

**FIXATION OF BIO-RESORBABLE AND TITANIUM
MINIPLATES IN MANDIBULAR FRACTURES – A
COMPARATIVE STUDY**

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MASTER OF DENTAL SURGERY



BRANCH III

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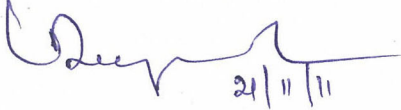
CERTIFICATE

This is to certify that the dissertation titled “**FIXATION OF BIO-RESORBABLE AND TITANIUM MINIPLATES IN MANDIBULAR FRACTURES – A COMPARATIVE STUDY.**” is a bonafide record of work done by **Dr.SUNDARARAJAN .V** under my guidance during his postgraduate study period between **2009 – 2012.**

This dissertation is submitted to **THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY**, in partial fulfilment for the degree of **MASTER OF DENTAL SURGERY** in **Branch III – Oral and Maxillofacial Surgery.**

It has not been submitted (partially or fully) for the award of any other degree or diploma.

Professor and Guide

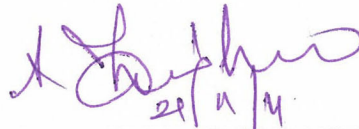


21/11/11

Dr.L.DEEPANANDAN,M.D.S.,

Professor
Department of Oral & Maxillofacial Surgery
Sri Ramakrishna Dental College & Hospital,
Coimbatore.

Professor & Head



21/11/11

Dr.T.VIGNESWARAN,M.D.S.,

Professor & Head
Department of Oral & Maxillofacial Surgery
Sri Ramakrishna Dental College & Hospital,
Coimbatore.

Principal

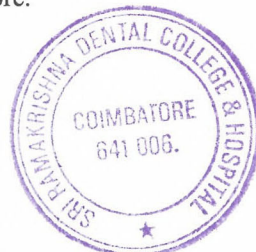


Dr.V.Prabhakar,M.D.S.,

Principal
Sri Ramakrishna Dental College & Hospitals,
Coimbatore.

Date : 21.11.11

Place : Coimbatore.



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Introduction

INTRODUCTION

In a developing country like India, with increasing urbanization, and rapid influx of high speed automobiles, poor road conditions and over population, the road traffic accidents are scaling heights and the incidence of traumatic injuries to the maxillofacial skeleton are increasing alarmingly.

Mandibular fractures are among the most common injuries to the facial skeleton, with a 6:2 proportion between mandibular and zygomatic fractures. This is due to its relatively prominent position and is common to injuring forces. Many studies have shown that mandibular fractures are the commonest of all maxillofacial fractures with a frequency of occurrence up to 70%. Mandibular fractures occur in people of various ages and races, in a wide range of social settings.

The causes of maxillofacial injuries have changed over the past four decades, road traffic collisions being the main cause all over the world. Other causes include assaults, fall from a height, and sports injuries. Socioeconomic circumstances, social behavior, type of industry, transportation, driving skills, consumption of alcohol and legislation all play their part in establishing the prevalence of the various causes.

The aim of mandibular fracture treatment is the restoration of anatomic form and function, with particular care to reestablish the occlusion and esthetic phenomenon. The management of trauma has evolved greatly

over the decades from supportive bandages, splints, circummandibular wiring, extra oral pins, and semi rigid fixation with transosseous wiring to rigid fixation. It was after the Second World War that the treatment modality has changed from closed reduction to open reduction and direct fixation using transosseous wiring, bone plates and screws.

The 2 mm miniplate system originated from the work of Champy et al who initially advocated the possibility of treating mandibular fractures by placing the miniplate with monocortical screws in the neutral axis of the mandible along with the dental arch as a tension band without requiring post surgical intermaxillary fixation (IMF). By using this kind of treatment, acceptable results were reported.

Bone plating systems manufactured from titanium are currently used extensively for fixation of facial fractures, in the form of compression plates, miniplates, micro plates, such bone plate's possess the property of biocompatibility and provides adequate strength. But several disadvantages persist with these systems, including palpability, hardware loosening, temperature sensitivity, fretting corrosion, interference with radiographic imaging, and subsequently need for a second surgery for removal of implant.

In order to overcome some of the problems a new class of materials, namely bioresorbable polymers have been developed for the use in internal fixation of maxillofacial injuries.

The use of bioresorbable materials in bone surgery started almost four decades ago. The use of bioresorbable plates and screws in the fixation of maxillofacial bone fragments was first reported by Kulkarni et al in 1966. It took more than 20 years before the first clinical maxillofacial series were published. The first reports concerned the fixation of zygomatic fractures with melt -molded poly - L - lactide (PLLA) plates and screws. The resorbable polymer is designed to retain the sufficient rigidity until bone healing has taken place. These bioresorbable materials subsequently undergo resorption, thereby achieving the advantages of titanium fixations without the associated long term problems.

Bioresorbable miniplate fixation has recently been studied in maxillofacial patients. Eppley and Prevel et al reported high success rate with resorbable plates and screws in maxillofacial fractures. A co-polymer Poly (L) lactide represents another technologic advancement in the use of resorbable materials for internal fixation of the fractures. The advantages of this polymer includes that it can be used in the increased load bearing areas like mandible.

Bioresorbable bone plates which is having main ingredient has Poly (L) lactide been chosen for our study because of the fact that it composed of natural non-antigenic material, which is not expected to give foreign body reaction and inflammation.

The aim of our study is to assess the outcome of treatment of mandibular fractures with the biodegradable system compared with titanium miniplates .The hypothesis for this evaluation is that 2 mm bioresorbable plates are equal to the performance of 2 mm titanium miniplates, regarding healing of the fracture with bone union and restoration of function.

The primary end point variable for this analysis is the union of the fracture and return to normal function highlighting those cases involving the parasymphysis and condyle wherein open reduction was done in parasymphysis fracture and closed reduction was done in condylar fractures. Secondary end point variables included the incidence of complications such as pain, paraesthesia, oedema, occlusion, mouth opening, infection, step deformity and mal union.

Review of Literature

REVIEW OF LITERATURE

Adell R et al 1987² was analyzed 401 mandibular body fractures occurring during a 5-year period were analyzed retrospectively. Out of these, 38 fractures (9.5%) were not consolidated by 50 days and made up the delayed healing group (DHG). A control group (CG) of another 38 fractures was constituted using the first mandibular body fracture consecutively following one in the DHG. The mean time until consolidation of the fractures was 116 days in the DHG and 35 days in the CG. The 2 groups were statistically analyzed and mutually compared using a great number of variables including patient, fracture site, treatment and end result characteristics. It was concluded that a few days delay between trauma and treatment did not necessarily lead to a delayed healing. Un cooperative alcoholics with psycho-social handicaps, and general as well as local periodontitis, were found to be especially liable to consolidate their fractures at a slower rate than the average patient. The DHG more often required changes of unstable dental fixation, prolonged maxillomandibular fixation time and treatment for late infections at the fracture site. The patients in DHG group lost more teeth than those in the CG but above all required considerably extended therapeutic efforts. It is suggested that patients with the above mentioned characteristics should be given special attention and care.

Moberg LE, Nordenram A and kjeliman O 1989⁴¹ investigated the occurrence of corrosion associated with the use of metallic implants to stabilize jaw fractures. Three different types of plates, CO-Cr, Ni-Cr alloys and titanium were used. The mucous membrane and bone tissues were analyzed for concentration of Co,Cr,Ni,Mo,Al, and Ti by atomic absorption spectrophotometer and a radiochemical neutron activation technique. Two conclusions were drawn,

- A. Higher concentrations of all the above elements were found in the tissue near the implants when compared with contra lateral controls. With the exception of titanium, all the others are potentially allergic sensitizers and their permanent reaction after healing of the fracture is therefore contraindicated.
- B. Secondly the titanium implants is to be preferred in the event plates are not removed.

Boss RRM et al 1989⁷ studied on resorbable plate fixation for mandible fractures in artificially created mandibular fractures in six dogs. Plate fixation was done based on CHAMPY'S line of osteosynthesis. Clinical and radiographic follow up was done. Examination of fracture sight under General anaesthesia showed fracture healing without any complications.

Rozema FR et al 1990⁴⁹ studied the influence of poly (L-lactide) bone plates and screws on the dose distributions of radiotherapy beams. The study showed that PLLA plate does not influence the electron and photon beams. There was absence of back scatter in front of plate, whereas a mixture of scatter and absorption were seen behind the plate. The plates were hence thought to be tissue equivalent.

Allan BP, Daly CG 1990³ carried out of patients presenting with fractures of mandible over the 35-year period 1951-1985 in Newcastle, Australia retrospectively. The male to female ratio was 4.4:1. The highest incidence of trauma was in the 20-29 year age group (38.3% of all patients). The major causes assault (38.1%), road traffic accidents (21.5%) and sport (19%). Males accounted for most of the patients in all causes of trauma. In sports, the male: female ratio was 30.6:1, whilst for assaults it was 6.3:1.

Leesa Rix, Stevenson AR, Punnia-Moorthy A 1991³³ analyse data collected from patients suffering mandibular fractures who presented to the university of Sydney department of oral surgery. A study of 80 consecutive cases of mandibular fractures treated utilizing miniplate osteosynthesis is reported. Analysis of the data collected from 2 inner city hospitals revealed a high incidence of males (90%), alcohol abusers (44%), smokers (77%) and unemployed (36%). Assault was the etiological factor in 72.5% of cases, with alcohol implicated in 58%. The injuries were predominantly non-complex in nature, 94% having one or 2 mandibular fractures and only 11% having

additional facial fractures. The results compared favourably with those found in previous studies with 8% having complications.

Iizuka T, Lindquist C 1992²⁷ reviewed patients treated with AO/ASIF principle of rigid internal fixation between 1983 & 1989. Both intraoral and extra oral approaches were used. The complications directly observed with the rigid plate system were injury to the facial nerve & development of the visible skin scar following extra oral approach, post operative malocclusion with difficulties relating to bending of the rigid plate & problems relating to sensitivity to cold because of large amounts of metal used. Also bicortical screws could increase the risk of inferior alveolar nerve damage .They concluded that monocortical miniplate fixation avoiding extra oral incision may offer the best advantages.

Oikarinen K et al 1993⁴³ studied of 317 mandibular fracture patients treated over a period of 10 years retrospectively. They evaluated the cause of accident, age and sex of the patient, the day and month of injury. The annual distribution of mandibular fractures ranged from 21 to 45 cases, the mean being 31.7 injuries per year. Two hundred and thirty nine cases were males while 78 were females with a mean age of 31.3 years. Violence as the major cause of accidents was encountered in 48 % of cases in the age range of 30-39 years and 53 % of these were between 20 -29 years of age.

There was a prominent accumulation of injuries noted at the weekends with 55% of fractures in men to that of 44% in women occurring predominantly in the age groups of 20-29 years or 30-49 years. The study showed a slight increase in the mean age of mandibular fracture patients, the proportion of female victims and a decrease in the role of violence and traffic accidents in causing these injuries.

Hayter IP, Cawood JL 1993²⁴ reviewed the application of miniplates in maxillofacial surgery, with an emphasis on trauma. The main functional advantages of the miniplates according to them are improved jaw function, in terms of mouth opening and bite force, decreased weight loss, and improved pulmonary function. Other advantages are improved speech and oral hygiene. They concluded that miniplates are considered to be the best treatment for patients with maxillofacial fractures.

Tanaka N et al 1994⁵⁵ conducted a statistical study of 695 cases of maxillofacial trauma was reported. The male to female ratio noted was 3.2:1. The most common age group affected was 20-29 years and accounted for 30.7%. Cases reporting within one week of injury were 63.9% while those reporting later were being treated for other associated injuries. Road traffic related accidents were the highest (38.4%) and mandibular body region was the commonest site of fracture. In 68.6% of the cases, the most frequent one to fracture was the mandible.

Tuovinen V et al 1994⁵⁷ addressed the suitability of semi rigid fixation for the treatment of mandibular fractures. Between 1986 and 1991, 279 patients with 447 isolated mandibular fractures were treated with miniplate fixation using the tension-band principle of Champy et al. The time from trauma to treatment, etiology, number and location of the fractures and the presence of preoperative infection and neurosensory disturbances were recorded.

Postoperative complications such as infections, neurosensory disturbances, malocclusion, and nonunion also were recorded, as well as the reasons for removal of the miniplates. Postoperative infection occurred in 10 patients (3.6%). These infections were controlled by antibiotics and the miniplates were removed after the acute phase. Occlusion disturbances were noted postoperatively in 13 patients (4.7%), and they were corrected by minimal occlusal grinding in the majority of cases. Neurosensory disturbances were noted preoperatively in 26.9% of the patients and 12 months postoperatively in 1.4% of the patients. No cases of nonunion occurred. Author concluded that Semi rigid fixation of mandibular fractures with miniplates is a viable treatment option for the management of such injuries.

Renton TF, Wiesenfeld D 1996⁴⁷ performed a retrospective study of 205 consecutive patients at the Maxillofacial Unit of The Royal Melbourne Hospital to assess if adherence to Champy's principles in placement of miniplates in mandibular fractures minimizes morbidity. 205 well documented

cases of mandibular fractures treated with internal fixation. The patients were assigned into three groups according to the type of fixation; 83 patients had miniplate fixation according to Champy's principles, 40 patients had miniplate fixation ignoring Champy's principles, 82 patients had transosseous wire fixation.

