Comparative Study Of The Effectiveness Of Microplates And Miniplates In The Treatment Of Maxillofacial Fractures

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Abstract

Introduction:
The increased incidence of face trauma has resulted in the development of new methods for internal fixation, enhancements to plating systems, and innovations in the exposure of facial skeleton, all of which have fueled the fast adoption of internal fixation for the treatment of facial fractures. This study presents the efficacy of microplate in comparison to miniplate by evaluating 40 patients who had confirmed midfacial (Le Fort I and II) and mandibular fractures. The evaluation was done in order to compare the two types of plates in terms of load bearing capacity, stability at the fracture site, and postoperative palpability. The goals of this study are to determine whether or not microplates are more effective than miniplates in the treatment of maxillofacial injuries.

Materials and the Methods:
The study sample consisted of 40 patients, 20 from each of two groups clinically and radiographically diagnosed with either Group 1 (maxillary) or Group 2 (mandibular) fractures. These groups were further separated into 10 subjects each who were treated with miniplate and microplate, respectively. Following surgery, observations were made about the stability of the fracture, the biting force, the need for postop MMF, pain, infection, wound dehiscence, mouth opening, and occlusion, as well as palpability. Every patient has been clinically examined for a minimum of three months using a variety of measures in order to determine any potential postoperative problems.
Results: As a result of our research, we discovered that microplates had sufficient load bearing capability and sufficient stability. Postoperative palpability is reduced because to close adaptation and fewer pieces of hardware, but a bigger sample research with a longer-term follow-up is required before a conclusion can be drawn about its effectiveness in load-bearing fracture sites.

Conclusion: Biting force efficiency, bite force devices, microplates, and miniplates are some of the keywords that may be found here.

INTRODUCTION

Facial trauma has become a sort of societal sickness that is unavoidable in today's world due to the demanding nature of contemporary living, which includes high-speed travel and an increasingly violent culture. No one is immune to this condition.[1] The occurrence of maxillofacial injuries ranges from 17% all the way up to 69%, and this wide range might be caused by a variety of environmental variables, socioeconomic situations, cultural causes, and traffic restrictions, among other possible explanations.[2,3] There are approximately 1.25 million fatalities that occur annually as a result of road traffic accidents (RTAs)[4,5,6]; of these, the frequency of all-terrain vehicle collisions and motor cycle accidents constitute approximately 32%. There are 8% of maxillofacial injuries, and the mean age of the victims is 31 years old. There are more male victims than female victims. [7,8] The choice between open and closed reduction should be made based on the location of the fracture, although the main method of immobilisation is still the maxillomandibular fixation.[9] Nonrigid fixation allows for interfragmentary movement across the fracture line and includes techniques for stabilisation such as intraosseous wiring, interdental bridal wiring, and interdental bridal wiring. However, on occasion, this type of fixation can also result in malunion or nonunion of the fractured bone. [10] Interfragmentary distance under active load may be prevented with the use of rigid fixation, which contributes to overcoming these defects. This comprises compression plates, reconstruction plates, bone plates, lag screws, and arch bars placed over a fracture. [11] Establishing absolute stability across a fracture was the objective of the compression plating systems described by AO. This was accomplished by having the plate itself provide traction in a direction that was perpendicular to the fracture. [12]

Afterwards, Champy et al. improved the approach of Michelet et al. to describe a method of monocortical, small-plate osteosynthesis making use of pliable plates implanted intraorally. This method was called monocortical, small-plate osteosynthesis. [13,14] Microfixation, which Luhr invented, is credited with having a transformative effect on the surgical treatment of maxillofacial fractures (MFFs). [15] It was created with the goal of lowering the bone plate ratio and reducing the amount of hardware in order to make it easier for patients to adapt closely to their fractures. [14,16] Because it is less traumatic to soft tissue, causing minimum tissue interference, resistant to corrosion, has a special design of connecting bars between the plate holes that serves proper contouring that provides 3-dimensional geometric stability, patient comfort on the basis of palpation, and thermal conduction due to the thin cutaneous cover, the use of microplates is considered to be a meaningful shift in the practise. [17,18,19,20,21] This justifies the ability to maintain anatomic apposition of the bone segments, which translates into functional and aesthetic results that jeopardise the fracture stability and the cost of the system. Miniplates, on the other hand, require more manipulation and are associated with a higher likelihood of iatrogenic damage than microplates. Microplates are used for the internal fixation of MFFs because they require less manipulation and have a lower likelihood of iatrogenic damage. [22,23,24]

As a result, we made the decision to carry out a clinical prospective study in order to evaluate the efficacy of microplates over miniplate osteosynthesis in terms of occlusal stability, the stability of the fracture involved, along with the postoperative biting efficiency utilising a bite force device.

MATERIALS AND METHODS

Study sample collection

The study sample consists of 40 patients above the age of 16 years reporting to the Department of Oral and Maxillofacial Surgery, at a teaching dental hospital with confirmed clinically and radiographically diagnosed midfacial or mandibular fractures. Written informed consent was taken from all patients. Ethical clearance was taken from institutional ethical board.

