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Incidence of Plate Removal and its Correlation to the Site of Injury in Patients with Maxillofacial Trauma: A Retrospective Study

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Abstract

Background: Maxillofacial injuries can be classified according to its anatomical location of the involved bone and by the degree of involvement like simple, compound or comminuted. Regardless of the site of involvement and nature of trauma the fracture can be addressed by closed and open methods of reduction. **Objective**: The aim of this retrospective study was to record the incidence and factors associated with plate removal in patients with maxillofacial trauma. **Materials and Methods:** Records of 280 cases managed for maxillofacial trauma in the last (5 years) period from January 2010 to Dec 2014 by open reduction and internal fixation (ORIF) with osteosynthesis plates were analyzed at a tertiary health care facility. Logistic regression analysis was done to find an association between the variables studied and incidence of plate removal. **Results:** 32 cases (11.42%), 55 number of implants underwent removal of plates due to reasons ranging from infection(50%), Plate exposure(9.375%), treatment failure(15.625%), palpability(12.50%), and persistent pain(12.50%), Zygomatic buttress and Parasymphysis sites had highest incidence of plate removal compared to other sites. Being a female [OR 9.87(4.21–10.72)], age groups of 46-60 [OR 6.39(4.43-9.62)], 31-45 [OR 11.25(6.81-13.77)] and 15-30 [OR 10.01(5.74-12.22)], infra orbital rim among sites [OR 2.03 (1.48-4.67)] significantly increased the odds of incidence of plate removal. **Conclusion:** In our retrospective analysis, the overall incidence of plate removal was 11.42%. Maximum plate removals were from Zygomatico-Maxillary Buttress and Symphysis and Parasymphysis regions. Infection was found to be the most common cause of plate removal.

Keywords: Infection, Plate Removal, Palpability, Malunion, Treatment Failure

1. Introduction

Maxillofacial injuries can be classified according to its anatomical location of the involved bone and by the degree of involvement like simple, compound or comminuted. Regardless of the site of involvement and nature of trauma the fracture can be addressed by closed and open methods of reduction. Since the introduction of small plate osteosynthesis by Champy *et al.*[1], open reduction and internal fixation of the fractures of maxillofacial skeleton are commonly practiced to achieve optimal result and early return to function. Various types of fixation materials have been used for fixation of maxillofacial skeleton[2–5]. Titanium plates are compatible with investigation procedures like Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) scan[2,6]. The commercially pure titanium is preferred because of its biocompatibility[7,8]. However, the fixation systems sometimes are required to be removed[9]. Common causes for removal of plates are infection, persistent pain,

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subcutaneous palpability, and failure of treatment. In the present study we have analyzed 280 cases of maxillofacial trauma treated at a tertiary health care facility so as to record the incidence and factors associated with implant removal in patients with maxillofacial trauma treated with open reduction and internal fixation.

2. Material and Methods

The study was conducted in a tertiary care facility from Jan 2010 to Dec 2014. A total of 280 cases of maxillofacial trauma treated by open reduction and internal fixation were analyzed. This is a retrospective study and due ethical permission has been taken from the ethical committee.

Inclusion Criteria

Both the male and female patients between the age group of 15–75 years who underwent removal of plates were included in the study. There was no restriction on the type of fracture, number of fractures per patient to be included.

Exclusion Criteria

Patients treated with resorbable plates and lag screws and patients treated with closed reduction were excluded from the study. Patients who were on medications for Hypertension, Diabetics and immunocompromised were also excluded from the study.

3. Method

All cases were operated by the same team. The selected cases were operated under general anesthesia or local anesthesia with sedation. The implants were exposed through the existing scar. The bone plates and screws were removed, curettage done and wound sutured. Standard post op protocol was followed. All the cases were followed for a period of six months post operatively. In cases of treatment failure such as malunion and nonunion implants were removed, fracture site retreated with reconstruction plate.

4. Principles of Fixation

The type of implants used for mandibular fractures were 2mm miniplates with 2mm diameter screws of varying length, while for midface fractures, 1.5mm miniplates with 1.5mm diameter screws of varying lengths were used. 2 or 3 point fixation was followed for ZMC fractures, depending upon the case. For 2-point fixation, plates were fixed at Zygomatico-maxillary buttress and frontozygomatic suture, in case where fracture stability was not achieved even after 2-point fixation, plating was done at infra-orbital rim. For symphysis and Parasymphysis fractures, 2 miniplates were used.

5. Statistical Analysis

Logistic regression analysis was done to assess the association between incidence of plate removal and various factors in patients with maxillofacial trauma. A p-value less than or equal to 0.2 in the bivariate analysis was considered statistically significant for the parameters to be considered in the multivariate analysis. A p-value of 0.05 was considered statistically significant in the multivariate regression analysis.