Outcome was measured by preoperative variables (age, gender, mechanism of fracture, site and number of fractures, nerve function, associated injuries and treatment delay) and postoperative variables, malocclusion, infection, dehiscence, union, removal of fixation and nerve function which were assessed and compared. The results show that the preoperative variables were statistically similar in all groups. The postoperative variables indicated a statistically higher complication rate for the transosseous wire group compared with the miniplate groups, and morbidity was reduced in the group following Champy's principles. Titanium miniplates appear as effective as miniplates constructed of other materials used in previous studies, especially when Champy's lines of osteosynthesis principles are followed.

Matthew IR et al 1996³⁷ characterized the surfaces of Champy's titanium and stainless steel miniplates and screws that had been used to stabilize fractures of the mandible in an animal model. Miniplates and screws were retrieved at 4, 12, and 24 weeks after surgery. Low-vacuum scanning electron microscopy (SEM) of autoclaved unused (control) and test miniplates

from the same production batches was undertaken. Energy-dispersive X-ray (EDX) analysis was used to identify compositional variations of the miniplate surface, and Vickers hardness testing was performed. At autopsy, clinical healing of all fractures was noted. SEM analysis indicated no perceptible difference in the surface characteristics of the miniplates at all time intervals.

Aluminium and silicon deposits were identified by EDX analysis over the flat surfaces. There was extensive damage to some screw heads. It is concluded that there were no significant changes in the surface characteristics of miniplates retrieved up to 24 weeks after implantation in comparison with controls. Damage to the screws during insertion due to softness of the materials may render their removal difficult. There was no evidence to support the routine removal of titanium or stainless steel miniplates because of surface corrosion up to 6 months after implantation.

Kawai T et al 1997³⁰ aimed to find out the best time to undertake radiological follow-up examinations and remove fixation materials after fractures of the mandible through a retrospective study of radiographs. Outcome was measured by radiographic features of healing at less than 2, 2-3, 3-4, and 4 or more months. Osteogenic change (osteogenesis and union) was the best radiographic criterion for evaluating follow-up radiographs. This change started to predominate 1-2 months after injury in patients less than 18 years of age and 2-3 months after injury in older patients. Overall, union was noted in 3 months or more after the fracture. Author recommend follow-up

radiographic examination to confirm clinical judgment during the fifth week after a mandibular fracture in patients less than 18 years of age and the ninth week for older patients. The fixation materials should be removed during the fifth month after injury.

Suuronen R et al 1997⁵³ fixed mandibular osteotomy with biodegradable plates and screws in an animal study. They showed that the mechanical properties of the SR-PLLA plates and screws were sufficient for a long enough period to enable good consolidation and bone healing. As the plates and screws they used were large, they suggested reduction in size to that of miniplates before use in humans.

Tams J et al 1997⁵⁴ determined and compare bending and torsion moments across mandibular fractures, for different positions of the bite point and different sites of the fracture. Three identical resin mandibles, each with a single fracture, were used. The fracture sites were in the angle, body and symphyseal regions. A polyethylene bone plate was used for fixation. Simulated bite forces were applied at 13 bite points. For each bite point, the displacements of the fragments were registered and converted into bending and torsion moments across the fracture.

Positive bending moments were defined as those moments that caused compression at the lower border and tension at the alveolar side of the mandible; negative bending moments did the opposite. Angle fractures had

relatively high positive bending moments. Body fractures had positive as well as negative bending moments and the highest torsion moments. Symphyseal fractures had negative bending moments only and relatively high torsion moments. It was found that angle, body and symphyseal fractures each have a characteristic load pattern. These load patterns should play a decisive role in the treatment of mandibular fractures with regard to number and positioning of plates.

Enslidis G et al 1998¹⁶ used a new biodegradable co-polymer osteosynthesis system for fixation of zygomatic fractures. They used plates and screws made of 82% L-lactic acid 18% glycolic acid. Complications due to implants were not seen. They suggest that this was due to reduced crystallinity of the product used which was 10%.

Fordyce AM et al 1999¹⁸ conducted a retrospective study to find out the necessity of IMF to reduce mandibular fractures.. One group of patients had fractures reduced normally to obtain anatomical reduction without the use of perioperative IMF.The second group of patients were treated conventionally using the perioperative IMF.IMF was not used routinely postoperatively. Overall there were few occlusal discrepancies in the early postoperative period in those patients treated by anatomical reduction but there was no difference in the final outcome of the occlusion between the two methods of fixation. They concluded that IMF is not usually necessary to reduce fracture of the mandibular bone.

Jan Tams et al 1999²⁹ performed Computer-based study was done to determine whether a small biodegradable plate system was suitable for internal fixation of mandibular fractures. In a three-dimensional computer model of the mandible, fracture mobility and plate strain were calculated for bite forces applied on 13 bite points on the dental arch. Simulated solitary angle, body, and symphysis fractures were fixed with one titanium miniplate, one polylactide (PLA) midplate, one PLA maxiplate, or two PLA midplates. Fractures with and without inter fragmentary bone contact were studied. In the case of fractures with bone contact, the loads were transmitted through the fracture surfaces and the plate; when there was no contact, the loads were transmitted only through the plate. Maximum fracture mobility was set at 150 µm. Maximum plate strain was set at the yield strain of PLA and titanium. For fractures without inter fragmentary bone contact, all plate fixations resulted in a fracture mobility and plate strain higher than the limits set, except for the symphysis fracture fixed with two PLA miniplates.

Interfragmentary bone contact significantly reduced fracture mobility and plate strain. For the angle fracture with bone contact, all PLA plate fixations resulted in fracture mobility above the limit, whereas the titanium miniplate fixation had fracture mobility below the limit. For the body and symphysis fracture with bone contact, only double PLA miniplate fixation resulted in fracture mobility below the limit. From a mechanical point of view, based on the computer model, small PLA plates are only suitable for

symphysis fractures with and without inter fragmentary bone contact and for body fractures with inter fragmentary contact. However, fixation with two PLA plates is always necessary to provide sufficient reduction of fracture mobility and plate strain.

Marker P, Nielsen A, Bastian HL 2000³⁶ studied the results of conservative treatment of condylar fractures to find out if there were any variables that were predictive of complications. During the period 1984–1996, all patients who presented with a fracture of the mandibular condyle and who attended for control examination one year after treatment were recorded at the end of treatment and one year later. The ability to open the mouth, deviation and occlusion were recorded.

After one year 45 of the 348 patients (13%) had minor physical complaints such as reduced ability to open the mouth, deviation, or dysfunction. Ten of them (3%) had pain in the joint or muscles or both. Eight patients (2%) had malocclusion, which in seven could be related to dislocation of the condylar head out of the fossa. Five of the eight patients had bilateral fractures. We conclude that conservative treatment of condylar fractures is non-traumatic, safe, and reliable and in only a few cases may cause disturbances of function and malocclusion. The risk associated with the latter is greatest with bilateral fractures and dislocation of the condylar head from the fossa.

Marcelo M Araujo, Waite PD, Lemons JE 2001³⁵ compared the biomechanical characteristics of metallic and polymeric fixation systems using a 3-dimensional skull model to simulate clinical conditions of maxillary advancement and loading. Standard titanium, pre bent titanium, and resorbable plates and mesh were applied to surgically altered polyurethane skulls. The constructs were loaded using an Instron machine in anterior-posterior (AP) and inferior-superior (IS) directions. The load displacement, load to failure, and deformation magnitudes and modes of failure were recorded. Statistical studies included analysis of variance (ANOVA) at $P < .05$. Elastic stiffness was different among groups in the AP direction, but no significant difference was found in the IS direction. The overall evaluation of the model and test analyses supported the relative value of this in vitro system and study procedure. All systems showed load capacity magnitudes above 285 N (64 lbs) and more elastic resistance in the IS direction. The resorbable systems showed lower elastic stiffness compared with the titanium systems, but they appear to be adequate for fixation and withstanding the forces of mastication.

Iida S et al 2001²⁶ reported a fifteen-year retrospective analysis of 1502 patients with facial fractures. The male population, 73.9% were reported while the remaining were females and the largest subgroup was seen between the 10-19 years of age group. Maxillofacial fractures, 52% were caused by road traffic accidents and motor bikes were frequently involved making up 23.1% of cases and was followed up with bicycles in

13.5%. Falls and assaults closely followed with 16.6% and 15.5% respectively. Isolated mandibular fractures, 56.9% were the most common and combination with maxilla was seen only with 6.7% of cases. Single fractures of the mandible were present in 51.4% of cases while 39.9% and 8.7% of them had two and three fractures of mandible respectively. The highest incidence of two or more fractures was found to be associated with motor bike accidents. Condylar fractures were most common and were around 33.6%, followed by angle region being 21.7%. Bicycle related fractures showed a high preponderance for Condylar fractures and falls showed a high incidence for bilateral Condylar fractures.

Omar Abu baker A, Michael K, Rollert 2001⁴⁵ used prophylactic antibiotics in mandibular fractures to show that have shown there is a clean benefit to their use in preventing infection. A higher infection rate for mandibular angle fractures is reported than other sites of the mandible. The authors evaluated the difference between the effect of a 5-day postoperative course of oral antibiotics & a placebo on the incidence of postoperative infection in uncomplicated fractures of mandible. They found no statistical difference between patients treated with closed reduction & those treated by ORIF in the postoperative oral penicillin group. Also in patients receiving antibiotics, a delay in treatment of fractures will not add to risk of infection

Schön R, Roveda SI, Carter B.2001⁵⁰ noted that fifty six Percent of the patient population had mandibular fractures and in 83% of these

fractures were due to interpersonal violence. The percentage account for males was 81% showing a high male domination and male to female ratio was 4:1. The most common site fractured was the mandibular angle region accounting to 43% and had the highest incidence of complications. Mandibular fractures and alcohol abuse was found to be closely related and preference was given to rigid fixation through extra oral route. The site of fracture was found to be related to the cause and left sided injuries were more common. Only 10% of patients experienced complications. Author concluded that osteosynthesis of mandibular fractures by the 2.0 AO/ASIF titanium miniplate system is reliable.

Meningaud JP et al 2001⁴⁰ showed that titanium (Ti) has dramatic success in many surgical procedures as a result of its excellent mechanical properties and resistance to corrosion. There is still concern, however, about the release of metal and controversy surrounding whether or not the plates should be removed after bone healing. This study has been conducted to investigate whether or not there is a relationship between duration of plating and metal release from Ti miniplates in maxillofacial surgery. A prospective cohort study design was used. Correlation coefficients and two-way ANOVA data were processed. The average amount of total Ti in the soft tissues surrounding the plates was 1306 µg/g dry tissue. The mean of soluble Ti was 0.53 µg/g dry tissues. Almost 100% of Ti is released during the osteosynthesis. Then Ti levels remain constant in the surrounding tissues. Most of the time, Ti

seems to be clinically inert. Compared to the possible risks of a second operation, removal of Ti miniplates should not be a routine procedure except in the case of complaints from patients, particularly in the case of infection, hypersensitivity, dehiscence or screw loosening.

Gerlach KL, Schwarz A 2002²⁰ evaluated maximal biting forces in 22 patients with mandibular angle fractures treated with miniplate osteosynthesis according to Champy's line of osteosynthesis. An electric test procedure for evaluating the load resistance between the incisors, canines and molars was carried out 1 to 6 weeks following the treatment and additionally in 15 controls too. This revealed that after surgical fracture treatment 1 week postoperatively only 31% of the maximal vertical loading found in controls was registered. These values increased to 58% at the 6th week postoperatively.

Adebayo, Ajike OS, Adekeye EO 2003¹ evaluated of the pattern of maxillofacial fractures, associated injuries and treatments using a 10 year retrospective survey (1991-2000) of patients seen at the maxillofacial unit in Kaduna, Nigeria. A total of 700 fractures were observed in 443 patients during the study, there was an overwhelming male preponderance noted with peak incidence during 20-39 years and road rashes was the most common cause of these fractures. 66.4% of cases were of mandibular fractures and only 12% had associated injuries. They finally stated that the age incidence peaks within the third decade while fractures are rare at the extremes of life. The rate of mandibular fracture was found to be related to etiology and a high rate of

road crashes caused about 1.5 mandibular fractures per patient. Maxillomandibular fixation using dental wires was advocated as the mainstay of treatment owing to its few complication rates and cost effectiveness in underdeveloped and developing countries.

Matthews NS et al 2003³⁸ studied skeletal stability during the first year after mandibular advancement and fixation with bioresorbable self-reinforced poly-L-lactide (SR-PLLA) screws in 11 patients by cephalometric measurements. They compared these with a cohort of 11 patients, in whom titanium screws were used for fixation. They found no significant difference between the two groups in the median preoperative cephalometric values and the median changes after operation. There was also no significant difference between the two groups regarding the median extent of relapse 1-year after operation. They concluded that bioresorbable SR-PLLA screws are comparable to metallic screws for fixation of bone after sagittal split mandibular advancement.

Dogan Dolanmaz et al 2004¹⁵ performed an experiment wherein six unembalmed adult sheep mandibles were stripped of all soft tissues and sectioned at the midline. Each side had a sagittal split ramus osteotomy (SSRO) and was advanced 5 mm. Six of the hemimandibles were fixed with four-hole extended titanium miniplates and titanium screws and the other six were fixed with four-hole extended absorbable plates and absorbable screws. All specimens were mounted in a servo hydraulic testing unit, and a range of

forces (0–140 N) was applied. Displacement of each proximal segment was recorded at 10 N increments from 0 to 140 N. Values for the two groups were compared using the Mann–Whitney *U*-test, and significant differences in displacement were seen only at loads between 10 and 50 N. The results indicate that when absorbable miniplates are used intermaxillary fixation may be necessary to stabilise the bony fragments in the early postoperative period.