Inclusive criterion

• Patients older than 16 years and younger than 60 years

• Individuals of both sexes as patients

• Patients who have a clinically and radiographically verified diagnosis of a Maxillary-Le Fort I, II fracture or a mandibular fracture of any kind

• Dentate patient.

The criterion for exclusion

• Patients who were adamant about not signing a permission form

• Fracture with comminuted fragments

ASA levels III and IV

• Any fracture of the maxillary or mandibular bones that is non-displaced and does not involve occlusion

• Any fracture to both the maxilla and the mandible in combination.

We examined the patient based on the following parameters:

1. Pain-Visual Analog Scale

2.Occlusion-intercuspation of the molars and canines was seen in this patient.

3.Gnatho dynamometer for measuring the effectiveness of biting force (Axpert-An ISO 9001)

4.Symmetry of the face

5. Infection

6. Plate exposure

7. Opening for the mouth

8. The tangibility of the hardware

9. Swelling

10. Fixation of the maxilla and mandible after surgery is required (MMF)

11. Evaluation using radiographic techniques

After one and three months after surgery, each patient was assessed for their progress.

• Radiographic assessment: reduction of fracture fragment graded on a scale of one to three points

1: Anatomical reduction with a precision

2: occlusions that are somewhat misplaced but still adequate

3: inadequately decreased, which necessitates a second operation

A device that measures the biting force will record it using a bite fork to measure the bite force at both the front and back teeth.

Surgical procedure

After the usual painting and draping of the area, a local anaesthetic was given at the fracture site while the patient was under general anaesthesia with oral or nasal intubation. After making the appropriate incisions, a full thickness flap was then raised, which retracted the surrounding tissues and neurovasculature. In order to maintain a bloodless area while doing the dissection, sometimes cautery was utilised. Following the exposure of the fracture, reduction was performed in the maxilla and/or the mandible. It was possible to acquire sufficient exposure of the fracture segments. There was a diminution in the amount of anatomy. Fixation was achieved by using stainless steel miniplates and microplates, which, depending on the position, were fastened in place with screws of varied sizes and lengths. Betadine and saline were used as the irrigating agents for this region. The wound was closed with 3-0 silk or vicryl, or 5-0 prolene was used in layers if it was necessary to do so. The results were presented in the form of percentages, as well as the mean and the standard deviation. The threshold of statistical significance was established to be P = 0.05.

RESULTS

Forty different patients were examined in all. The types of maxillary and mandibular fractures that were treated with mini/microplates determined the distribution of the study subjects. Group 1A is the Maxilla Miniplate, Group 1B is the Maxilla Microplate, Group 2A is the Mandible Miniplate, and Group 2B is the Mandible Microplate (Microplate). In terms of palpability, statistically significant values were discovered in Group 1B-Microplate of the Maxilla and Group 2B-Mandible of the Mandible (microplate). When the load bearing capacity was tested using a biting force device three months after surgery in all groups, it was negligible in the first month for the microplate groups, which was less compared to the miniplate groups owing to occlusal self-adjustability. (Table 1)

Table 1: Comparison of biting force among patients treated with different treated by maxilla microplate/miniplate

	Maxillary miniplate	Maxillary micro plate	P value
Baseline	87.34± 2.22	105.23 ± 3.45	0.01
One month	133.23 ± 3.45	190.56 ± 4.56	0.00
Three month	202.45 ± 4.54	295.66 ± 4.55	0,00

DISCUSSION

Trauma to the craniofacial region has continued to be a problem in the medical field, adding significantly to the workload in many maxillofacial departments and placing a strain on the limited human and material resources available. [25,26,27,28] The World Health Organization (WHO) has compiled data from a variety of nations, including India, Japan, the United Arab Emirates, Pakistan, Turkey, and Brazil, and found that between 36 and 75 percent of all MFFs were caused by RTA. [29,30,31] Bony segment reduction, stable fixation and immobilisation of fragments, sustaining blood supply, and early function are the four key concepts that are followed by the AO-ASIF recommendations of rigid fixation. These principles provide proper treatment of fractures. [32,33,34,35] Hans Luhr described the clinical indications for the use of microplating systems, which were first presented in Atlanta in November 1987. These clinical indications include nasoethmoidal fractures, infraorbital fractures, frontal sinus fractures, and calvarium restoration. [14,36]

We conducted a study with forty patients, dividing them into two main groups and treating their maxillary and mandibular fractures with either a miniplate or a microplate. The focus of the study was on the load bearing capacity with a biting force device, as well as other parameters including pain, facial asymmetry, occlusion, wound dehiscence, the requirement for postoperative MMF, and mouth opening. The subsequent monitoring lasted for a period of three months. Discomfort continued for all groups, maxilla and mandible, treated with miniplate and microplate in our research. The level of pain remained the same up to the first week after surgery, but then it started to progressively reduce until it was gone by the end of the third month. These groups were compared statistically and there was found to be no discernible difference between them. In a similar vein, Schortinghuis et al. [37] and Lee et al. [38] did not discover any significant differences in the levels of discomfort caused by the use of mini or microplates in their respective research. When facial asymmetry was compared, there was found to be no significant difference, with the exception of one patient who had been treated with a miniplate in the maxilla and who presented with swelling until the first week, which then progressively reduced. There were no cases of facial asymmetry, malar asymmetry, or diplopia that were discovered by Al Sayed, Ozkan, and Cil [39, 40].