6. Results

A total number of 280 cases which were operated during the period of five years (268 males and 12 females) were evaluated out of which 32 cases were selected for removal of implants. 32 patients (26 males and 06 females) out of 280 cases were included in the study. The average age of the patients was 35.5 years. There was no case of panfacial injury. None of the patients had any co-morbidities. Patients were taken up for implant removal after 6 months to 1 year of primary surgery due to infection, pain at the surgical site, exposure of the plate, palpability of the plate, pain after treatment or treatment failure such as malunion or nonunion (Graph 1). The anatomical sites from where the plates were removed are Fronto-zygomatic region (04), Infraorbital rim (05), Zygomatic buttress (12), Symphysis and Parasymphysis regions (11). Of the 11 cases of mandibular fractures, 10 cases were single fractures while 1 case was of multiple fractures (bilateral parasymphysis fracture). There were 2 cases of comminuted mandibular fractures.

The age group distribution of 32 cases is given as follows: Table 1.

Incidence of plate removal

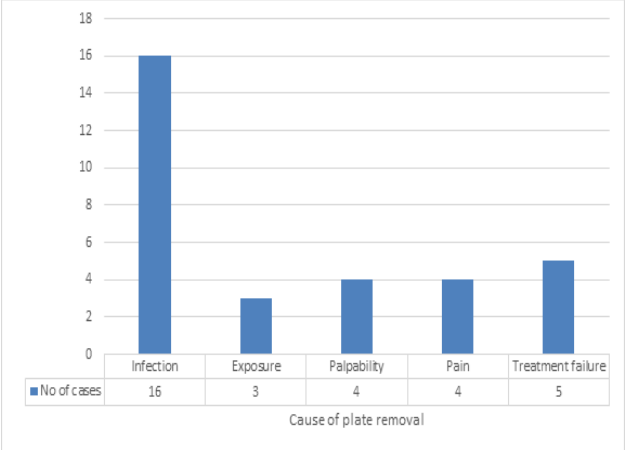
Zygomaticomaxillary buttress (13.95%) and Parasymphysis sites (12.5%) had highest incidence of plate removal compared to other sites.

Percentage of plate removal Infra orbital had high plate removal percentage (19.23%) when compared to the number of open reduction and internal fixations done amongst the mentioned anatomical sites. Fronto-zygomatic (FZ) site (11.11%) had lowest plate removal percentage. No plates were removed from orbital floor, frontal, and subcondylar fracture sites Table 2.

Results of the bivariate and multivariate analysis through logistic regression between the variables studied and incidence of plate removal Table 3.

Table 3 shows that when bivariate analysis was done, there was a significant association between gender, reason for plate removal (infection), age group and site of plate removal (infra-orbital rim) and incidence of plate removal. Being a female [OR 8.47(3.12–10.92)], infection being a reason for plate removal [OR 1.24(1.04-3.74)], age groups of 46-60 [OR 6.09(4.83-10.24)], 31-45 [OR 11.37(7.14-14.97)] and 15-30 [OR 10.11(5.14-12.78)], infra orbital rim among sites [OR 1.96(1.24-4.35)] significantly increased the odds of incidence of plate removal.

Multivariate analysis, when adjusted for all the variables included from the bivariate analysis having a p-value of less than or equal to 0.2 show a statistically significant association between gender (females), age group, site of plate removal (infra-orbital rim) and incidence of plate removal. Being a female [OR 9.87(4.21–10.72)], age groups of 46-60 [OR 6.39(4.43-9.62)], 31-45 [OR 11.25(6.81-13.77)] and 15-30 [OR 10.01(5.74-12.22)], infra orbital rim among sites [OR 2.03 (1.48-4.67)] significantly increased the odds of incidence of plate removal.



Graph 1. Causes of plate removal.

Table 1. Age group distribution

15 – 30 yrs	31-45 yrs	46- 60 yrs	61-75 yrs
11	12	08	01

Table 2. Percentage of plate removal

Site	Fronto zygomatic region	Infraorbital rim	Zygomatic buttress	Symphysis and parasymphysis regions	Condylar and subcondylar regions
Total cases	36	26	86	88	44
No of plate removal	04	05	12	11	--
	11.11%	19.23%	13.95%	12.5%	--

Table 3. Logistic regression analysis to assess the association between incidence of plate removal and various factors in patients with maxillofacial trauma

