliminary fixation was done with miniplates and bicortical screws for 1 month.

In a series reported by Neupert and Boyd<sup>15</sup> an infection rate observed after subjecting patients to external pin fixation was 27% and of them; 18% developed malocclusion. However, literature suggested that most of these infections are caused by loosening of the plates<sup>16</sup>. Dingman and Natvig et al<sup>17</sup>, reported surgical site infection in 13% cases, while Newlands et al<sup>18</sup> reported this in 10% cases. However, Neupert and Boyd<sup>15</sup> reported an infection rate of 27% with ORIF treatment, which is a high rate. Motamedi<sup>19,20</sup> reported a 20% infection rate.

Fixation of mandibular continuity defects with reconstruction plates have a variable outcome, the reported complications rate ranges from 7 to 69%<sup>13,21-24</sup>. Exposure of the hardware is most frequent complication associated with reconstruction plate reported in literature<sup>21,24</sup>. Moderately low success has been reported with miniplates, (34% to 64%)<sup>25</sup>.

Before applying methods of functionally stable fixation using miniplates with bicortical screws, preference was usually given to closed reduction techniques because of adverse outcome with open reduction involving internal wire fixation. That is why many cases developed infection and high rate of nonunion of fractures<sup>26,27</sup>. It is also pertinent to mention here that in the present study, 15.9% of patients developed malocclusion despite fixation with rigid wire. The malocclusion is a major problem when its time for bone

graft as exact approximation of bone is required for good outcome. We used MMF to fix the malocclusion before applying bone grafts. Rana et al<sup>28</sup> found MMF to be less time-consuming, technically easier to perform with a lower incidence of post-operative pain and less postoperative care was required along with shorter hospitalizations. Okoturo et al<sup>29</sup> reported occlusion problems as a most common adverse event in 23.3% patients. Smith and Johnson<sup>16</sup> reported 4.1% malocclusion in their series. Baumash<sup>26</sup> reported no malocclusion in their study however; a closed method of reduction was used in their study.

Proper positioning of the mandible helps establish the proper facial structure and in framing the face. Poor arch placement can lead to incorrect framing for the remainder of the reconstruction<sup>20</sup>. The placement of miniplates with bicortical screws help in maintaining the occlusion and it also further promotes reconstruction of facial structure<sup>30-32</sup>. Miniplates are often utilized in cranium and midface but larger (2.4mm) may be required for fixing the mandibular defects<sup>33,34</sup> and help in maintaining the continuity of the mandible<sup>19</sup>. Once stabilized, mandibular continuity defects need to be bone grafted<sup>24,35,36</sup>. In our study, iliac crest was the most common site of obtaining bone graft followed by costochondral grafts. The same is also reported in the literature with iliac crest being most commonly utilized bone graft and followed by rib and cranium depending upon the nature of the defect<sup>19,20,37,38</sup>.

## CONCLUSIONS

This study established that the use of miniplates with bicortical screws for initial stabilization of mandibular continuity defects with or without MMF followed by use of same hardware for bone graft fixation is a viable option for mandibular continuity defects reconstruction. Moreover it reduces the cost incurred traditionally where initially a reconstruction plate & later miniplates are used in such injuries. Both methods have similar infection rates. Further studies are encouraged to establish the fact.

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