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RESEARCH ARTICLE

EVALUATION OF EFFICACY OF MICROPLATES IN THE MANAGEMENT OF ZYGOMATIC COMPLEX FRACTURES - AN OBSERVATIONAL STUDY

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ABSTRACT

Background: The maxillofacial trauma is a more tedious and esthetically challenging surgeries till date. Microplates are materials which help us to achieve this both technically and esthetically with less obstacles. They take the maxillofacial trauma to the next level. **Objectives:** To evaluate the efficacy of Micro plates in fixation of Zygomatico- Complex fractures (Fronto Zygomatico Suture, Zygomatico Maxillary Buttress and Infra Orbital Rim). **Materials and Methods:** Study sample consists of 14 subjects with Zygomatico- Complex fractures, above 18 years of age. Microplates were used for fracture fixation. Intraoperatively - operating time, Hardware failure (screw breakage) was noted. Postoperatively - Stability of fracture fragments, Infection, Pain & Need for plate removal was noted. All cases have been evaluated clinically for various parameters for minimum of 3 months to assess any postoperative complications. **Results:** Total number of microplates used in the study is 29. Among them 14 were fixed in Fronto Zygomatic Suture area, 12 were fixed in Zygomatico Maxillary Buttress area and 3 were fixed in Infraorbital Rim area. The mean operation time per patient was 46.19 minutes. The time taken for placement of one screw was highest in the zygomatico maxillary buttress region (80.00 secs.). One screw fractured in Fronto Zygomatic Suture region & two screws in Zygomatico Maxillary Buttress. There was no screw breakage in Infra Orbital Rim region. One screw loosened while placement in Zygomatico Maxillary Buttress region. Post-operative pain present during first week reduced to 0% within one month. One patient needed for plate removal. **Conclusion:** The overall results demonstrated a success rate of zygomatico complex fractures. Infra Orbital Rim had the highest success rate of 100.00%. This study using microplates had given promising results, hence may be considered as a valid tool in the management of zygomatico complex fractures.

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INTRODUCTION

Maxillofacial trauma by their nature, impart emotional, and physical trauma to patients. The anatomy of the craniofacial skeleton is complex, the facial skeletal components articulate and interdigitate in a complex fashion [Naveen Shankar, 2012]. Fractures of zygomatico – orbital region are the most common in the maxillofacial practice. These fractures usually occur just at suture lines or in the thinner bones with which the zygoma articulates, and less often through the zygoma itself. The successful management of maxillofacial fractures remains a challenge for the oral and maxillofacial surgeon, demanding both skill and expertise in the treatment plan [Thomas, 2000] Trauma to the midface involves the maxilla, the zygoma, orbit and the naso orbital-ethmoid complex [Gassner, 2003].

Hans Luhr was the first to produce microsystem. The advantages of using microplates are eliminating potential nerve damage through minimal contact and simultaneous surveillance of reduced fracture stability after its fixation^[4] The microsystem has a good place in craniofacial surgery in infancy, provided that it is not used excessively, avoiding growing and expanding zones and that plate removal some months after surgery is considered. Hence these microsystem should be part of armamentarium of the reconstructive oral and cranio-maxillofacial surgery. Hence they are used in maxillofacial region [Clauser, 1999] Use of the microsystem, provide adequate fixation systems, should not be considered just a type of osteosynthesis, but rather as part of an up-to-date reconstructive surgical procedure Self-tapping screws are used for the placement of microplates [Clauser, 1999; Laughlin, 2007; Haerle] .

Microplates are very thin and can provide a rigid fixation in the fracture site. Miniplates disadvantage include the time taken for manipulating the miniplates for fracture adaptation, increased thickness and plate palpability [Zachariades, 1998; Mittal, 2011; Wu, 1998] is of concern, which can be overcome by using microplates. The purpose of this study was to evaluate the efficacy of microplates for clinical applications in fixation of midface fractures (Zygomatico maxillary complex)

Aims and Objectives: The aim and objective of this observational study were to evaluate the efficacy of microplates in the fixation of Zygomatic-maxillary complex fractures by assessing clinical and radiographic assessment of the stabilization of fracture segments, intra-operative determination of the ease of handling (Time taken for procedure) and recording of specific intra-operative technical challenges like screw breakage (Hardware Failure) & assessment and recording of post-operative complications such as infection, pain & cause for plate removal.

