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Removal of Titanium Miniplates In Isolated, Unilateral, Non Comminuted , Displaced , Zygomatic Complex Fracture Cases

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Abstract: *Purpose: We sought to conduct prospective study on patients who had titanium miniplates inserted during treatment of ZMC fracture and to study the incidence and factors associated with plate removal.*
Patients and Methods: During a period of 2 years, 64, 2mm titanium miniplates plates were inserted in zygomaticofrontal suture (ZF) and zygomaticomaxillary (ZB) buttress region for isolated unilateral displaced non comminuted ZMC fracture into 32 patients over follow up period of 4 years. Data concerning indications of plating, age and sex distribution, site of plating, time between injury and plate insertion, time between plate insertion and removal, antibiotic prophylaxis, general medical factors and clinical conditions for plate removal were evaluated for all patients.
Results: During follow up period, one plate was removed from female patient, within eight weeks after insertion, from ZB region purely due to plate related symptoms with dehiscence and infection being cause for its removal, accounting for 1.56% of the plates removed.
Conclusion: Longitudinal follow up at 4 years indicates that number of miniplates removed was small but not insignificant and are likely tobe removed in the first year after insertion. The low rate would seem to imply that routine removal of miniplates is not clinically indicated.

Keywords: *complications, removal, rigid fixation, titanium miniplate, trauma*

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I. Introduction

Titanium miniplates have been used for osteosynthesis in oral and maxillofacial region for over 50 years. It has been suggested that they are suitable as permanent implants because the biological compatibility of titanium is superior to that of other metallic fixation devices.[1, 2] Although the initial proponents of these plates suggested removal within 3 months of insertion, no specific reasons were provided.[3, 4] There is evidence in the literature of the excellent tissue compatibility and high corrosion resistance of titanium and its alloys and the lack of support for the routine removal of titanium miniplates.[5]

However metallic fragments have been found in adjacent tissues that may lead to chronic, inflammatory response or to immune reactions.[6, 7] Weingart et al also found that titanium plates release fine particles, which reach the regional lymph node, but without causing any signs of inflammation or foreign body reaction.[8]

In the past there are hardly any studies conducted to screen the incidence of plate removal and prognosis of titanium miniplates in unilateral, isolated, displaced, non comminuted ZMC fracture in particular. Therefore, this prospective study examines the indications for removal of miniplates from patients who had plates inserted after being treated for 2 point fixation of zygomaticomaxillary complex (ZMC) fracture at frontozygomatic suture (FZ) and zygomaticomaxillary buttress region (ZB).

II. Patients And Methods

All patients who had undergone miniplate fixation following ZMC fracture in the department of oral and maxillofacial surgery between January 2011 and March 2013 were followed for complications. The inclusion criteria were adult patients with unilateral, isolated, displaced, non comminuted ZMC fracture with definite indication for open reduction and fixation and subject willingness. The exclusion criteria were patients with systemic disease contraindicating general anesthesia, comminuted fracture of orbital floor requiring reconstruction, patients with history of previous zygomaticomaxillary complex fractures or osteotomies involving the mid face.

The titanium miniplates used in this study were standardized to a miniplate with 2.0 mm diameter holes and 2mm thickness. The FZ suture was stabilized with 4holes with gap and ZB region was stabilized with L

shape 4 holes with gap miniplate. Infraorbital rim and zygomatic arch fracture (if present), was elevated and reduced through intraoral approach without plating.

All patients had been given preoperative, intraoperative and postoperative antibiotics. The follow up period was 4 years. The age and sex of the patients, general medical factors, indications of plating, the number and the site of the plates involved, the interval between injury and plate insertion, the interval between plate insertion and plate removal and clinical conditions for plate removal were evaluated for all patients. The reason for plate removal was recorded based on the patient's report of symptoms, the surgeon's clinical assessment and radiographic data.

The clinical conditions for plate removal were categorized as follows:

1. Infection and / dehiscence: clinical evidence of infection, i.e., swelling, increasing pain, purulent discharge, wound breakdown (dehiscence). As infection is the usual cause for wound breakdown, all cases of dehiscence were included in this category, although microbial evidence was not established in the patient.
2. Pain: in the absence of any clinical or radiographic evidence of infection.
3. Denture position: where the position of the plate interfered with the wearing of the prosthesis.
4. Screw or plate failure: radiographic evidence of fracture of plate or screw loosening, in the absence of infection.
5. Palpability: plates or screws becoming palpable and causing discomfort to the patient and removed at their request.
6. Heat/ cold intolerance
7. Dental or nerve damage
8. Reconstructive / growth facilitation: plates removed during secondary reconstructive procedures and during the management of new facial fractures.[9]

III. Results

During the 2 year study period, 32 patients underwent open reduction and internal fixation (ORIF) with 2 point fixation at FZ and ZB region using 2mm titanium miniplates for isolated unilateral displaced non communited ZMC fracture. FZ area was approached extraorally by lateral eyebrow incision and ZB region along with zygomatic arch fracture if present, was approached through buccal vestibular sulcus incision intraorally.

