

USE OF TITANIUM VERSUS STAINLESS STEEL MINIPLATES FOR TRAUMA MANAGEMENT

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ABSTRACT:

AIM: To assess the use of titanium versus stainless steel miniplates for trauma management.

INTRODUCTION: Maxillofacial trauma is very frequent and associated with a high incidence of mandibular fractures. Mandibular fractures occur with high frequency in road traffic accidents and interpersonal violence. They are among the most common types of facial fractures treated by the plastic surgeons. They must be managed carefully to maintain the function of the mandible, reestablish proper occlusion, and minimize secondary complications. Over the years, the management of trauma has evolved from various forms of splinting to circum mandibular wiring, extra oral pins and semi rigid fixation with transosseous wiring followed by rigid fixation technique, which has lately given way to semi - rigid fixation with miniplate

MATERIALS AND METHODS: The data was collected from the DIAS of saveetha dental college and hospital. Out of 59531 cases, the details of 48 patients with trauma management with miniplates were used for the study and the results were analysed using SPSS software.

RESULTS: Results show that all the age group patients involved in the study were mostly managed with stainless steel miniplates and few of them were managed with titanium miniplates. Considering the usage of miniplates with respect to gender, stainless steel miniplates were used for 74% of the males and titanium were used for 23% of the males. The total female patients involved in this study was 2 % of which all of them were managed with stainless steel miniplates.

CONCLUSION: In this study, we conclude that stainless steel miniplates were predominantly used for trauma management considering its properties and cost factor, although titanium miniplates has its own properties.

KEYWORDS: Innovative technology, miniplates, stainless steel, titanium, trauma management.

INTRODUCTION: The face serves a crucial role in human interaction and injuries to it result in devastating esthetic and functional sequelae. Maxillofacial trauma is very frequent and associated with a high incidence of mandibular fractures. Mandibular fractures occur with high frequency in road traffic accidents and interpersonal violence. They are among the most common types of facial fractures treated by the plastic surgeons. They must be managed carefully to maintain the function of the mandible, reestablish proper occlusion, and minimize secondary complications. Although there is universal agreement as to the treatment goals and basic therapeutic principles of reduction and stabilization, a variety of currently accepted treatment modalities indicate a lack of consensus (Ajmal *et al.*, 2007) .

The treatment options in the management of maxillofacial injuries are numerous and not without controversies. Several techniques for treatment of mandibular fracture have evolved significantly in the past decade. From the time of Hippocrates, physicians have described many different techniques for treating mandibular fractures, the principle of which has always been repositioning and immobilization of the bony fragments (Mittal *et al.*, 2016) . However, during the past 50 years, perfection of anesthetic and radiographic methods, introduction of antibiotics, specially designed instruments, and advances in biomaterials practices allowed maxillofacial surgeons to improve outcomes of treatment of mandibular fracture while reducing morbidity. Over the years, the management of trauma has evolved from various forms of splinting to circum mandibular wiring, extra oral pins and semi rigid fixation with transosseous wiring followed by rigid fixation technique, which has lately given way to semi - rigid fixation with miniplate (Prasad, Thangavelu and John, 2013) .

Rigid fixation can be achieved by compression plates, however, they have many disadvantages ('Compression osteosynthesis in mandibular fractures', 1986; Iizuka *et al.*, 1991) . Preference should be given to a plate which is not a compression plate but still gives enough rigidity to fractures. Michelet in 1973, ended the search for simple osteosynthesis that would guarantee fracture healing without

compression which was modified, developed and put to practical use. The quadrangle geometry of plate assures a good stability in three dimensions of fracture, since it offers good resistance against torque forces . A three-dimensional (3D) stainless steel plate is based on the principal of a quadrangle, as a geometrically stable configuration for support. The

currently used conventional miniplate techniques require Maxillomandibular fixation for a short period and are unable to render 3D stability at the fracture site. Lai in 1997 operated on 30 patients with maxillo-mandibular fracture using 3D titanium miniplates system. He was of the opinion that the internal rigid fixation by 3D titanium miniplates is a promising method of treating fractures of maxilla and is better tolerated by the patient and technically easy for the surgeon. The quadrangular geometry of the titanium plate assured good stability in three dimensions of the space. Easy use, good resistance against torque and compact form of the plate were some of the advantages. Hence the aim of the study is to assess the use of titanium versus stainless steel miniplates for trauma management (Lai, 1997). Our team has extensive knowledge and research experience that has translate into high quality publications (J *et al.*, 2018), (Wahab *et al.*, 2018), (Mudigonda *et al.*, 2020), (Narayanasamy *et al.*, 2021), (Gan *et al.*, 2019; Li *et al.*, 2019; Ma *et al.*, 2019; Bishir *et al.*, 2020; Zhang *et al.*, 2020; Fan *et al.*, 2021; Saravanakumar *et al.*, 2021; Veeraraghavan *et al.*, 2021; Wang *et al.*, 2021; Wei *et al.*, 2021) (Sathya *et al.*, 2020), (Felicitia and Sumathi Felicitia, 2018; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Chandrasekar *et al.*, 2020). (Su *et al.*, 2019; Wan *et al.*, 2020)