Mazzonetto R, Paza AO, Spagnoli DB 2004³⁹ evaluated clinical and radiological evidence of osteotomy site healing in orthognathic surgery after rigid fixation using a biodegradable plating system and underwent orthognathic surgery using a biodegradable self-reinforced (70L:30DL) polylactide plating system for 30 patients. The follow-up schedule for all patients consisted of regular appointments at 1-180 days after surgery. Clinical evaluation involved notation of any abnormal swelling, infection, discoloration, or discharge at the osteotomy sites. Stability was evaluated by manual palpation. The radiographs were analyzed for any visual changes in osteotomy fragments, resorptive changes in osteotomy fragments, callus formation, and union of the osteotomy segments. No clinical complications and no radiological changes in the osteotomy sites were observed and concluded that self-reinforced (70L:30DL) polylactide was considered to be comparable to other forms of rigid internal fixation for orthognathic surgery.

Behcet Erol, Rezzan Tanrikulu, Belgin Gorgu 2004⁶ analysed retrospectively the demographic distribution, treatment modalities, and

complications of maxillofacial fractures in 2901 patients treated in the Southeast Anatolia between 1978 and 2002. In addition, the use of internal fixation was evaluated in an effort to determine whether there were changes in using internal fixation techniques. Two thousand nine hundred and one cases of facial trauma were assessed according to age, sex, and etiology, in addition to the distribution of the fractures relating to facial bones and seasons.

It was found that facial fractures were most frequent in males (77.5%) and in the 0-10 year age group; they tended to be more frequent during summer (36.3%); and traffic accidents were the most common etiological factor (38%). 77.9% of cases were treated with conservative methods, and 22.1% with one or more internal fixation techniques. The most favoured technique was miniplate osteosynthesis; the complication rate associated with internal fixation was 5.7%.

Pat Ricalde et al 2005⁴⁶ suggested that internal fixation using titanium plates and screws have the potential for interference with radiotherapy delivery. This in vitro study compares the strength of titanium and resorbable internal fixation in a mandibulotomy model by analyzing the force required for plate and screw breakage. Titanium and resorbable plates and screws in various configurations were used to stabilize pieces of the wood. They were arranged in 6 different groups. The specimens were individually tested with a vertical load, while the test machine recorded the force-versus-displacement behaviour automatically. Plate type and configuration affected the applied load

required to induce displacement of the simulated mandibulotomy. Heating and cooling the resorbable plates prior to strength testing also affected the load-versus-displacement curve. Overall, the titanium system they studied exhibited greater resistance to deformation from a vertical load than did the resorbable plate groups.

Guillermo E Chacon et al 2005²² determined if a specific resorbable plating system provides similar fixation, in terms of strain distribution under load, to a titanium system when the Champy's technique is applied for the treatment of a mandibular angle fracture. A formalin fixed cadaver mandible was harvested just before the study. A bicortical osteotomy was then made using a diamond disc extending in an oblique direction in the area of the angle. It was then passively fixated with a 4-hole 2.0-mm miniplate. Two stacked rosette strain gauges were bonded to the mandible on either side of the fracture. Each rosette had 3 strain gauges arranged in specific degrees relative to each other.

The mandible was then placed on a dynamometer and 30 lb loads were delivered on the ipsilateral molar. Static resistance was placed in the condylar neck region to simulate the glenoid fossa. Loading was repeated 10 times with a period of 3 minutes between loads. Measurements were recorded for each strain gauge after loads were in place for 30 seconds. The same process was repeated using a 4-hole 2.1-mm resorbable miniplate. The strains were then used to calculate the maximum and minimum strains for each rosette. Hooke's

law was used to calculate the principal stresses. Differences were observed between the strain gauges for each individual plating system. There was variability within the resorbable plate measurements as shown by the standard deviation.

Using the REML ANOVA test, a significant difference was found between the 2 materials. In this in vitro study, there were significant biomechanical differences observed between a 2.0-mm titanium miniplate and a 2.1-mm resorbable miniplate when used to treat a mandibular angle fracture following Champy's principles. Based on their finding, both systems cannot be used interchangeably for the treatment of mandibular angle fractures under the same clinical conditions.

Andrew JL et al 2005⁵ evaluated the various modalities of management of mandibular angle fractures is often challenging and results in the highest complication rate among fractures of the mandible. Optimal treatment for angle fractures remains controversial. Historically, treatment of mandible fractures included intraoperative maxillomandibular fixation (MMF) along with rigid internal fixation. More recently, non compression plates miniplates, which produce only relative stability, have gained popularity. The absolute necessity of intraoperative MMF as an adjunct to internal fixation has also become controversial. The current trends in the management of simple, non comminuted mandibular angle fractures are examined. A single miniplate

plate on the superior border of the mandible has become the preferred method of treatment among AO faculty.

KhaledSakr, Farag IA, Zeitoun IM 2006³¹ made a retrospective study of the medical records and radiographs of 509 patients treated for mandibular fracture at the University of Alexandria Hospital between 1991 and 2000. The data included that age, sex, etiology, date of injury, anatomical site of the fracture, associated maxillofacial trauma, and treatment. The prevalence of mandibular fractures was higher in male subjects in all age groups, and the male:female ratio was 3.6:1. Most fractures were sustained by men in the age group 21-30 years and girls between 0 and 10 years, and the monthly incidence were constant. Road crashes were the main cause, followed by falls and assaults. Fractures of the angle were the most common (22%) followed by parasymphyseal fractures (21%) and the lowest was in the coronoid region (1%). While dentoalveolar fracture accounted for 5% of total mandibular fracture.

Geoffrey D Wood 2006¹⁹ used the Inion biodegradable plate system to treat patients with facial fractures. They inserted 100 miniplates (68 mandible, 15 maxilla, 12 zygomatic bone, 3 nose, and 2 thyroid cartilage). All the fractures healed. The Inion system has been successful in the maxilla but further work in the treatment of mandibular fractures is advisable. The new generation of miniplates that involves its incorporation into bone rather than its degradation may be the answer in the mandible; we must await the

research. Nevertheless these plates are successful in the treatment of some facial fractures particularly in the maxilla.

Mukerji R, McGurk M 2006⁴² stated that the principles of the treatment of mandibular fractures have changed recently, although the objective of re-establishing the occlusion and masticatory function remains the same. Splinting of teeth is an old way of immobilizing fractures but the advent of modern biomaterials has changed clinical practice towards plating the bone and early restoration of function. In the 18th and 19th centuries, fractures were treated quite successfully in outpatients.

During that period the potential for sepsis was ever present and access to anaesthesia limited, so treatment was conservative; the teeth were simply repositioned (without anaesthetic) using bandages and dental splints to hold them in alignment. Today, this work is undertaken in a more sophisticated way under general anaesthesia. The ability to control infection together with the advent of new biomaterials has revolutionized treatment. Now open reduction is the norm and tiny titanium plates are used to immobilize fragments of the jaw. Morbidity of the procedure is low with the advantage that the patient returns to normal function within days of treatment. But low morbidity comes at a price of expensive materials and the need for inpatient hospital facilities.

Bousdras VA et al 2006⁸ described a novel device for a bite force measurement system in a porcine model. A single polyethylene layer was

vaccum-formed into a splint and a force sensor was fitted on to the splint's occlusal surface and seated with a silicone layer. This design enabled the measurement of bite forces on selected teeth in a large animal model with either natural dentition or single implant crowns and could be used in assessing information on biomechanical adaptation of the bone–implant interface to masticatory loads. Preliminary recordings of force values obtained during mastication in the premolar region (200–560 N).

Timothy A Turvey et al 2006⁵⁶ compared the skeletal stability and treatment outcomes of 2 similar cohorts underwent bilateral sagittal osteotomies of the mandible for advancement. The study groups included patients stabilized with 2-mm self-reinforced polylactate (PLLDL 70/30), biodegradable screws (group B), and 2-mm titanium screws placed in a positional fashion (group T). Sixty-nine patients underwent bilateral sagittal osteotomies of the mandibular ramus for advancement utilizing an identical technique.

There were no clinical failures in group T and a single failure in group B. The average difference in stability between the groups is small and subtle different at the mandibular angle. The data documented the similarity of postsurgical changes in the 2 groups with the only statistically significant difference being the vertical position of the gonion ($P < .001$) and the mandibular plane angle ($P < .01$) with greater upward remodeling at gonion in group T. Two-mm self-reinforced PLLDL (70/30) screws can be used as

effectively as 2-mm titanium screws to stabilize the mandible after bilateral sagittal osteotomies for mandibular advancement. The difference in 1-year stability and outcome is minimal.

Gerrit J Buijs et al 2007²¹ presented relevant mechanical data to simplify the selection of an osteofixation system for situations requiring immobilization in oral and maxillofacial surgery. Seven biodegradable and 2 titanium osteofixation systems were investigated. The plates and screws were fixed to 2 polymethylmethacrylate (PMMA) blocks to simulate bone segments. The plates and screws were subjected to tensile, side bending and torsion tests. During tensile tests, the strength of the osteofixation system was monitored. The stiffness was calculated for the tensile, side bending and torsion tests.

The 2 titanium systems (1.5 mm and 2.0 mm) presented significantly higher tensile strength and stiffness compared with the 7 biodegradable systems (2.0 mm, 2.1 mm, and 2.5 mm). The 2.0 mm titanium system showed significantly higher side bending and torsion stiffness than the other 8 systems. Based on the results of the current study, it can be concluded that the titanium osteofixation systems were (significantly) stronger and stiffer than the biodegradable systems.

Andersson J, Hallmer F, Eriksson L 2007⁴ standardized the trauma charts at the University Hospital of Malmo, Sweden, which was used for

registration of all jaw fractures from 1972 to 1976. During the year 2005 the aim was to interview all patients treated non-surgically for unilateral mandibular condylar fractures during this period. In total, 49 patients with unilateral condylar fractures were treated non-surgically in 1972–1976.

Information from original records, radiographic reports and the standardized trauma charts revealed fracture site, type of fracture and intermaxillary fixation if any. Eighty-seven percent of the patients reported no pain from the jaws, 83% had no problems chewing and 91% reported no impact of the fracture on daily activities. The 31-year results of non-surgical treatment of unilateral non-dislocated and minor dislocated condylar fractures seem favourable concerning function, occurrence of pain and impact on daily life.

Robert M Laughlin et al 2007⁴⁸ evaluated that resorbable plates are equal to the performance of titanium 2-mm plates, regarding healing of the fracture with bone union and restoration of function. To prove this hypothesis, specific end points will be compared with literature norms for titanium 2-mm miniplate rigid fixation. The primary end point variable for this analysis is the union of the fracture and return to normal function. Secondary end point variables included the incidence of complications such as infection, malunion with malocclusion, soft tissue dehiscence, the need for revision surgery, specific technical challenges, operative time, and the learning curve for the surgeon. This prospective study consisted of a sequential enrollment of 50

fractures that met the inclusion criteria of having a fracture of the mandibular body, symphysis, angle, or ramus and required an open reduction and internal fixation for stabilization and repair.

Clinical and radiographic evaluation indicated union of all fractures at the eighth follow-up visit. Three sites (6%) noted to have clinical signs of infection were treated immediately upon presentation, with fracture union by 8 weeks. There was no need for revision surgery in this series of patients; 12 screw heads fractured during screw placement and were immediately replaced without significant fracture sequelae.

Simsek S et al 2007⁵¹ compared the data on mandibular fractures that occurred in a city in the United States and one in Turkey between 1991 and 2000. The 210 Turkish patients had 252 mandibular fractures, whereas the 665 US patients had 1042 mandibular fractures. Males accounted for 84% (560 patients) and females for 16% (105 patients) of the cases in the US. The male: female ratio was 5.5:1. In Turkey, males accounted for 76% (160 patients) and females for 24% (50 patients) of cases. The male : female ratio was 3.2:1. Assault (53.7%) was the most common cause of fracture in the US, whereas in Turkey the most common cause was a motor vehicle accident (36.2%). The most common site of mandibular fracture in the US was the angle (27.57%); in Turkey the most common site was the body (28.97%). Many of these variations may be related to socioeconomic, cultural and environmental differences between the two countries.

Buitrago Tellez CH 2008¹¹ evaluated a comprehensive classification system for mandibular fractures based on imaging analysis. The AO/ASIF scheme, defining three fracture types (A, B, C), three groups within each type (e.g. A1, A2, A3) and three subgroups within each group (e.g. A1.1, A1.2, A1.3) with increasing severity from A1.1 (lowest) to C3.3 (highest) was used. The mandible is divided into two vertical units (I and V), two lateral horizontal units (II and IV) and one central unit (III) comprising the symphyseal and parasymphyseal region. Type A fractures are non-displaced, type B are displaced and type C are multi fragmentary/defect injuries. Groups and subgroups are further defined in the classification system. Two classification sessions using semi-automatic software with 7 and 9 surgeons were performed to evaluate 100 fracture cases in the first session and 50 in the second. This system allows standardization of documentation of mandibular fractures, although improvement in the definition of categories and their application is required.

Olmedu DG 2008⁴⁴ evaluated histologically the biological effect of pitting corrosion and to contribute clinically relevant data on the permanence of titanium metal structures used in osteosynthesis in the body. Commercially pure titanium laminar implants (control) and commercially pure titanium laminar implants with pitting corrosion (experimental) were implanted in the tibiae of rats. The micro chemical analysis of corrosion products revealed the presence of titanium. The adverse local effects caused by pitting corrosion

suggest that titanium plates and grids should be used with caution as permanent fixation structures.