Variables	Plate removal		Unadjusted OR (95% CI)	p value[a]	Adjusted OR (95% CI)	p value[b]
1. Gender	Yes	No				
Males	26	242	1.00 (ref)	$p < 0.001$	1.00	$p < 0.001$
Females	06	06	8.47(3.12–10.92)		9.87(4.21–10.72)	
2. Reason for plate removal						
Treatment failure	5		1.00 (ref)	$p < 0.2$	1.00 (ref)	p =0.35
Pain	4		0.84(0.47-1.83)		0.74(0.38-1.69)	
Palpability	4		0.83(0.51-1.42)		0.81(0.49-1.34)	
Exposure	3		0.71(0.59-1.58)		0.64(0.41-1.54)	
Infection	16		1.24(1.04-3.74)		1.21(1.11-3.87)	
3. Age group						
15 – 30 years	11		10.11(5.14-12.78)	$p < 0.01$	10.01(5.74-12.22)	$p < 0.005$
31 – 45 years	12		11.37(7.14-14.97)		11.25(6.81-13.77)	
46 – 60 years	08		6.09(4.83-10.24)		6.39(4.43-9.62)	
61 – 75 years	01		1.00 (ref)		1.00 (ref)	
4. Site of plate removal	Yes	No				
Condylar and sub-condylar region	00	44	1.00 (ref)	p =0.15	1.00 (ref)	$p < 0.05$
Fronto-zygomatic region	04	32	1.75 (0.97-3.49)		1.71 (0.85-3.73)	
Infra-orbital rim	05	21	1.96 (1.24-4.35)		2.03 (1.48-4.67)	
Zygomatic buttress	12	74	1.44 (0.71-3.43)		1.31 (0.65-3.41)	
Symphysis and parasymphysis region	11	77	1.65 (0.62-2.40)		1.61 (0.59-2.48)	

a- Results of bivariate binary logistic regression analysis; $p < 0.20$ considered significant,
b- Results of multivariate binary logistic regression analysis; $p < 0.05$ considered significant
OR- Odds Ratio, CI – Confidence Interval

7. Discussion

Miniplate fixation for the treatment of maxillofacial fractures has multiple advantages. It offers semi rigid fixation. On completion of radiological union of fracture after six months the fixation device has no role to offer. Due to poor tissue response Ni-cad and stainless steel plates are routinely recommended for removal. Interference in investigation like MRI, CT scan are the factors for concern. However, titanium implants are superior to others in terms of biocompatibility and radiological compatibility.

The indication of plate removal is Infection, and wound dehiscence. In our study there were cases of palpability, infection, pain, pressure symptoms in whom plates were removed. Infection cause had a significant association with incidence of plate removal.

The anatomical sites for plate removal did not have any relationship to the site. In our study the most common site of plate removal are Zygomatic buttress, Symphysis and

parasymphysis regions. The incidence of plate removal had a significant association with infra-orbital rim anatomical site Compared to George R and Abdulaziz A in their study had told that there was maximum incidence of plate removal in the mandible[18,19].

Iizuka and Lindqvist routinely removed stainless steel plates about a year postoperatively[10]. In our study it was after a period of six months post operatively the plates were removed as none of the patients were symptomatic before that time. Brown *et al.*[11] challenged the practice of routine removal of stainless steel miniplates 3 or 4 months after insertion. Moberg *et al.*[12] recommended removal of nickel-chromium and cobalt-chromium alloy implants after satisfactory healing, because metal elements released from the surface could induce allergic sensitization. However, it has been suggested that titanium and titanium alloys are suitable for use as permanent maxillofacial implants because their biocompatibility is superior to that of stainless steel[2,13]. In our study all cases were treated only with titanium plates and screws. Rosenberg *et al.*[14] removed titanium miniplates only if the patient had symptoms, or due to infection or wound dehiscence. Our policy was to remove plates only if indicated. Symptomatic patients underwent removal of plates in our study.

Our retrospective study aimed at establishing a link between the anatomical site of fracture and incidence of plate removal. The overall rate of plate removal was 11.42%. The main cause of removal of plates was infection which was similar to other reported studies[15,16].

The location of plates on the facial skeleton may also influence symptoms and subsequent internal fixation removal[17]. Brown *et al.*[11] reported that there was no relationship between the site of the plates and their survival. The presence of plates in the parasymphysis and zygomatic buttress region was a high risk factor for plate removal in our study. The plate removal from these sites amounted to be 21.81% compared to the total incidence. Other studies have reported 57% to 79.8% of plate removal from the mandible[18,19].

8. Conclusion

All the patients were treated with biocompatible Ni Ti plates and screws. The Incidence of plate removal can be minimized by taking the above mentioned factors in to consideration. It also depends on the immune factor of the patient and patient acceptability which varies from individual to individual. In our retrospective analysis, the overall incidence of plate removal was 11.42%. Maximum plate removals were from zygomatico-maxillary buttress and symphysis & parasymphysis regions. Infection was found to be the most common cause of plate removal. However still more number of cases to be studied for a longer duration of followup for better results.

9. Compliance of Ethical Standards

Funding: No funding received

Conflict of Interest: Authors declares they have no conflict of interest. Ethical Approval "All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards."

Informed Consent: Informed consent was obtained from all individual participants included in the study.

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