MATERIALS AND METHODS:

It is a single centered retrospective study conducted in a private dental institution, Chennai. The data was collected from the Dias of Saveetha dental hospital management system. 59,531 patient details were analysed between March 2020 to February 2021 out of which the details of 47 patients with trauma managed with miniplates were used. Ethical clearance for this study was obtained from the Institutional review board. The internal validity included diagnosed cases as per criteria, medical history, chief complaint and clinical findings. The data analysis was performed using SPSS software. The chi square test and Pearson correlation was done. P value < 0.005 was considered statistically significant.

RESULTS:

Although various devices and techniques have been used to treat these fractures, modern plate and screw fixation systems have proved to provide the best rigid stabilization, early mobility and associated with least complications. The present study included 47 patients who undergone trauma management with miniplates out of which 98% are males and 2% are females. The age group was categorised into 10-25 years, 26-40 years and 41-55 years. On analysing with respect to age, all the age group patients involved in the study were mostly managed with stainless steel miniplates (i.e) overall 76% of the patients were managed with stainless steel plates and a few of them were managed with titanium miniplates (i.e) overall 24% of the involved patients. Chi-square test was done and the association was found to be statistically insignificant. p value : 0.879 (p>0.05). Hence statistically insignificant. Considering the usage of miniplates with respect to gender, stainless steel miniplates were used for 74% of the males and titanium were used for 23% of the males. The total female patients involved in this study was 2 % of which all of them were managed with stainless steel miniplates. Chi-square test was done and the association was found to be statistically insignificant. p value : 0.576 (p>0.05). Hence statistically insignificant.

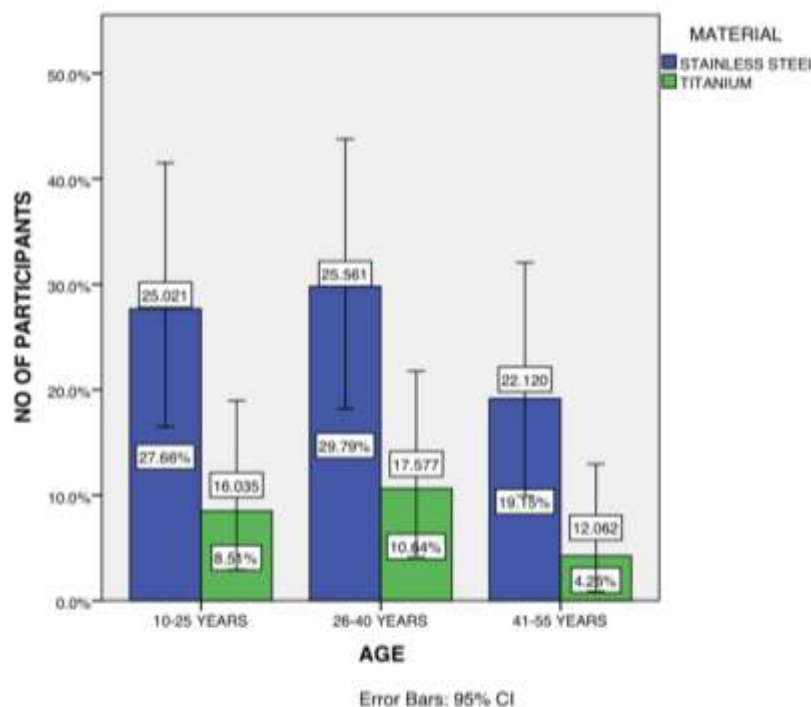


Fig.1 Graph representing the correlation between age and usage of miniplates. X axis represents the age and Y axis represents the number of participants who undergone trauma.. Blue colour denotes stainless steel miniplates and green colour denotes titanium miniplates. It shows that most of the patients were managed with stainless steel miniplates with respect to all age groups.