Except for two patients who were treated with a miniplate in the maxilla, we did not find any significant values for infection. These patients' infections were controlled with antibiotic treatment and occasional irrigation. Occlusal discrepancy across the groups showed no significant values, with the exception of two patients who had been treated with osteotomy and who were controlled by IMF for three to four weeks after surgery. Sadove and Eppley,[41] Gupta et al.,[42] Xie et al.,[43] Huston and Stassen; [41] Xie et al.; [42] Huston and Stassen; [43] (2016) [44] Anand et al., Abdullah (2009), Ozkan and Cil, and Anand et al.[45] discovered that there was no significant difference between the groups that they studied for fractures treated with microplates in terms of infection and plate exposure. [45] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] Burm et al. (2002), Jack (2005), Abdullah WA (2009), Ahmed et al., and Joon and Burm [50] showed that there was no significant

difference in occlusal discrepancy between the groups that were treated with miniplate and microplate. They came to the conclusion that the use of microplates is permissible as a result of the self-adjustability of occlusion that these plates possess.

Extrusion of the plate was observed in two patients, one in the infraorbital region and the other in the mandibular angle. Both patients had been treated with a miniplate, and the extrusion was managed by removing the miniplate, providing antibiotic coverage, and planning a second surgery using a microplate and MMF, respectively. There were no statistically significant results found for wound dehiscence, the need for postoperative MMF, or mouth opening between the groups, with the exception of one patient who had a mandibular fracture treated with a miniplate, who had wound dehiscence that was managed by irrigation and resuturing. Many researchers, including Haug and Morgan[51], Lee et al., Abdullah (2009), and Ahmed et al., came to the same conclusion: wound dehiscence is lower for microplates than for miniplates. During the follow-ups utilising microplates, Haug and Morgan [52] discovered that there were no occlusal discrepancies in the mandibular angle fracture patients who had also been treated with IMF for microadaptation for a period of six weeks. Both Cawood 1985 and Xie et al. found that condylar fractures and other mandibular fractures treated with microplates had more mouth opening than those treated with miniplates. In our research, we observed that fractures of the maxilla and mandible treated with microplate had much better palpability than fractures treated with miniplate. Due to their near adaptation at the fracture site, Sadove and Eppley Lee et al., as well as Schortinghuis et al., came to the same conclusion that using microplates results in decreased palpability. It was proposed by Mccleod (1992) and Xie et al. that microplates make it easier to make tiny incisions, which in turn results in a lower risk of nerve injury. However, maxillary fractures treated with microplates show relatively adequate biting efficiency, which was measured by a jaw biting force device postoperatively during follow-up until the third month. The load bearing capacity of miniplates in mandibular fractures is comparatively more than that of microplates. It was discovered that the load bearing capacity of microplates was lower than that of miniplates a few weeks after the surgery; however, after three months, a positive correlation was found between the values that presented statistically insignificant differences in terms of load bearing among the groups. Because of the mechanism of muscle splinting at the time of fracture, where selective components of the neuromuscular system activate and deactivate to take forces off of the damaged bone, Tate et al. [52] discovered that fractures treated with mini and microplates had similar values of load bearing three months after surgery. This is because of the mechanism of muscle splinting at the time of fracture. There are a number of factors that are related to bite force, including tactile impulses, the reception of pain and pressure in the periodontal ligament, the number of teeth that are still present, and a visible decrease in bite force with age as a result of the age-dependent deterioration of dentition. Only after three months has passed after the osteosynthesis, Feller et al. [53] came to the conclusion that the masticatory stress on the plates might approach 200N. Cawood [54] discovered that the test group was able to return to their normal weight in only four weeks, but the control group, in which direct fixation with tiny plates was not performed, took much longer. In the care of facial fractures, we discovered that the use of microplates may be considered, which indicates minimal usage of hardware, less bone plate ratio, fracture stability, less wound dehiscence, and enough strength at the fracture site. Those are the findings that we came to.

CONCLUSION

In the treatment of facial injuries, several plating methods are used to complement the aims of reconstruction and functional stability. This approach has been used for a long time. The designs of these systems relied on the material's handling capabilities, such as adaptability and strength, as well as the functional consequences of strength and force distribution. Due to the fact that microplates are unable to resist stress in adverse mandibular fractures, their use in load bearing locations is severely restricted. However, the results of our research provide a rationale for the use of microplates in the treatment of facial fractures. Nonetheless, we advocate for additional research involving a larger number of participants and a more extensive follow-up period before concluding that microplates are an appropriate method of fixation in MFFs.

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