METHODOLOGY

The study sample consists of 14 subjects based on the stability of fracture segment from the key article was derived (14 males), from the Department of Oral and Maxillofacial Surgery, Indira Gandhi Institute of Dental Sciences, Pillayarkuppam, Pondicherry. Patients with midface fractures referred to the department of OMFS from the year December 2015 to June 2017. The age of patients ranged from 20 to 55 years. The ethical committee approval was obtained (IGIDSIEC2016NDP06PGTGOMS) before proceeding with the study. It includes patients who are willing for this study with complex zygomatic fractures & above 18 years of age. Patients with concomitant head injury seeking emergency treatment, medically compromised patients, patients with comminuted fractures & severely infected fractures are excluded from the study. Informed consent was signed by the patient after explaining the study to them. Sample sheet enclosed both in English and in the vernacular language (The use of human subjects in this study was reviewed and approved by Institutional Ethical Committee).

All cases were treated by the same surgeon under general anesthesia with naso-tracheal intubation using same armamentarium. Under strict aseptic precaution, surgical site was prepared with povidone-iodine. The oral cavity was irrigated with povidone-iodine solution. The surgical site was isolated using sterile drapes. Local infiltration at the fracture site was given using 2% lignocaine with 1:2,00,000 concentration of adrenaline for vasoconstriction. The incision required will clearly depend upon the level of fracture and associated problems of the orbital, nasoethmoid, frontal and zygomatic regions for the complete exposure of all fracture sites. periosteal stripping of the facial skeleton is carried out, which reveals the extent of the comminution, displacement and dislocation of the bony segments. In zygomatic maxillary complex fractures stabilization was done using titanium microplate (Jayon Implants NS-EN ISO 13485:2012 a Norwegian Accreditation MSYS 002) at the Frontozygomatic Suture area. Additional fixation was done at the Infraorbital Rim or intraorally at Zygomaticmaxillary region) area depending on the requirement of fracture stabilization. The extra oral sites were closed using 3-0 vicryl and 4-0 prolene(Ethicon).

Intraoral sites were closed using 3-0 vicryl (Ethicon). Post-operatively all patients were followed with same antibiotics and analgesics. (Figure 1-6)

Method of evaluation: All cases have been followed up for minimum of 3 months. Parameters evaluated were based on AAOMS parameters:

Assessment was made with relevant radiographs 37° occipitontal views (paranasal sinus view) of operated site for monitoring stability- 1st week, 1st month and 3 months postoperatively. All cases have been evaluated clinically for following six parameters as described in the case performa.

- **Operating time:** The time taken for fixation of each individual plate was recorded.
- **Hardware failure:** Screw fractures are noted. This defines the technique sensitivity in using microplates.
- **Stability of fracture fragments:** The post-operative segmental mobility was assessed as follows: No mobility, minor mobility & grossly mobile.
- **Infection:** Signs and symptoms of infection included the presence of erythema, edema or purulent discharge over the fracture site.
- **Pain:** Evaluated by using a scale of no pain, mild pain, moderate pain, severe pain.
- **Plate removal:** Need for plate removal is evaluated by prominence of plate and patient request.

Statistical analysis (subsection):“Data were expressed as percentage, mean and standard deviation . Statistical significance level was defined at P = 0.05.”

RESULTS

A total of 14 patients were evaluated using SPSS software version 17. Data were expressed in percentage, mean and standard deviation. In our study, the minimum age of the patient was 20 years and maximum was 50 years, with a mean age of 38.8 years (Table 1).