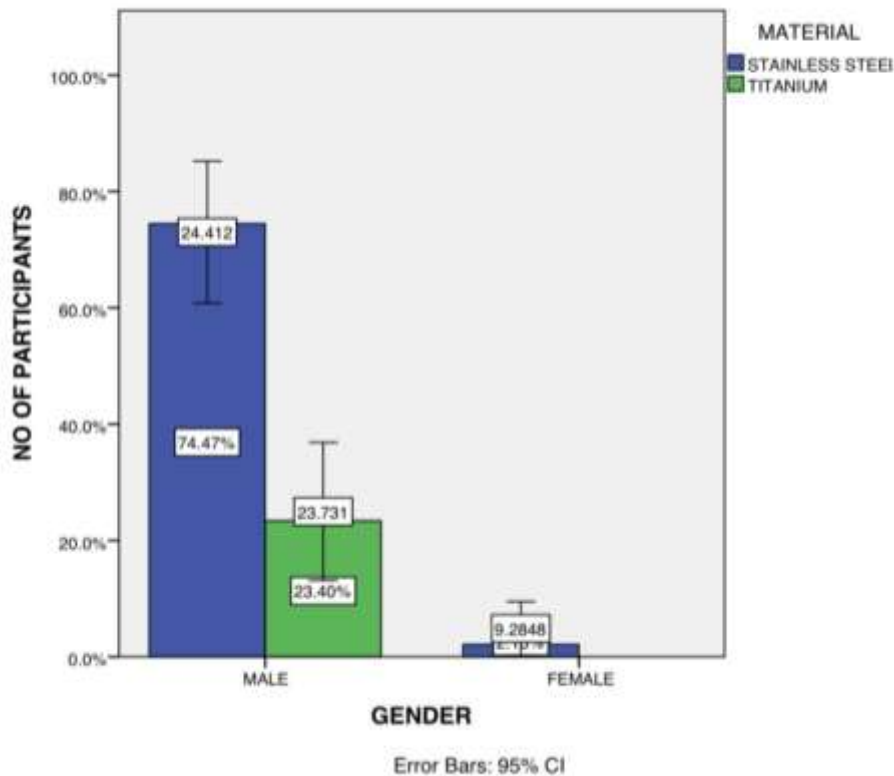


Fig.2 Graph representing the correlation between gender and usage of miniplates. X axis represents the gender and Y axis represents the number of participants who undergone trauma.. Blue colour denotes stainless steel miniplates and green colour denotes titanium miniplates. It shows that most of the male patients and all the female patients involved were managed with stainless steel miniplates.

DISCUSSION:

The most common cause of fracture was a result of road traffic accident accounting for 61.1%. The next common etiology of fracture was inter-personal violence accounting for the remaining 38.8% of total cases. The anatomical distribution of fracture was as follows: Parasymphysis fracture (38.8%), Symphysis (11.1%), Angle (27.7%), Body (11.1%), Angle with Parasymphysis (11.1%). Stainless steel and titanium are two different metals with different mechanical and metallurgical properties. Stainless steel is twice more stiffer than titanium. Internal fixation of fractures with stainless steel plates is likely to produce more rigid fixation than titanium plates (Tuli, 2019) Hence, stainless steel plate fixation is likely to produce healing of fracture site with minimum callus/primary healing. Stainless steel is cheap, has good ductility, can be well machined, and contoured easily. It has good tensile strength, but in terms of corrosion resistance, biocompatibility, and fatigue strength, stainless steel is inferior to titanium. Stainless steel has modulus of elasticity eight times greater than the bone. The internal fixation provided by stainless steel plate is said to produce more rigid fixation than titanium plate of same size and dimension (Disegi and Eschbach, 2000) . The other disadvantage is the allergic reaction to nickel content of steel in 1%–2% of the patients (Disegi and Wyss, 1989) . Stainless steel though cheap has modulus of elasticity eight times greater than bone. When used for internal fixation, it produces rigid fixation leading to primary fracture union with no callus formation; hence, radiological assessment of fracture healing is difficult. The rigid fixation by stainless steel plate unloads the protected segment leading to osteoporosis and reduction in the bone mass (Pohler, 2000) . Titanium has half of the modulus of elasticity as that of stainless steel, and its stiffness is more

close to the bone than stainless steel. The lower modulus of elasticity of Ti provides an advantage by reducing the stress protection. Thus, it reduces the osteoporosis and allows the fracture to heal with callus formation. The ideal implant material is one which has biomechanical properties close to the bone and is biocompatible. Use of other innovative materials for fracture fixation has scope for future research.

CONCLUSION:

The present study was carried out to evaluate the usage of stainless steel and titanium miniplates in trauma management. Mandibular fractures occur with high frequency in road traffic accidents and interpersonal violence. They are among the most common types of facial fractures treated by the plastic surgeons. They must be managed carefully to maintain the function of the mandible, reestablish proper occlusion, and minimize secondary complications. In this study, we conclude that stainless steel miniplates were predominantly used for trauma management considering its properties although titanium miniplates has its own properties.

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