In the study group, 84.4% were male and 15.6% females, aged between 21 to 50 years , with peak age of incidence being 30.94 years. In the study sample 68.8% (n = 22)patients had fracture of ZMC alone and 31.3% (n =10) of the patients had fracture of ZMC along with zygomatic arch. None of the patients were noted to have significant underlying medical condition which may have lead to compromised immunity, such as diabetes mellitus, steroid therapy, immune disorders etc. The mean duration from initial trauma to definitive fixation (IT-DF Interval) in the patients was 2.56 days and no hardware complication was reported intraoperatively. Postoperatively one patient developed soft tissue infection in the buccal vestibular incision in the first week which was managed with intravenous antibiotics and surgical drainage. The plate was removed in the eighth week as it was exposed. Later the wound healing was satisfactory and reduction was found stable even after removal of plate. Removal of one plate was performed in a young healthy female patient (1.56%) of the total number of cases over 4 years follow up period because of purely plate related symptoms. One plate was removed out of 32 plates from ZB region (3.12%). Plate survival analysis did not show any significant effect with seniority of the operator on overall survey.

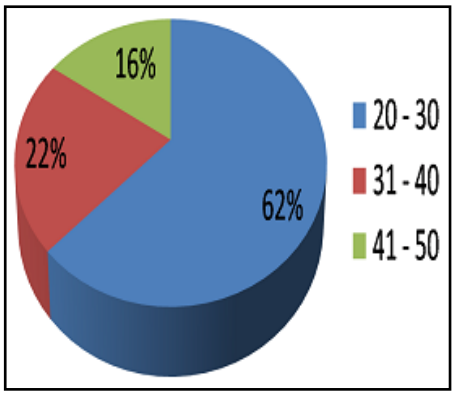

Fig 1 Mean age of patients in study group

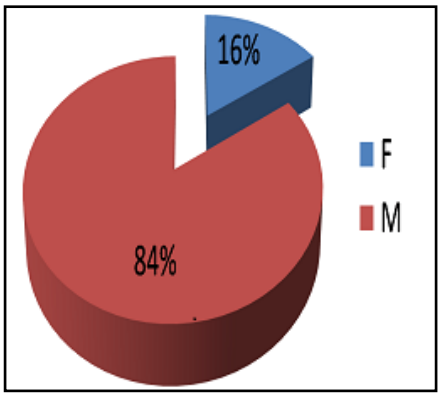

Fig 2 Gender distribution of patients in study group

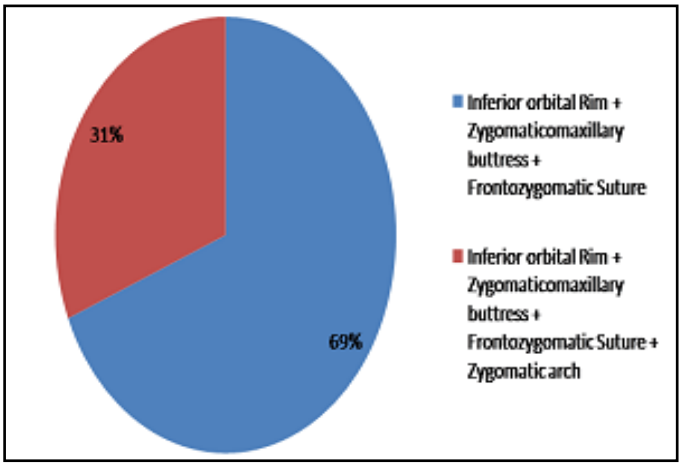

Fig 3 Distribution of site of fracture

IV. Discussion

The study considers the clinical indications for removal of miniplates following their placement in isolated unilateral displaced isolated non comminuted ZMC fracture. In 1991, the Strasbourg Osteosynthesis Research Group recommended that the removal of a non functional plate is desirable provided that the procedure does not cause undue risk to the patient.[10]

Most surgeons believe that, there is less risk in leaving symptomless plates in situ than in removing them and there is yet no consensus among surgeons on the need for routine removal of titanium miniplates. It is a routine policy in most units not to remove miniplates following bony union, but to remove them only when clinically indicated.[2, 11, 12]

The mean age group in our study was 30.94 years. Hence age group of our study confirmed with study of Adekeye O.E, who found that out of 337 Nigerian patients with zygomatic complex fractures, 80% were between age group of 21 and 40 years.[13] The increased incidence of ZMC fractures in this age group appears to be there because; it is this age group which is most commonly involved in rash driving and inter personnel violence.