Ferretti C 2008¹⁷ analyzed the performance of poly-L-lactic/poly glycolic acid (PLLA/PGA) co-polymer plates and screws in the fixation of mandibular fractures. Following clinical and radiographic examination, internal fixation was achieved with PLLA/PGA co-polymer plates and screws in 31 patients. Elastic maxillomandibular fixation was maintained for 4 weeks and a blenderized diet for 6 weeks and evaluated clinically for swelling, pain, mucosal discoloration and occlusal relation. Segment stability, fracture healing and screw-hole ossification were assessed radiographically. Nine patients developed complications ranging from minor dehiscence (4 patients) to frank sepsis requiring plate removal (5 patients), resulting in a 22.5% complication rate. There were no cases of non-union at the end of the fixation period. The reported complication rate following titanium internal fixation of mandibular fractures is 13.7%-43%. PLLA/PGA co-polymer plate and screw fixation of mandibular fractures, although technically more challenging and costly, is a viable alternative to traditional metal devices in selected patients.

Leonhardt H et al 2008³⁴ studied two groups of 30 patients to assess the outcome of treatment of mandibular fractures with the biodegradable INION[®] system compared with osteosynthesis with titanium miniplates prospectively. The degree of occlusion, wound healing, and swelling, were noted preoperatively and at 1 week, 6 weeks, and 6 months postoperatively.

All fractures healed uneventfully, both clinically and radiologically, and independently of the osteosynthesis used INION plates were biocompatible and strong enough to treat mandibular fractures. The disadvantages of biodegradable materials such as costs, breakage of screws, more difficult operative handling and swelling of the plate during degradation contrast with the potential risks of removing the titanium plates (cost , time and a relatively high morbidity)

Burak Bayram et al 2009¹² compared the fixation reliability and stability of titanium and resorbable plates and screws by simulating chewing forces. Mandibular angle fractures in 11 sheep hemimandibles were fixed with 4-hole straight titanium plates and 2.0×7 -mm titanium screws; in addition, 11 hemimandibles were fixed with 4-hole straight resorbable plates and 2.5×6 -mm resorbable screws according to the Champy's technique. The hemimandibles were mounted with a fixation device in a servo hydraulic testing unit for compressive testing. Displacement values under 20, 60, 100, 120, 150, and 200 N; maximum displacements and maximum forces that the model could resist before breakage were recorded and compared.

Significant differences were found between resorbable and titanium plates and screws at all forces (20, 60, 100, 120, 150, and 200 N) ($P < .05$). They found that no statistically significant differences in the breaking force and maximum displacement values between the groups. The stability of

mandibular angle fractures with titanium miniplates under simulated chewing forces was significantly higher than with the resorbable system.

Sina Uckan et al 2009⁵² evaluated the effect of metallic rigid fixation of mandibular corpus fracture on mandibular growth in growing rabbits. Unilateral mandibular fractures were created in all of the animals and fixed with microplates and screws. Microplates that had been adapted for fixation of the left (experimental) side were also used as a template for the drilling procedure on the right (control) side of the mandible. The plate was then removed and screws were inserted. Digital submento vertex radiographs of each animal were taken before the operation and 6 months after surgery. Cephalometric values were analyzed. The distance between the centers of the 2 screws on the right side of the mandible was measured with a caliper in all samples and values were compared with measurements taken from the left (experimental) side of the mandible upon which the plates had been placed.

The mean amount of mandibular growth was 4.38 ± 2.43 mm on the right (control) side and 4.64 ± 2.27 mm on the left (experimental) side. This difference was not statistically significant ($P > .05$). The distance between the 2 screws was 13.89 ± 0.23 mm on the experimental side and 13.44 ± 0.46 mm on the control side. This difference was statistically significant ($P < .05$). Metallic fixation of a mandibular body fracture did not cause mandibular asymmetry or restricted mandibular growth in growing rabbits in this relatively small sample.

Connell JO et al 2009¹³ evaluated the indications for the removal of titanium miniplates following osteosynthesis in maxillofacial trauma and orthognathic surgery. All patients who had miniplate placed in a Regional Oral and Maxillofacial Department between January 1998 and October 2007 were included. The following variables were recorded patient gender and age, number of plates inserted, indications for plate placement, location of plates, number and location of plates removed, indications for plate removal, time between insertion and removal, medical co-morbidities, and the follow-up period. During the 10 years of the study, 1247 titanium miniplates were placed in 535 patients. A total of 32 (3%) plates were removed from 30 patients. Superficial infection accounted for 41% of all plates removed. All complications were minor and most plates were removed within the first year of insertion. A low removal rate of 3% suggests that the routine removal of asymptomatic titanium miniplates is not indicated.

HyoBin Lee et al 2010²⁵ compared the use of biodegradable miniplates and titanium miniplates for the fixation of mandibular fractures. BioSorb FX biodegradable plates and screws and titanium miniplates were used in 91 patients (65 males and 26 females; age range 11 to 69 years) for the treatment of mandibular fractures. The overall complication rate was 4.41%. In the biodegradable plate group, infection occurred in 2 cases (4.26%) and was resolved by incision and drainage and antibiotics. In the titanium plate group, infection occurred in 1 case and plate fracture in 1 case (4.56%).

Results have shown that the rate of morbidity is very low with the use of biodegradable plates and titanium plates, suggesting that biodegradable and titanium plates have the potential for successful use in the fixation of mandibular fractures.

KrishnaBhatt et al 2010³² compared bioresorbable fixation versus titanium for equivalence in terms of clinical union and complications using the American Association of Oral and Maxillofacial Surgeons parameters of care. A total of 40 patients were enrolled and allocated to the titanium group and bioresorbable group using a computerized randomization table. Evaluation of the study endpoint was done at 8 weeks postoperatively.

Of the 40 patients, 21 were in the titanium group and 19 were in the bioresorbable group. The complications noted were nonunion in 0%, malocclusion in 7.7%, continued postoperative swelling in 0%, chronic pain in 2%, infection in 5.2%, an inability to chew hard food after 8 weeks in 7.7%, the need for alternative treatment in 0%, and the need for reoperation in 31%. In the bioresorbable group, the complications were nonunion in 4.17%, malocclusion in 11.1%, swelling in 8.3%, chronic pain in 37.5%, infection in 0%, an inability to chew hard food in 11.1%, the need for alternative treatment in 11.1%, and need for reoperation for plate removal in 0%. The avoidance of repeat surgery for plate removal is a definite advantage of using resorbable plates.

Hang Wang et al 2010²³ analysed the stress distribution in a symphyseal fractured human mandible reduced by 2 different methods--reduction with 1 miniplate or with 2 miniplates by using finite element analysis, and then compared the results with an intact mandible. Three-dimensional Finite element models of an intact mandible and symphyseal fractured mandibles reduced by 2 fixation methods were developed to analyze mandibular stress distribution and bite forces under 2 basic loading conditions, namely clenching in the intercuspal position and left unilateral molar clenching. It is suggested that the effect of the miniplates in stabilizing the continuity-broken mandible influence the restorations of the stress distribution pattern and bite force. Two miniplates have a biomechanical advantage over 1 miniplate on these restorations.

De Matos FP et al 2010¹⁴ evaluated the epidemiology, treatment and complications of mandibular fracture associated, or not associated, with other facial fractures, when the influence of the surgeon's skill and preference for any rigid internal fixation system devices was minimized. The files of 700 patients with facial trauma were available and 126 files were chosen for review. Data were collected regarding gender, age, race, date of trauma, date of surgery, addictions, etiology, signs and symptoms, fracture area, complications, treatment performed, date of hospital discharge, and medication. The incidence of mandibular fractures was more prevalent in males, in Caucasians and during the third decade of life. The most common

site was the condyle, followed by the mandibular body. The therapy applied was effective in handling this type of fracture and the success rates were comparable with other published data.

Tuovinen V et al 2010⁵⁸ evaluated the stability of rigid internal fixation in orthognathic surgery with either bioabsorbable or titanium osteosynthesis. Orthognathic surgery was performed on 101 patients that include bilateral sagittal ramus osteotomy, Le Fort I osteotomy ,bimaxillary osteotomies . Poly-70L/30DL-lactide copolymer (PLDLA) consisting of 70% L-lactide and 30% DL-lactide was used as the bioabsorbable osteosynthesis material. These plates and screws were compared with corresponding titanium materials. Statistically a clear relapse tendency was seen in skeletal measurements in all patient groups but without clinical importance.The materials used did not cause any adverse reaction except in three cases, one in the bioabsorbable group and two in the titanium group where fistula in connection with the osteosynthesis material was noted resulting in removal of the materials. Based on the current study , it can be concluded that the use of bioabsorbable materials in orthognathic surgery is reliable.

Yu Seok Ahn et al 2010⁶⁰ evaluated the clinical application of resorbable and non resorbable plates for correction of facial asymmetry. A total of 272 patients who had undergone orthognathic surgery were enrolled. The site of osteotomy was fixed using a non resorbable plate in group I (n = 152) and using a resorbable plate in group II (n = 120). The postoperative

complications included postoperative anterior open bite, infection, temporomandibular joint dysfunction, and postoperative relapse. The incidences of all complications were examined. The surgical outcome was successful in 269 patients (98.89%). Of the 152 patients with a titanium plate, 13 (8.6%) developed complications. Of the 120 patients with a resorbable plate, 22 (18.3%) developed complications. A greater degree of postoperative open bite and a trend toward relapse were observed in patients' cases in which an absorbable fixation plate was used. Postoperative infection occurred in patients with an absorbable fixation plate. On the basis of these data, They have concluded that an absorbable fixation plate should be used instead of a titanium fixation plate in indicated patients.

Izumi Yoshioka et al 2011²⁸ compared material related complications using biodegradable and titanium miniplates after bilateral sagittal split mandibular setback surgery. The subjects included 200 Japanese adults (67 men and 133 women, age range 18 to 45 years) with jaw deformities diagnosed as mandibular prognathism. All patients were prospectively and consecutively randomized to 2 study groups, receiving biodegradable or titanium fixation plates. Of the 200 patients, 110 underwent bilateral sagittal split ramus osteotomy with a biodegradable fixation plate and 90 underwent bilateral sagittal split ramus osteotomy with a titanium metal plate. The clinical records and radiologic findings of the patients were reviewed, and the incidence of material-related complications was compared.

The incidence of postoperative complications and breakage in the biodegradable group was 8.2% (9 cases) and in the titanium group was 3.3% (3 cases). No statistically significant difference in the incidence of complications was found between the 2 groups. Fractures of the biodegradable plate occurred at a significantly greater frequency in patients with asymmetry than in patients without asymmetry. Biodegradable plates were reliable with minimal material related complications. However, the use of biodegradable plates should be recommended for minimally loaded situations.

Bregagnolo LA et al 2011¹⁰ compared, by mechanical in vitro testing, a 2.0-mm system made with poly-L-DL-lactide acid with an analogue titanium-based system. Mandible replicas were used as a substrate and uniformly sectioned on the left mandibular angle. The 4-hole plates were adapted and stabilized passively in the same site in both groups using four screws, 6.0mm long. During the resistance-to-load test, the force was applied perpendicular to the occlusal plane at three different points: first molar at the plated side; first molar at the contralateral side; and between the central incisors. At 1mm of displacement, no statistically significant difference was found. At 2mm displacement, a statistically significant difference was observed when an unfavourable fracture was simulated and the load was applied in the contralateral first molar and when a favourable fracture was simulated and the load was applied between the central incisors. In conclusion, despite more failure, the poly-L-DL-lactic acid-based system was effective.

Brajdic D et al 2011⁹ evaluated inferior alveolar nerve disturbances by assessing tooth sensitivity after mandibular fracture with the use of an electric tester and to determine the number of denervated teeth and time period in which normalization of tooth sensitivity or devitalisation occurred. The sensitivity of teeth anterior to a fracture between the mental and mandibular foramina has been tested and followed up until reinnervation or 3 years has passed. This study assessed the reinnervation period, the number of denervated teeth, and their clinical importance. Fifty patients and 459 teeth were examined. Two hundred and seventy-three teeth were affected and had potentially impaired innervation. Denervated teeth should not be treated if no clinical or radiological signs of devitalisation exist.

Turvey TA, Proffit WP, Phillips C 2011⁵⁹ included in the sample are 745 patients who underwent 761 separate operations, including more than 1400 surgical procedures (orthognathic surgery (685), bone graft reconstruction (37), trauma (191) and transcranial surgery (20). Patient acceptance, safety, and efficacy of poly-L/DL-lactic acid (PLLDL) bone plates and screws in craniomaxillofacial surgery was reported. The success (no breakage or inflammation requiring additional operating room treatment) was 94%. Failure occurred because of breakage (14) or exuberant inflammation (31).

All breakage occurred at mandibular sites and the majority of inflammatory failure occurred in the maxilla or orbit (29), with only two in the

mandible. PLLDL 70/30 bone plates and screws may be used successfully in a variety of craniomaxillofacial surgical applications. The advantages include the gradual transference of physiological forces to the healing bone, the reduced need for a second operation to remove the material and its potential to serve as a vehicle to deliver bone-healing proteins to fracture/osteotomy sites. Bone healing was noted at all sites, even where exuberant inflammation required a second surgical intervention.

Materials and Methods

MATERIALS AND METHODS

STUDY DESIGN

This study consisting of a sequential enrollment of 32 fractures met the inclusion criteria of having a fracture of the mandibular body, symphysis, parasymphysis, angle, condylar region, and required an open reduction and internal fixation for stabilization and repair. All patients who presented for treatment of mandibular fractures were treated regardless of systemic disease, use of tobacco, alcohol abuse, and/or drug abuse. All patients were treated at Sri Ramakrishna general hospital, Coimbatore.