Table 1. Age wise distribution of sample

Age in Years	No. of patients
20-30 years	7 Patients
31-40 years	6 Patients
41-50 years	1 Patient

Table 2. Distribution of Zygomatic Complex fracture according to site

Site	Total number of patients
Zygoma	10 Patients
Maxilla	3 Patients
Infra Orbital rim	1 Patient

All the patients were males and there were no females in the study .Zygomatic-maxillary complex was the only site of fracture involved in evaluating the microplates. Distribution of fracture was also noted (Table 2). Total number of microplates used in the study is 29. Intra-operative evaluation parameters of microplate placement are recorded. Among the 29 microplates, 14 were fixed in FZS area, 12 were fixed in ZMB area and 3 were fixed in IOR area (Figure 1). The overall intra-operative parameters include operating time and hardware failure.

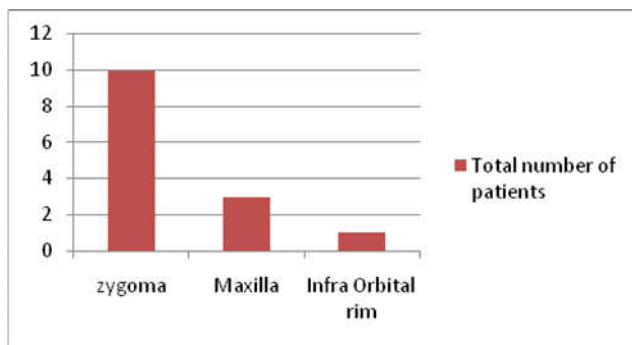
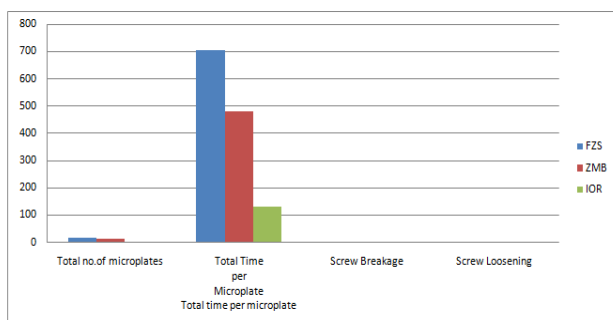
Table 3. Intra-operational evaluation of microplates & screw properties

Area	Total Number of Microplates	Total Time per Microplate	Screw Breakage	Screw Loosening
FZS	14	703.17	1	0
ZMB	12	481.45	2	2
IOR	3	131.53	0	0

Table 4. Postoperative evaluation – parameters

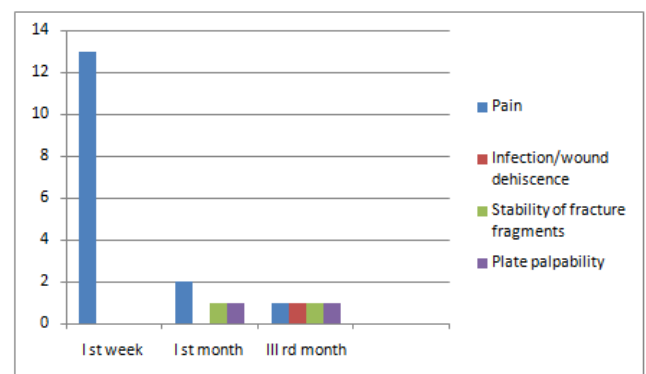
Assessed parameters	I ST week	I ST month	III RD month
Pain	13	2	1
Infection/wound dehiscence	0	0	1
Stability of fracture fragments	0	1	1
Plate palpability	0	1	1

The time taken for placement of microplates was noted (Table 3). The lowest time taken for microplate fixation was 28.05 seconds in the frontozygomatic region. The highest time taken for a microplate fixation was 80.00 seconds in the zygomatico maxillary buttress. (Figure 2) The mean operating time per patient is 46.19 minutes with a standard deviation of 12.26. The follow-up duration for the patients included in the study was three months. One screw fractured in FZS region (7.1%) & two screws in ZMB (7.1%) which were recorded as intra-operative parameters for hardware failure (Table 3). There was no screw breakage in IOR region. Two screws loosened while placement in ZMB region (Figure 2).