Our study sample consisted of 32 patients out of which 84.4% of the patients were male and 15.6% were females. This observation was confirmed with the study carried out by Ellis et al, who reported 80.2% of incidence of male predominance. [14]

Researchers have claimed that anatomical reduction of displaced fragments is easily accomplished before the onset of early bone healing and that delayed treatment might necessitate refracture or osteotomy for the movement of displaced skeletal segments.[15] The duration taken between initial trauma occurring to the patient to the definitive fixation provided by the surgeon is referred as the IT-DF Interval. Richard et al, in their studies evaluated IT-DF intervals and found that they ranged from 1 – 22 days.[15] We agree with an early operation and hence in our study, the mean IT-DF Interval in our study was 2.56 days, which allowed the edema to diminish, allowed for palpation of step deformity and provided easier manipulation of bones and soft tissue. Hence, the referral pattern and speed of our trauma centre to address to ZMC fractures was far superior and aided in achieving primary repair and avoided delayed repair. Further, Chen et al noted that an early operation is better than a conservative or delayed operation.[16] and Champy et al also recommended early placement of miniplate to prevent infection.[17] Whereas other studies stated that delay in treatment has little effect on the survival of the miniplate.[12, 18, 19]

The location of plates on the facial skeleton may influence symptoms and hardware removal.[20] Francel et al found that infection and exposure were common in mandibular plates and ZB plates.[21] Hence we evaluated the correlation between reason for removal and site of plate insertion. Francel et al and Islamoglu et al claimed that the close approximation of ZB region to anterior wall of antrum may lead to screw loosening, bone resorption, granulation tissue formation and even inflammation.[20, 22] The presence of maxillary sinusitis or close vicinity of ZB plate to infected maxillary posterior teeth will further complicate the situation and lead to infection of miniplate. The plate might also dehisce owing to severe comminution of underlying fractured bone. In converse to above studies, only one plate out of 32 plates in ZB region was removed in our study group. Brown et al reported that there was no relationship between the site of the plate insertion and their survival.[12]

Considering the time that the plates remained in situ before removal, one plate out of 64 plates was removed within 8 weeks of insertion in our study. The total removal rate was 1.56%. But this rate can vary with the severity of trauma and location of fracture. Brown et al found no plates that had been in situ for more than 30 months needed removal.[12]

In previous studies they found that, plate survival is affected as age at insertion increased. Some studies have reported increased rates of removal above the age of 30 years.[12, 23] In converse in our study, we had to remove a plate from a young healthy female patient of 25 years with good oral hygiene at ZB region, within 8 weeks of insertion.

Factors influencing removal of miniplates are old age related issues, general condition of patient, whether accompanied with adverse habits such as smoking, drug abuse, alcohol intake and poor oral hygiene. Maxillary sinusitis, size, shape and composition of implants, site of implantation, purity of implant material, tissue reaction, secondary trauma in the same region, non union or malunion also play significant role in plate removal.[24]

In literature, reasons quoted for removal of miniplates are; non union, loosening of plates and screws, removal at the time of secondary procedures;[25] (Secondary surgeries may include substitution with heavy plates ,extraction in nearby region, incorporation of dental implants and corrective surgery for post trauma deformity); local tissue reaction leading to edema, patient request because of anxiety of metallic plate in facial region, dislodgement, extrusion ; deformation of the miniplate,[26] ; pain, wound dehiscence, infection, interference with denture position, screw or plate failure;[27] hypersensitivity, palpability, mal union and migration.[28]

Unpleasing consequences of removing miniplates are; esthetic problem if removed from extraoral approach, diet restriction until the wound heals if approached intraorally, cost ineffective as the patient has to bear the secondary surgical expenses, leads to demoralization of patient and might lead to apprehension, non union or malunion of fracture site if removed before initial healing phase and scar contracture.

Eppey BL quoted that the widespread availability of resorbable miniplates and screws made it possible to have rigid fixation without permanent hardware and that, it was of particular significance in the paediatric population.[29] He also concluded that shelf life of hardware of resorbable systems is limited and cost is significantly higher. Additionally, they are thicker than their equivalent – strength titanium counterparts which increases the potential risk of overlying soft tissue coverage.[29] These factors have ensured that titanium is still the most widely used material for craniofacial trauma osteosynthesis.

The seniority and experience of the operator at initial plate insertion was studied as a possible factor affecting rates of plate removal. The study did not show any significant difference in these groups with regard to rate of plate removal.

V. Conclusion

The ZB region was the area from which plate had been removed due to dehiscence. The number of miniplates removed from ZB region was small. This suggests that placement of plates at these sites carries a low risk for subsequent removal and is clinically not indicated as routine protocol. Age did not play a critical role in leading to plate removal in our study. Operator seniority is not a significant factor in plate survival. Removal of plates does not mean failure of the treatment as union may have occurred former to removal, or may occur consequent to removal of plates. Our current practice is to only remove miniplates from unilateral isolated displaced non comminuted ZMC fractures treated with two point fixation, only when they are symptomatic.

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