MATERIALS

From March 2009 to 2011 two groups of 32 patients with isolated mandibular fracture evaluated with 2 mm INION[®] bioresorbable miniplates and 2 mm titanium miniplates and screws. The assignment of the patients to the two groups was initially planned to be randomised, however on occasion, unavailability of the required plating system did not allow this. The groups were similar: patients in the INION group had a mean age of 46 years (range 20 to 72), and 6 were male and 2 female. In the titanium group the mean age was 43 years (range 18 to 67), and 18 were male and 6 female.

The patients in the INION[®] group had 8 mandibular fractures (1 symphyseal, 7 parasymphyseal.). In the titanium group, 24 mandibular fractures were treated (13 parasymphyseal, 5 symphysis and 6 mandibular

angle). Three patients in the INION[®] group and 9 in the titanium group had additional fractures of the mandibular condyle that were treated by closed reduction.

Fractures were treated by open reduction under general anaesthesia or local anaesthesia. The miniplates were adapted to the bone and the reduced fracture was fixed by inserting mono cortical screws according to Champy's principles. Wounds were closed with 3-0 black silk. Postoperative intermaxillary fixation (IMF) was used in combined parasymphysis and condylar fractures, symphysis and condylar fractures. Osteosynthesis was achieved with 2 mm INION[®] bioresorbable and titanium miniplates.

SEQUENCE OF PATIENT CARE

On initial presentation to the department, patients were clinically and radio graphically evaluated. Mandible fractures combined with condylar fractures were manually reduced and patients were placed into maxillomandibular fixation with the use of arch bars or eyelets and 26-gauge wires with heavy elastics under local anesthesia. All patients received either

- Cap.Amoxycillin-500mg(TID) for five days or
- Inj.Taxim - 1g (BID)-IV for 5 days
- Tab.Aceclofenac (BID) and

- Chlorhexidine mouth rinse (2 times/ day) for 1 week.

Patient's folders were assigned a numeric reference specific for each case. Clinical examination was performed. Extra oral and intraoral photographs were taken and panoramic radiographs or CT scan was taken. Preoperative data forms were completed and placed into the patient's case folder.

Subsequently, the patient was scheduled for open reduction under general anesthesia or local anesthesia either on the same day of the fracture or within seven days. On postoperative period, patients underwent clinical examination that included pain, paraesthesia, oedema, infection, mouth opening, occlusion, step deformity, malunion and postoperative panoramic radiographs were taken.

The patient was given follow-up appointments for postoperatively 1st week, 1st month and after 6 months and discussion criteria such as included pain, paraesthesia, odema, infection, mouth opening, occlusion, step deformity, malunion were evaluated . Bite force were evaluated to assess the stability of bioresorbable and titanium miniplates fixation in parasymphysis fractures by using indigenous bite force equipment in anteriors, canines, molars (5 bite point). Panoramic radiographs were taken at the final visit after 6 months. Data were collected and statistically analysed and compared.

SRI RAMAKRISHNA DENTAL COLLEGE AND HOSPITAL.

DEPARTMENT OF ORAL & MAXILLOFACIAL SURGERY

PROFORMA FOR EVALUATION

NAME: I.P.No:

AGE: OPD No.:

SEX: DOA:

ADDRESS: DOS:

OCCUPATION: DOD:

1. COMPLAINTS

- Facial asymmetry
- Inability to open the mouth
- Bleeding from ear, nose or mouth.
- Difficulty to eat.
- Discharge from the wound.

2. HISTORY

- Cause of Trauma
- H/O unconsciousness

- H/O vomiting

- H/O amnesia

- H/O epistaxis

- H/O bleeding from ear, nose, mouth

- Number of days lapsed after trauma

- Medical history
 - CVS

 - RS

 - CNS

 - Personal habits

 - Family history

3. CLINICAL EXAMINATION:

- General Examination.

- Local Examination

EXTRA ORAL

a. Inspection

- Hemorrhage
- Laceration
- Tissue loss
- Abrasion
- Edema
- Ecchymosis
- Contour defects
- CSF leak.

b. Palpation

- Tenderness
- Step deformity

INTRA ORAL

a. Inspection

- No. of Teeth
- Teeth in the line of fracture

- Presence of infection
- Hematoma
- Trismus
- Deviation of the jaw
- Ecchymosis
- Occlusion after the injury

b. Palpation

- Tenderness of tooth / teeth
- Tenderness at fracture site
- Step deformity
- Bimanual palpation
- TMJ movements
- Paraesthesia or anaesthesia of the involved nerve.

4. RADIOGRAPHIC EXAMINATION

OPG

CT scan

PA Chest

5. CLASSIFICATION OF FRACTURE

6. LABORATORY INVESTIGATIONS

- Hemoglobin %
- Bleeding time, clotting time
- Total Leukocyte count
- Differential Leukocyte count
- Blood urea
- Serum creatinine
- Blood group
- Electrocardiogram
- Random blood sugar
- HIV,HbsAg,HCV

7. TREATMENT

- REDUCTION

a. Closed

b. Open

- FIXATION

a. 2 mm Titanium miniplates

b. 2 mm Bioresorbable miniplates

POST OPERATIVE EVALUATION OF THE PATIENT

Inclusion Criteria:

- Post operative pain
- Paraesthesia
- Post operative infection
- Oedema
- Mouth opening
- Occlusion
- Step deformity
- Malunion
- Bite Force measurement

b. RADIOLOGICAL

- O.P.G's

a. Pre operative

b. Immediate post operative

c. 1st week post operative

d. 1st month post operative

c. 6th month post operative

TABLE -1: PATIENT DATA

S. NO	PATIENT NAME	AGE	SEX	CAUSE OF INJURY	DIAGNOSIS	FIXATION	FOLLOW UP
1	Mr.Siva Kumar	20	Male	RTA	# Right Sub Condyle, # Left Parasymphysis	Titanium	1 Year
2	Mr.Jeevasakthi	22	Male	RTA	#Right Parasymphysis # Left Condyle	Bioresorbable	1 Year
3	Mr.Gowtham	18	Male	RTA	#Left Condyle #Right Parasympysis	Titanium	1 Year
4	Mrs .Kavitha	28	Female	Fall	# Symphysis # Bilateral Condyle	Titanium	1 Year
5	Mr.Krishnan	65	Male	RTA	# Right Parasymphysis #Left Angle	Biorsorbable	1 Year
6	Mr . Mohana Sundaram	23	Male	RTA	# Right Parasymphysis	Titanium	10 Months
7	Mr.Ramesh Kumar	29	Male	RTA	# Left Parasymphysis	Bioresorbable	10 Months
8	Mr.Ravi Chandran	34	Male	RTA	# Left Parasymphysis # Right Condyle	Bioresorbabale	10 Months
9	Mr.Mani	38	Male	RTA	# Symphysis	Titanium	1 Year
10	Mrs.Chitradevi	39	Female	RTA	# Bilateral Paasymphysis	Titanium	1 Year
11	Mrs.Chinnakkal	30	Female	RTA	# Left Parasymphysis # Bilateral Condyle	Titanium	1 Year
12	Mr.Selvam	34	Male	RTA	# Left Angle,Parasymphysis # Right Cndyle	Titanium	1 Year
13	Mrs.Aisha Banu	35	Female	Fall	# Angle Of The Mandible	Titanium	7 Months
14	Mrs.Kanagamani	36	Female	RTA	# Symphysis	Bioresorbable	7 Months
15	Mr.Arun Kumar	23	Male	FALL	# Left Angle Of The Mandible	Titanium	6 Months
16	Mr.Jayakumar	28	Male	RTA	# Symphysis	Titanium	6 Months
17	Mr.Selvaraj	24	Male	RTA	# Right Parasymphysis # Left Condyle	Titanium	6 Months
18	Mr.Nagalingam	40	Male	RTA	# Right Angle	Titanium	6 Months
19	Mrs.Suseela	21	Female	Fall	# Left Angle	Titanium	6 Months
20	Mr.Ravikumar	23	Male	RTA	# Symphysis	Titanium	6 Months

Materials and Methods

21	Mr.Eswaramoorthy	20	Male	RTA	# Symphysis	Titanium	6 Months
22	Mr .Dhandapani	29	Male	RTA	# Parasymphysis	Titanium	18 Months
23	Mrs.Latha	26	Female	RTA	# Right Parasymphysis # Bilateral Condyle	Titanium	1 Year
24	Mr.Marappan	30	Male	RTA	# Right Parasymphysis # Right Sub-Condyle	Titanium	10 Months
25	Mr.Sathish	19	Male	Fall	# Right Parasymphysis # Left Angle	Titanium	6 Months
26	Mr.Mahendran	38	Male	RTA	# Left Parasympyhsis # Right Sub - Condyle	Titanium	6 Months
27	Mr.Palanisamy	67	Male	RTA	# Left Parasymphysis	Titanium	6 Months
28	Mr.Palanisamy	53	Male	Fall	# Right Angle	Titanium	1 Year
29	Mr.Mohammed Rafiq	20	Male	RTA	# Right Parasymphysis	Bioresorbable	6 Months
30	Mr.Surender	27	Male	Fall	# Symphysis # Left Condyle	Titanium	6 Months
31	Mrs.Latha	35	Female	Assault	# Left Parasymphysis	Bioresorbable	4 Months
32	Mr.Nachimuthu	72	Male	RTA	# Right Parasymphysis # Left Angle,Ramus	Bioresorbable	4 Months

Figures



Figure1: Armamentarium – Titanium Mini Plate Fixation



Figure 2: Titanium Mini Plates & Screws



Figure 3: Armamentarium –Bioresorbable Mini Plate Fixation



Figure 4: Bioresorbable Mini Plates & Screws, Pilot Drill, Screw Holders



Figure 5: Bite Force Measurement Equipment

TITANIUM MINI PLATES FIXATION



Figure 6: Titanium Group: Pre-Operative Photograph



Figure 7: Titanium Group: Pre-Operative Radiograph



Figure 8: Titanium Mini Plates Fixation

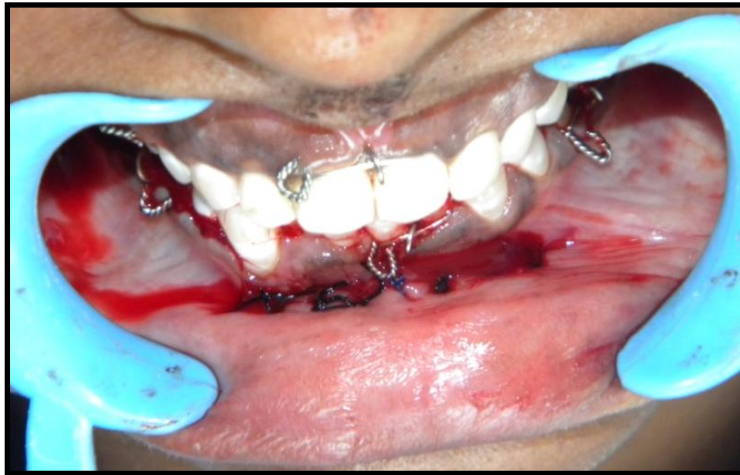


Figure 9: Titanium Group: Wound Closure



Figure 10: Titanium Group: Immediate Postoperative Radiograph



Figure 11: Titanium Group: 6th month Postoperative Radiograph

BIODEGRADABLE MINIPLATE FIXATION



Figure 12: Bioresorbable Group: Pre-Operative Photograph



Figure 13: Bioresorbable Group:Pre Operative Radiograph



Figure 14: Bioresorbable Mini Plates Fixation



Figure 15: Bioresorbable Group: Wound Closure



Figure 16: Bioresorbable Group: Immediate Post Operative Radiograph



Figure 17: Bioresorbable Group: 6th Month Post Operative Radiograph

Results

RESULTS

A 2-year clinical study was conducted between titanium and bioresorbable miniplates in 32 patients who were treated for isolated mandibular fractures from 2009 to 2011 in the department of Oral and Maxillofacial surgery, Sri Ramakrishna Dental College and Hospital, Coimbatore.

The results of this study are shown under the following sub headings:

1. Age and Gender distribution.
2. Causes of mandibular fractures.
3. Time elapsed since the time of injury to initialization of treatment.
4. Anatomic sites of mandibular fractures.
5. Fixation of titanium and bioresorbable miniplates.
6. Bite force measurement after fixation

Mandibular fractures were analysed in the 32 patients with respect to:

AGE AND GENDER DISTRIBUTION:

Patients sustaining mandibular fractures ranged from 18 years to 72 years. There were 24 males and 8 females accounting for the 32 patients. The gender distribution of the study population over the 2-year period showed that males were affected 75% of the time compared with females (25%) for an

approximately 3:1 distribution ratio.(TABLE:3,GRAPH:2)

The peak incidence of trauma was noted with patients in 21 to 30 years of age accounting for 14 cases, amongst maximum were males and 31 to 40 years old were the second most common affected age group having 9 cases in their share.(GRAPH:1)

ETIOLOGY OF MANDIBULAR FRACTURES:

The major cause of mandibular fractures in this study was Road traffic accidents comprising 75% of the entire sample (24 patients). The second most common cause was falls (21.9%, 7 patients). The causes of the remainder of the mandibular fractures were grouped into Assault (1 patient, 3.1%). (TABLE: 4, GRAPH: 3)

TIME ELAPSED:

The majority of the patients were reported to the unit within one week of injury making 21(66%) cases of the total. 6 (19%) cases reported within the second week while 3(9%)cases reported within the third week and 2(6%) cases were reported in more than four weeks.(TABLE:5,GRAPH:4)

ANATOMIC SITES OF MANDIBULAR FRACTURES:

Amongst the 32 patients with mandibular fractures, single fractures of the mandible were present in 20 patients and two fractures were seen in 12 patients. 20 fractures occurred in the Parasymphyseal region of the mandible

and was the most frequently affected. This was followed by the Condylar region (12 fractures) and then the angle and symphysis region (6 fractures each). The most frequent combination of two sites was the parasymphyseal and Condylar region (10 fractures) (TABLE: 6, GRAPH: 5 GRAPH: 6).