**Figure 1. Total number of patients****Figure 2. Intra-operational evaluation of microplates & screw properties**

Postoperatively, all the patients were evaluated at first week, first month and three months intervals. In the first week, three patients had moderate pain (21.4%), one patient had no pain and ten patients had mild pain (71.4%). In the first month follow up, twelve patients had no pain (85.7%), one patient had mild pain (7.1%) and one patient had moderate pain (7.1%). After three months, thirteen patients had no pain (92.9%), one patient had mild pain (7.1%) (Table 4).

The results clearly demonstrate good analgesic protocol post-operatively. None of the patients had immediate inflammatory reactions to microplates after surgery, any signs of infection, purulent discharge, wound dehiscence or any need for removal during the first week and first month (100%), but one patient developed pain and had a mild infection (7.1%) in the microplate which was fixed in the ZMB region also led to plate removal. The following week due to patient's compliance (discomfort due to microplate palpability). Segmental mobility of fracture fragments was found in one patient (7.1%) which was present from the first month review in the fracture reduction done in relation to the maxillary zygomatic buttress region of a zygomatico maxillary complex. Due to infection, need for microplate removal was there but the mobility reduced significantly by the end of third month (Figure 3). The overall results of our study demonstrate a good success rate in the treatment. Among these three regions (FZS, ZMB and IOR), IOR was having the highest success rate.

**Figure 3. Postoperative evaluation – parameters**

DISCUSSION

The aim of the treatment of mid face fracture is to accomplish the anatomic and functional restoration of the maxilla in relation to skull base and mandible. Various techniques were used for decades and success of certain extent with each was obtained for midface fracture correction. Forces of mastication are distributed along the fragile air filled pneumatic spaces [Zachariades, 1998]. The fixation of fracture for stability by using microplates was first described by Luhr 1979 but midface it was not possible to have sufficient compression and caused segment displacement. In our study to overcome these technical challenges and better adaptability with use microplates which was proposed by Mitchell in 1995 [Pinczower, 1995; Mitchell et al., 1995]. Titanium microplates is used due to its mechanical properties, malleability and ductility.



Pre-operative photograph



Intraoperative photographs



Postoperative evaluation at 1st Week



Postoperative evaluation at 1st month Month



Postoperative evaluation at 3rd month Month

Eric et al in 1995 suggested that microplates have better fixation even in malar prominence. Schortinghuis J et al has described about various complications which are associated with microplates that was experienced in our study [Schortinghuis, 1999]. Feller in 2002 stated metal usage is minimal in microplates and since the screws were of small diameter, the mechanical anchorage was good with less bony involvement which was consistent with our study. The same was emphasized by Walid Abdullah in 2009. In our case, we had post operative infection in one patient in the third month follow up with plate loosening and segmental mobility in the left zygomatico maxillary buttress region which had to undergo plate removal in the fourth month follow up period since patient insisted on it. Plate palpability was considered as a factor for evaluation on the research by Chris A. Campbell in 2009. In our study, 1 patient had the complaint of plate palpability which was minimal and patient was advised about the time taken for healing and in later visit he was satisfied. Vijay Ebenezer in 2012 found that microplates provide adequate fixation with negligible palpability and minimal thermal conductivity.

Conclusion

We used microplates for fracture fixation in zygomatico maxillary fracture in frontozygomatic suture, infraorbital rim

& zygomatico maxillary buttress region and found acceptable stability of fracture segment with minimal infection and good esthetic outcomes. There were few technical difficulty and intra-operative hardware failure. Of all the segments reduced infra orbital rim had good success rate. Thus we observed that microplates are better in fracture management in midface trauma.

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