FIXATION OF TITANIUM AND BIORESORBABLE MINIPLATES AND ITS COMPLICATIONS: (TABLE: 2, GRAPH: 7)

The patients with mandibular fractures were treated by open reduction and internal fixation with bioresorbable and titanium miniplates. Out of 32 patients, 24 patients were treated with 2mm titanium miniplates and screws and 8 patients were treated with 2 mm bioresorbable miniplates and screws. In few cases within the group Intermaxillary fixation was used commonly in fractures involving the condylar region.

1. PAIN

Out of 24 patients in titanium miniplate fixation, 8 patients (33.3%) were postoperative pain and in bioresorbable miniplate fixation 4 patients (50%) were postoperative pain during the 1st week follow up period. There is no significant association between the Miniplate fixation and pain. Since significant value is greater than 0.05 (5% level of significance) the null hypothesis is accepted. There is no significant difference between the fixation of Bioresorbable and Titanium Mini-plate statistically. (TABLE:7,GRAPH: 8)

2. PARAESTHESIA

Out of 24 patients in titanium miniplate fixation, no patients were reported postoperative paraesthesia and in bioresorbable miniplate fixation one patient(12.5%) were reported postoperative paraesthesia during the 1st week follow up period. There is no significant association between the Miniplate fixation and paresthesia. Since significant value is greater than 0.05 (5% level of significance), the null hypothesis is accepted. There is no significant difference between the fixation of Bioresorbable and Titanium Mini-plate statistically. (TABLE: 8, GRAPH: 9)

3. MOUTH OPENING

Out of 24 patients in titanium miniplate fixation, 4 patients (16.7%) were reported postoperative restricted mouth opening and in bioresorbable miniplate fixation 5 patients (62.5%) were reported postoperative paresthesia during the 1st week follow up period. There is significant association between the Miniplate fixation and restricted mouth opening. Since significant value is less than 0.05 (5% level of significance) the null hypothesis is rejected. Restriction of mouth opening is more common (62.5%) in Bioresorbable fixation than in Titanium (16.7%) during the first week of follow up. (TABLE: 9, GRAPH: 10)

4. OCCLUSION

Out of 24 patients in titanium miniplate fixation, 10 patients (41.7%) were deranged occlusion and in bioresorbable miniplate fixation 3 patients (37.5%) were deranged occlusion during the 1st week follow up period. There is no significant association between the miniplate fixation and occlusion. Since significant value is greater than 0.05 (5% level of significance) the null hypothesis is accepted. There is no significant difference between the fixation of Bioresorbable and Titanium Mini-plate statistically. (TABLE: 10, GRAPH: 11)

5. INFECTION

Out of 24 patients in titanium miniplate fixation, 2 patients (8.3%) were postoperative infection and in bioresorbable miniplate fixation 1 patient (12.5%) were postoperative infection during the 6th month follow up period. There is no significant association between the Miniplate fixation and occlusion. Since significant value is greater than 0.05 (5% level of significance) the null hypothesis is accepted. There is no significant difference between the fixation of Bioresorbable and Titanium Mini-plate statistically. (TABLE: 11, GRAPH: 12)

6. OEDEMA

Out of 24 patients in titanium miniplate fixation, 4 patients (16.7%) were reported postoperative oedema and in bioresorbable miniplate fixation 5

patients (62.5%) were reported postoperative oedema during the 1st week follow up period. There is significant association between the Miniplate fixation and post operativeoedema. Since significant value is less than 0.05 (5% level of significance) the null hypothesis is rejected. Postoperative oedema exists more in Bioresorbable (62.5%) than in Titanium fixations (16.7%) during the first week of follow up. (TABLE: 12, GRAPH: 13)

7. STEP DEFORMITY

Out of 24 patients in titanium miniplate fixation, 1 patient (4.2%) were step deformity and in bioresorbable miniplate fixation no patient were step deformity during the1st week follow up period. There is no significant association between the Miniplate fixation and step deformity.Since significant value is greater than 0.05 (5% level of significance) the null hypothesis is accepted. There is no significant difference between the fixation of Bioresorbable and Titanium Mini-plate statistically. (TABLE: 13, GRAPH:14)

8. MALUNION

Out of 24 patients in titanium miniplate fixation, 1 patient (4.2%) weremalunion and in bioresorbable miniplate fixation no patient was malunion during the1st week follow up period. There is no significant association between the Miniplate fixation and malunion.Since significant value is greater than 0.05 (5% level of significance) the null hypothesis is accepted.There is no

significant difference between the fixation of Bio-resorbable and Titanium Mini-plate statistically. (TABLE: 14, GRAPH: 15)

BITE FORCE MEASUREMENT AFTER FIXATION

(TABLE: 15, 16, 17, 18; GRAPH: 16)

Eleven patients with mandibular parasymphysis fracture who had been treated with miniplate osteosynthesis according to Champy's line of osteosynthesis were evaluated for bite force measurement. All fragments were stabilized following open reduction after an intraoral approach with a single miniplate fixation.

- The mean maximal bite force of the control group between the incisors were 125.62 N, between the canines 80.88 N (Right) and 69.29 N (Left).
- There was a slight but not significant difference between the molars of the left 227.33N and the right side (259.21 N).
- There is no significant difference between bioresorbable miniplate and titanium miniplate on evaluating the bite force for parasymphysis fracture.

Tables & Graphs

27	Mr.Ramesh Kumar	Present (1 Week) (Score :2-4)	Present (1 Week)			Present (1 Month)				Bioresorbable
28	Mr.Ravi Chandran			Restricted (1 Week)	Deranged (1 Week)		Present (1 Week)			Bioresorbable
29	Mrs.Kanagamani			Restricted (1 Week)			Present (1 Week)			Bioresorbable
30	Mr.Mohammed Rafiq	Present (1 Week) (Score :2-4)		Restricted (1 Week)	Deranged (1 Week)		Present (1 Week)			Bioresorbable
31	Mrs.Latha	Present (1 Week) (Score :2-4)		Restricted (1 Week)			Present (1 Week)			Bioresorbable
32	Mr.Nachimuthu	Present (1 Week) (Score :2-4)		Restricted (1 Week)			Present (1 Week)			Bioresorbable

TABLE – 3: SEX DISTRIBUTION

		FIXATION				Total	
		Titanium		Bioresorbable		Count	% within FIXATION
		Count	% within FIXATION	Count	% within FIXATION		
SEX	Male	18	75.0%	6	75.0%	24	75.0%
	Female	6	25.0%	2	25.0%	8	25.0%
Total		24	100.0%	8	100.0%	32	100.0%

TABLE – 4: CAUSE OF INJURY

		FIXATION				Total	
		Titanium		Bioresorbable		Count	% within FIXATION
		Count	% within FIXATION	Count	% within FIXATION		
CAUSE OF INJURY	RTA	17	70.8%	7	87.5%	24	75.0%
	Fall	7	29.2%	0	.0%	7	21.9%
	Assault	0	.0%	1	12.5%	1	3.1%
Total		24	100.0%	8	100.0%	32	100.0%

TABLE – 5: TIME ELAPSED SINCE INJURY

TIME ELAPSED SINCE THE TIME OF INJURY TO INITIALIZATION OF TREATMENT.	NO OF PATIENTS
1-7 days	21(66 %)
8-14 days	6(19%)
15-21 days	3(9%)
4 weeks and above	2(6%)

TABLE – 6: SITE OF FRACTURE

TYPE OF FRACTURE	TITANIUM	BIORESORBABLE	TOTAL
Parasymphysis	13	7	20
Combined condyle	8	2	10
Only Parasymphysis	5	5	10
Symphysis	5	1	6
Combined condyle	1	1	2
Only Symphysis	4	0	4
Angle	6	0	6

TABLE – 7: STATISTICAL ANALYSIS OF PAIN

			PAIN		Total
			No problem	Present	
FIXATION	Titanium	Count	16	8	24
		% within FIXATION	66.7%	33.3%	100.0%
	Bioresorbable	Count	4	4	8
		% within FIXATION	50.0%	50.0%	100.0%
Total		Count	20	12	32
		% within FIXATION	62.5%	37.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.711(b)	1	.399		
Continuity Correction(a)	.178	1	.673		
Likelihood Ratio	.697	1	.404		
Fisher's Exact Test				.433	.332
Linear-by-Linear Association	.689	1	.407		
N of Valid Cases	32				

- a. Computed only for a 2x2 table
- b. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.00.

TABLE – 8: STATISTICAL ANALYSIS OF PARAESTHESIA

Crosstab

			PARESTHESIA		Total
			No problem	Present	
FIXATION	Titanium	Count	24	0	24
		% within FIXATION	100.0%	.0%	100.0%
	Bioresorbable	Count	7	1	8
		% within FIXATION	87.5%	12.5%	100.0%
Total		Count	31	1	32
		% within FIXATION	96.9%	3.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.097(b)	1	.078		
Continuity Correction(a)	.344	1	.557		
Likelihood Ratio	2.872	1	.090		
Fisher's Exact Test				.250	.250
Linear-by-Linear Association	3.000	1	.083		
N of Valid Cases	32				

- a. Computed only for a 2x2 table
- b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .25.

TABLE – 9: STATISTICAL ANALYSIS OF MOUTH OPENING

Crosstab

			MOUTH OPENING		Total
			No Problem	Restricted	
FIXATION	Titanium	Count	20	4	24
		% within FIXATION	83.3%	16.7%	100.0%
	Bioresorbable	Count	3	5	8
		% within FIXATION	37.5%	62.5%	100.0%
Total		Count	23	9	32
		% within FIXATION	71.9%	28.1%	100.0%

Chi-Square Tests

	Value	df	Asymp.Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.235(b)	1	.013		
Continuity Correction(a)	4.174	1	.041		
Likelihood Ratio	5.812	1	.016		
Fisher's Exact Test				.023	.023
Linear-by-Linear Association	6.040	1	.014		
N of Valid Cases	32				

- a. Computed only for a 2x2 table
- b. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.25.

**TABLE – 10: STATISTICAL ANALYSIS OF OCCLUSION
Crosstab**

		OCCLUSION			Total
			No problem	Deranged	
FIXATION	Titanium	Count	14	10	24
		% within FIXATION	58.3%	41.7%	100.0%
	Bioresorbable	Count	5	3	8
		% within FIXATION	62.5%	37.5%	100.0%
Total		Count	19	13	32
		% within FIXATION	59.4%	40.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.043(b)	1	.835		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.043	1	.835		
Fisher's Exact Test				1.000	.587
Linear-by-Linear Association	.042	1	.838		
N of Valid Cases	32				

- a. Computed only for a 2x2 table
- b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.25.

TABLE – 11: STATISTICAL ANALYSIS OF INFECTION

Crosstab

			INFECTION		Total
			No problem	Present	
FIXATION	Titanium	Count	22	2	24
		% within FIXATION	91.7%	8.3%	100.0%
	Bioresorbable	Count	7	1	8
		% within FIXATION	87.5%	12.5%	100.0%
Total		Count	29	3	32
		% within FIXATION	90.6%	9.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.123(b)	1	.726		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.116	1	.734		
Fisher's Exact Test				1.000	.592
Linear-by-Linear Association	.119	1	.730		
N of Valid Cases	32				

- a. Computed only for a 2x2 table
- b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .75.

TABLE – 12: STATISTICAL ANALYSIS OF OEDEMA

Crosstab

			OEDEMA		Total
			No problem	Present	
FIXATION	Titanium	Count	20	4	24
		% within FIXATION	83.3%	16.7%	100.0%
	Bioresorbable	Count	3	5	8
		% within FIXATION	37.5%	62.5%	100.0%
Total		Count	23	9	32
		% within FIXATION	71.9%	28.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.235(b)	1	.013		
Continuity Correction(a)	4.174	1	.041		
Likelihood Ratio	5.812	1	.016		
Fisher's Exact Test				.023	.023
Linear-by-Linear Association	6.040	1	.014		
N of Valid Cases	32				

TABLE – 13: STATISTICAL ANALYSIS OF STEP DEFORMITY
Crosstab

			STEP DEFORMITY		Total
			No problem	Present	
FIXATION	Titanium	Count	23	1	24
		% within FIXATION	95.8%	4.2%	100.0%
	Bioresorbable	Count	8	0	8
		% within FIXATION	100.0%	.0%	100.0%
Total		Count	31	1	32
		% within FIXATION	96.9%	3.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.344(b)	1	.557		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.586	1	.444		
Fisher's Exact Test				1.000	.750
Linear-by-Linear Association	.333	1	.564		
N of Valid Cases	32				

- a. Computed only for a 2x2 table
- b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .25.

TABLE – 14: STATISTICAL ANALYSIS OF MALUNION

Crosstab

			MAL UNION		Total
			No problem	Present	
FIXATION	Titanium	Count	23	1	24
		% within FIXATION	95.8%	4.2%	100.0%
	Bioresorbable	Count	8	0	8
		% within FIXATION	100.0%	.0%	100.0%
Total		Count	31	1	32
		% within FIXATION	96.9%	3.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.344(b)	1	.557		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.586	1	.444		
Fisher's Exact Test				1.000	.750
Linear-by-Linear Association	.333	1	.564		
N of Valid Cases	32				

- a. Computed only for a 2x2 table
- b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .25.

TABLE -15: BITE FORCES IN CONTROL GROUPS

S. NO	AGE	MOLARS (RIGHT)	CANINE (RIGHT)	ANTERIOR TEETH	CANINE (LEFT)	MOLARS (LEFT)
1.	35	198.55 N	43.12 N	122.5 N	54.19 N	209.13 N
2.	32	310.87 N	122.5 N	160.13 N	65.66 N	237.16 N
3.	38	335.16N	156.90 N	126.81 N	131.22 N	219.13 N
4.	32	183.16 N	68.69 N	111.82 N	63.60 N	187.28 N
5.	40	185.12 N	19.50 N	117.80 N	25.38 N	187.96 N
6.	31	277.34 N	38.22 N	92.12 N	33.32 N	181.30 N
7.	35	317.52 N	109.76 N	141.12 N	104.86 N	384.16 N
8.	34	336.73 N	105.06 N	202.46 N	68.89 N	228.93 N
9.	37	275.38 N	101.92 N	81.54 N	101.92 N	213.93 N
10.	39	172.28 N	43.22 N	99.96 N	43.90 N	224.32 N

TABLE -16: BITE FORCES IN PATIENTS AFTER TREATMENT OF MANDIBULAR PARASYMPHYSIS FRACTURES

S. NO	PATIENT NAME	AGE/S EX	FIXATION	MOLARS (RIGHT)	CANINE (RIGHT)	ANTERIOR TEETH	CANINE (LEFT)	MOLARS (LEFT)
1.	Mr.Siva kumar	22/M	TITANIUM	242.06 N	86.24 N	116.62 N	91.14 N	26.80 N
2.	Mr.Gowtham	18/M	TITANIUM	218.54 N	82.32 N	99.96 N	70.56 N	291.06 N
3.	Mrs.Chinnakkal	30/F	TITANIUM	183.3 N	50.96 N	93.10 N	65.66 N	169.54 N
4.	Mr.Marappan	30/M	TITANIUM	291.06 N	95.06 N	120.73 N	80.36 N	269.5 N
5.	Mr.Sathish	19/M	TITANIUM	195.02 N	80.36 N	130.34 N	72.52 N	208.74 N
6.	Mr.Mahendran	38/M	TITANIUM	266.66 N	43.12 N	81.34 N	70.56 N	232.26 N
7.	Mr.Palanisamy	67/M	TITANIUM	238.14 N	60.76 N	97.02 N	76.44 N	198.94 N
8.	Mr.Ramesh kumar	29/M	BIORESORBABLE	204.82 N	66.15 N	102.9 N	86.24 N	231.28 N
9.	Mr.Ravi chandran	34/M	BIORESORBABLE	241.08 N	86.24 N	61.74 N	67.62 N	261.66 N
10	Mr.Mohammed rafiq	20/M	BIORESORBABLE	259.7 N	77.42 N	98.98 N	109.76 N	533.12 N
11.	Mrs.Latha	35/F	BIORESORBABLE	190.12 N	54.88 N	70.56 N	71.54 N	179.34 N

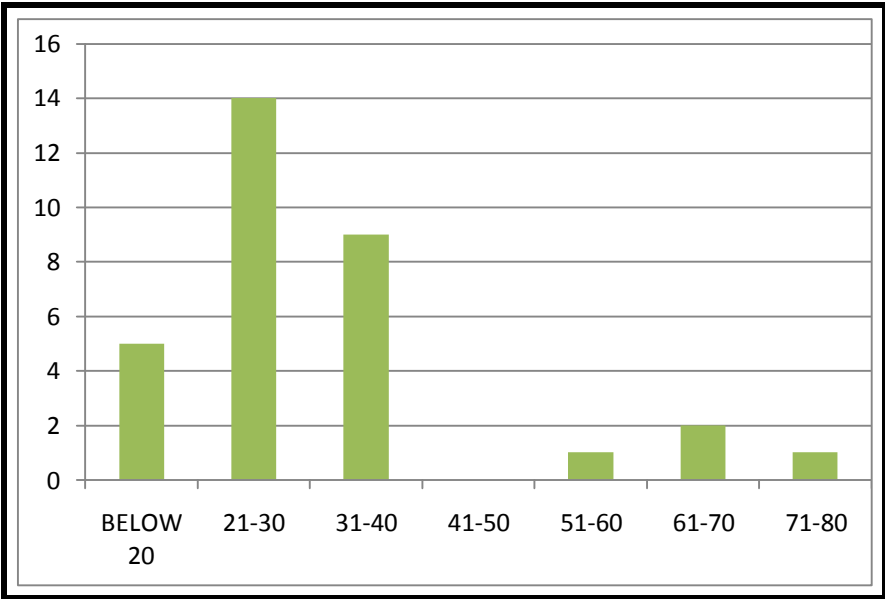
**TABLE -17: STATISTICAL ANALYSIS FOR BITE FORCE
MEASUREMENT-ONE-WAY**

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
MOLARS(RIGHT)	Between Groups	4690.754	2	2345.377	.800	.465
	Within Groups	52760.128	18	2931.118		
	Total	57450.882	20			
CANINE (RIGHT)	Between Groups	488.898	2	244.449	.211	.811
	Within Groups	20819.647	18	1156.647		
	Total	21308.545	20			
ANTERIOR TEETH	Between Groups	5359.300	2	2679.650	3.352	.058
	Within Groups	14391.621	18	799.535		
	Total	19750.921	20			
CANINE (Left)	Between Groups	616.952	2	308.476	.470	.633
	Within Groups	11820.945	18	656.719		
	Total	12437.897	20			
MOLARS (Left)	Between Groups	26826.849	2	13413.424	1.601	.229
	Within Groups	150808.590	18	8378.255		
	Total	177635.438	20			

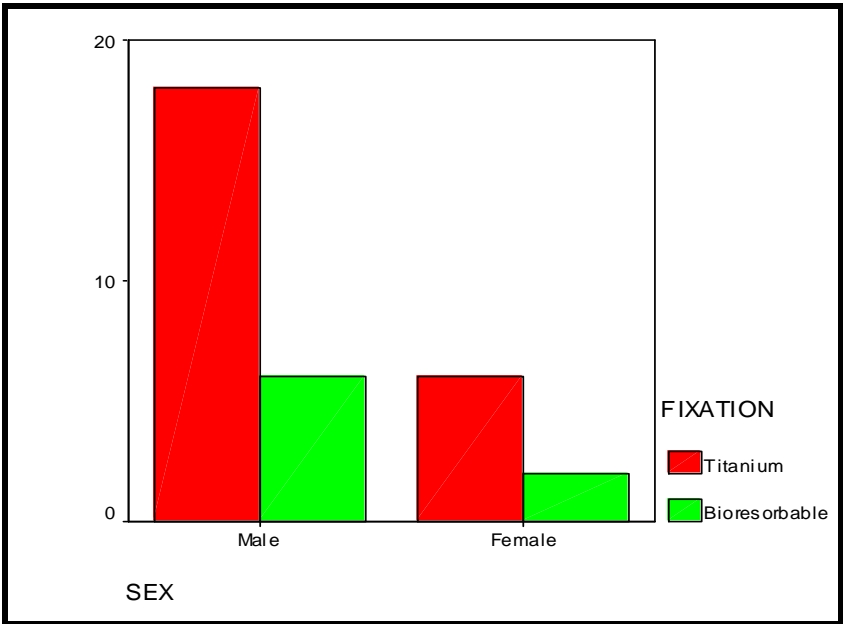
TABLE -18: STATISTICAL ANALYSIS FOR BITE FORCE MEASUREMENT-KRUSKAL WALLIS TEST

Ranks			
	FIXATION	N	Mean Rank
MOLARS(RIGHT)	Control group	10	12.30
	Titanium	7	10.14
	Bio-resorbable	4	9.25
	Total	21	
CANINE (RIGHT)	Control group	10	11.65
	Titanium	7	10.43
	Bio-resorbable	4	10.38
	Total	21	
ANTERIOR TEETH	Control group	10	13.75
	Titanium	7	10.21
	Bio-resorbable	4	5.50
	Total	21	
CANINE (Left)	Control group	10	8.85
	Titanium	7	12.36
	Bio-resorbable	4	14.00
	Total	21	
MOLARS (Left)	Control group	10	10.60
	Titanium	7	10.00
	Bio-resorbable	4	13.75
	Total	21	

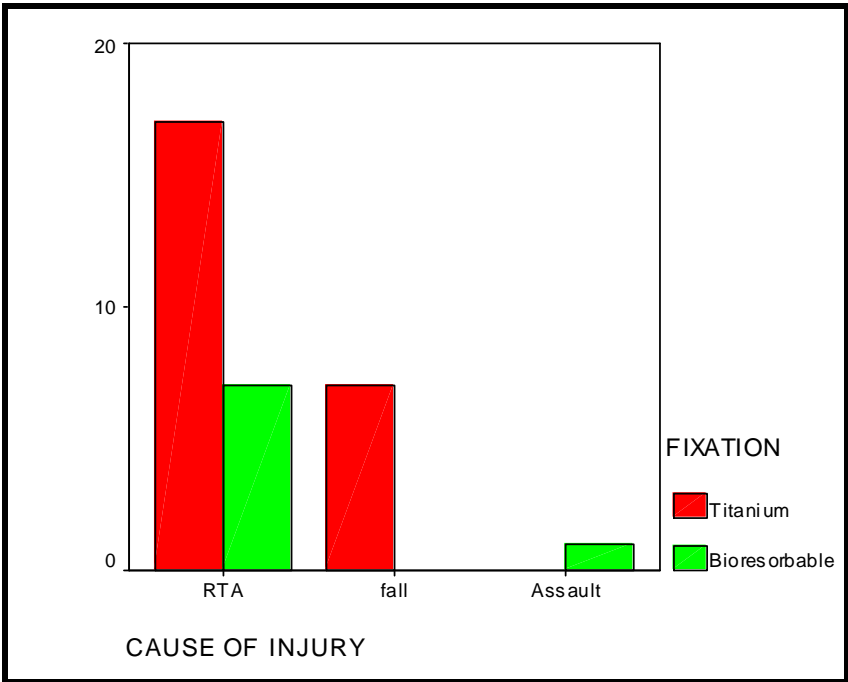
GRAPH – 1: AGE DISTRIBUTION



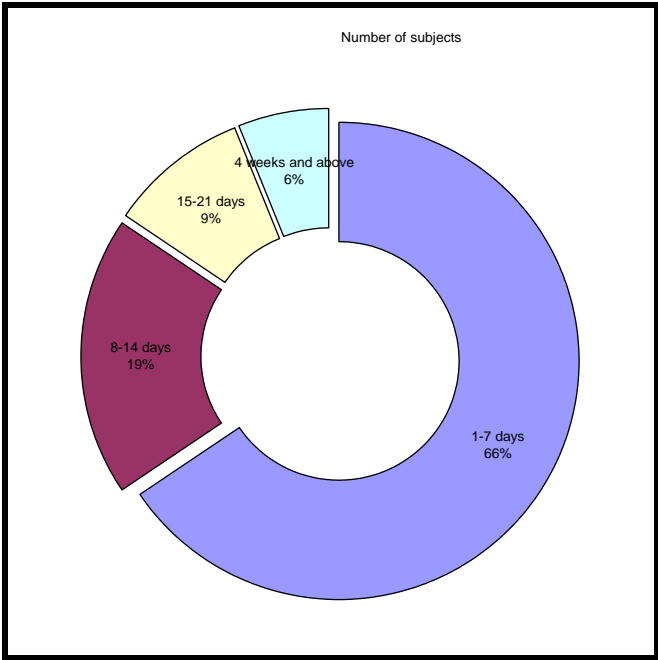
GRAPH – 2: SEX DISTRIBUTION



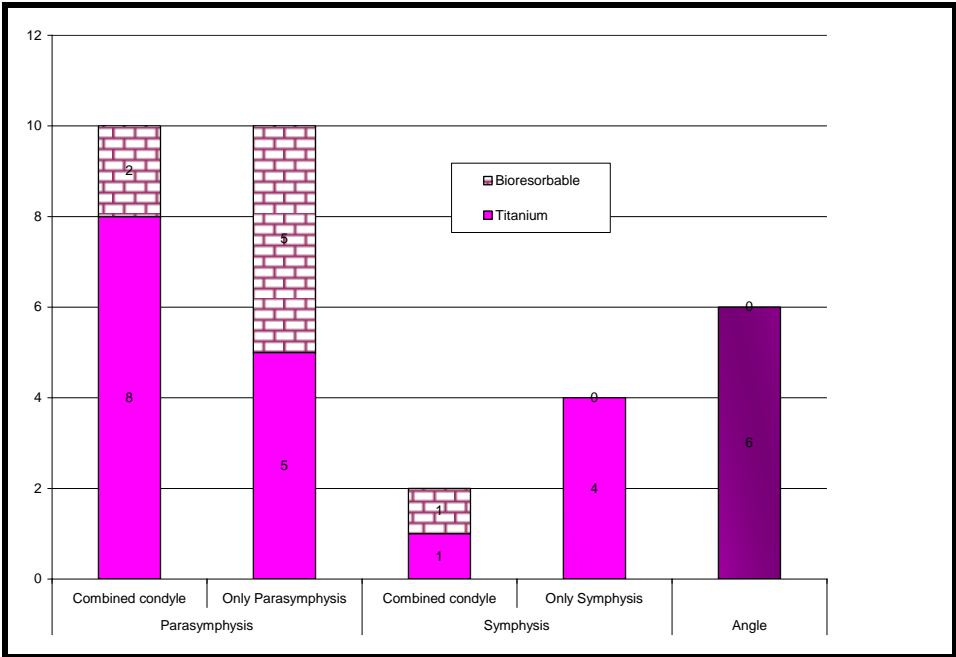
GRAPH – 3: CAUSE OF INJURY



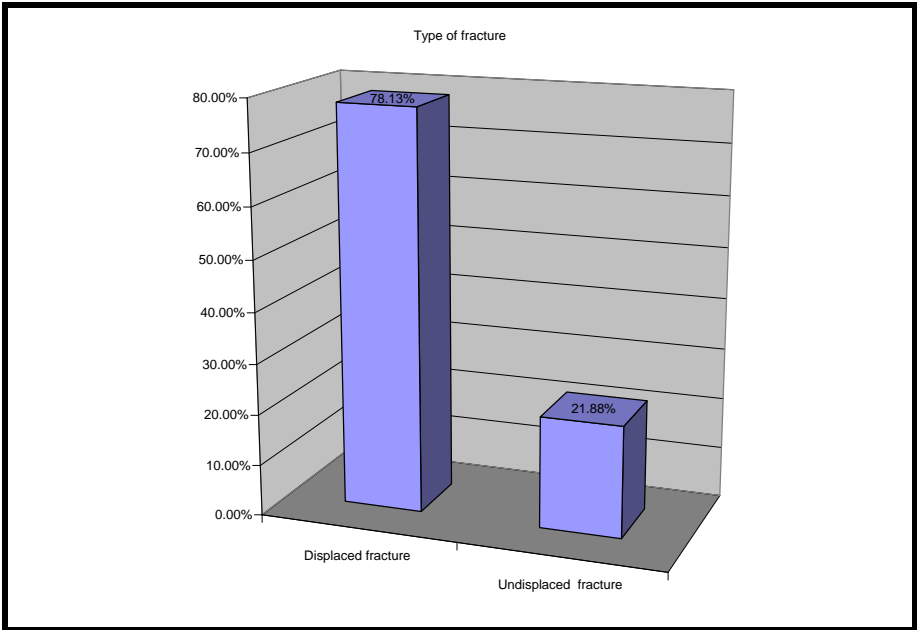
GRAPH – 4: TIME ELAPSED SINCE INJURY



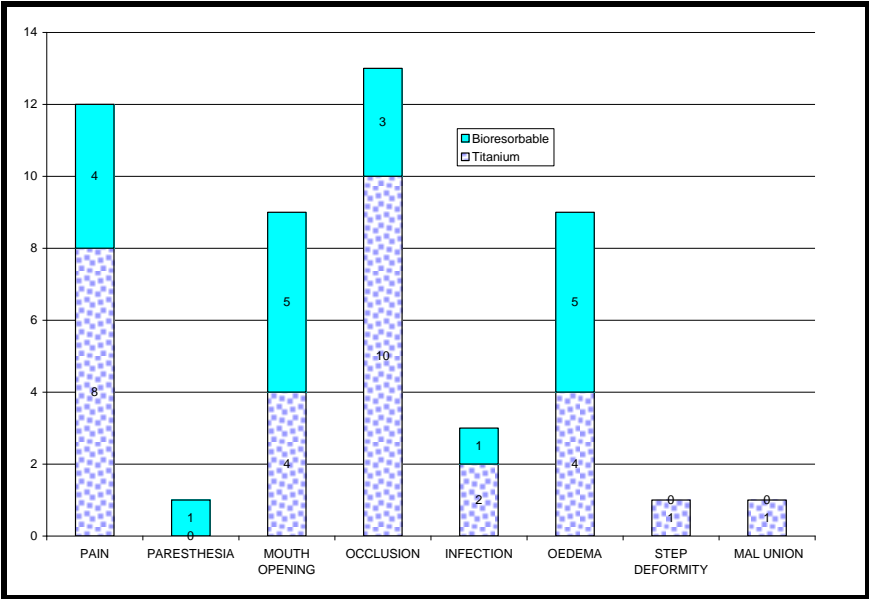
GRAPH – 5: SITE OF FRACTURE



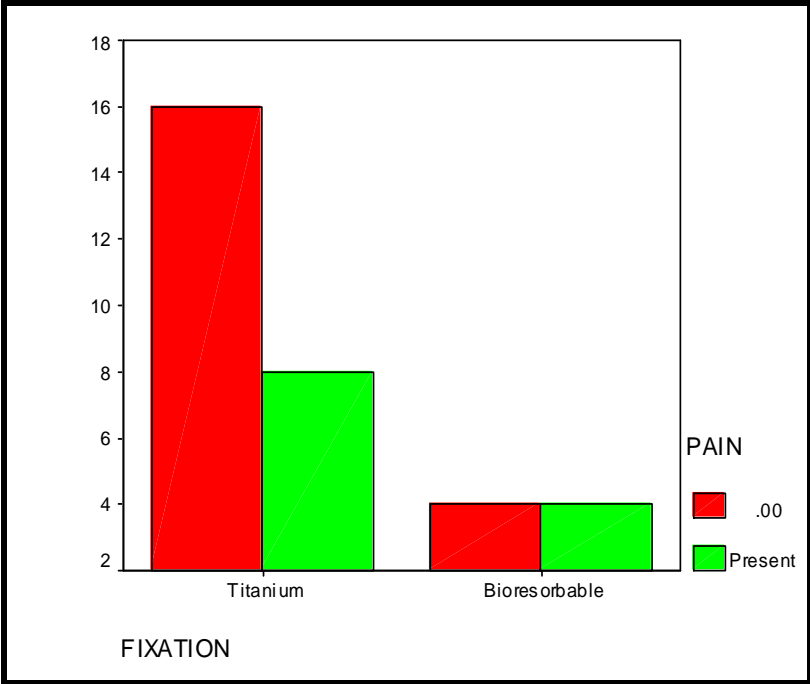
GRAPH –6: TYPE OF FRACTURE



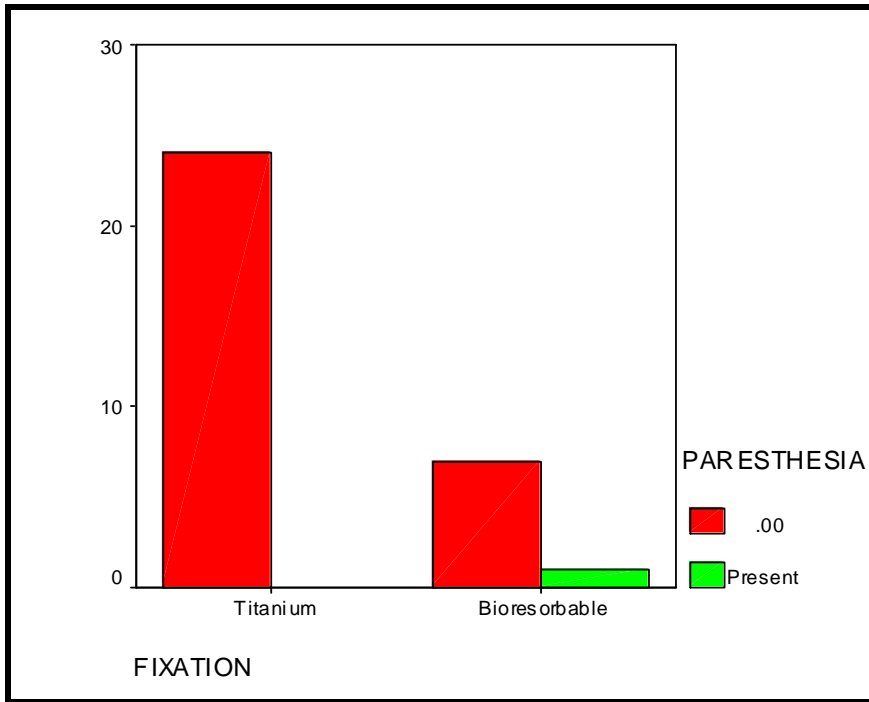
GRAPH – 7: INCLUSION CRITERIA



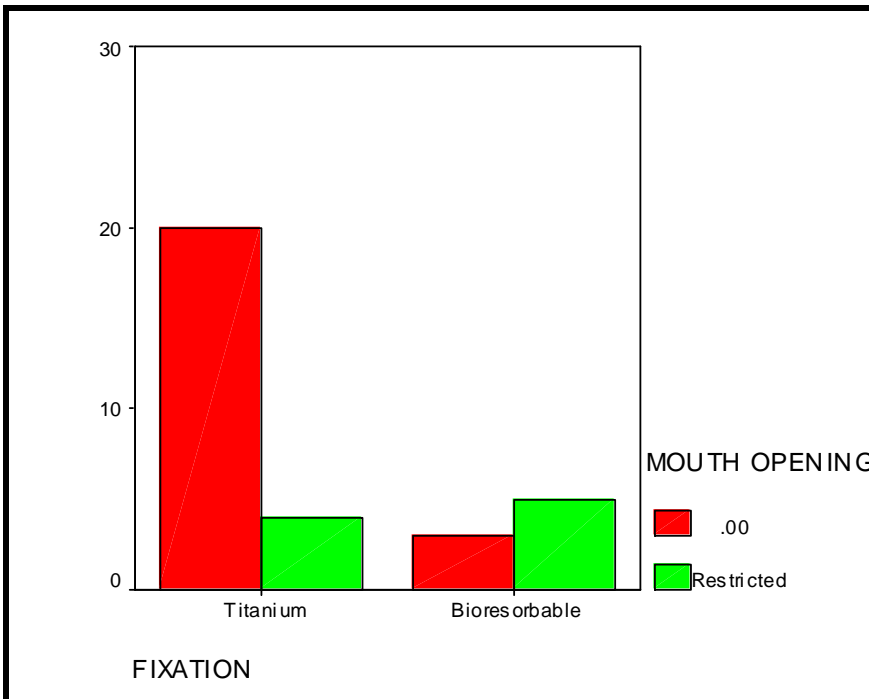
GRAPH – 8: STATISTICAL ANALYSIS OF PAIN



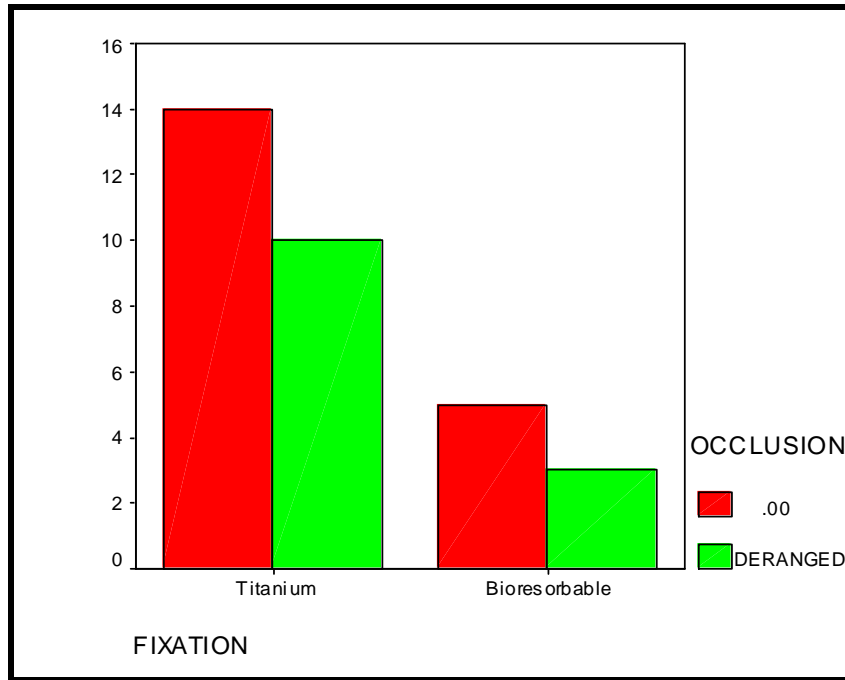
**GRAPH - 9: STATISTICAL ANALYSIS OF
PARAESTHESIA**



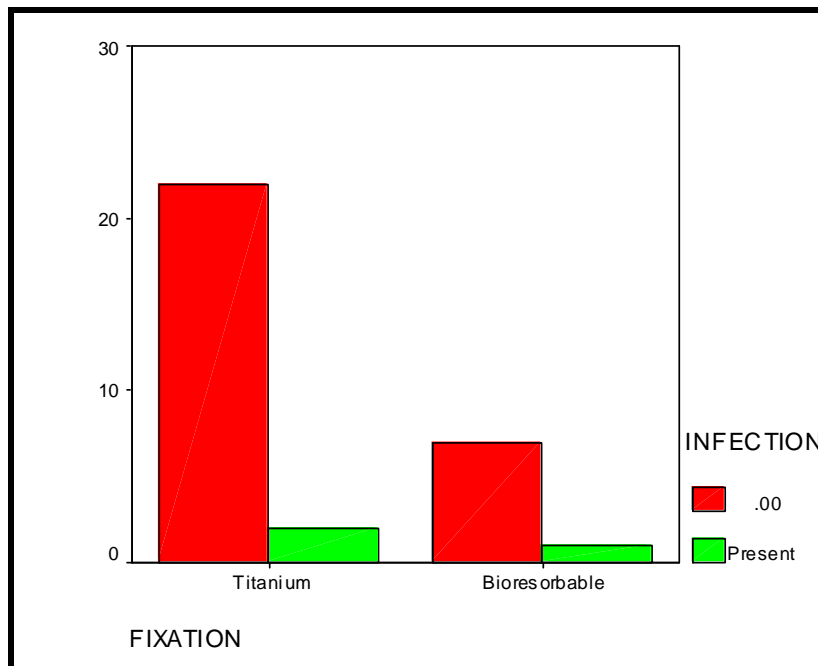
GRAPH- 10: STATISTICAL ANALYSIS OF MOUTH OPENING



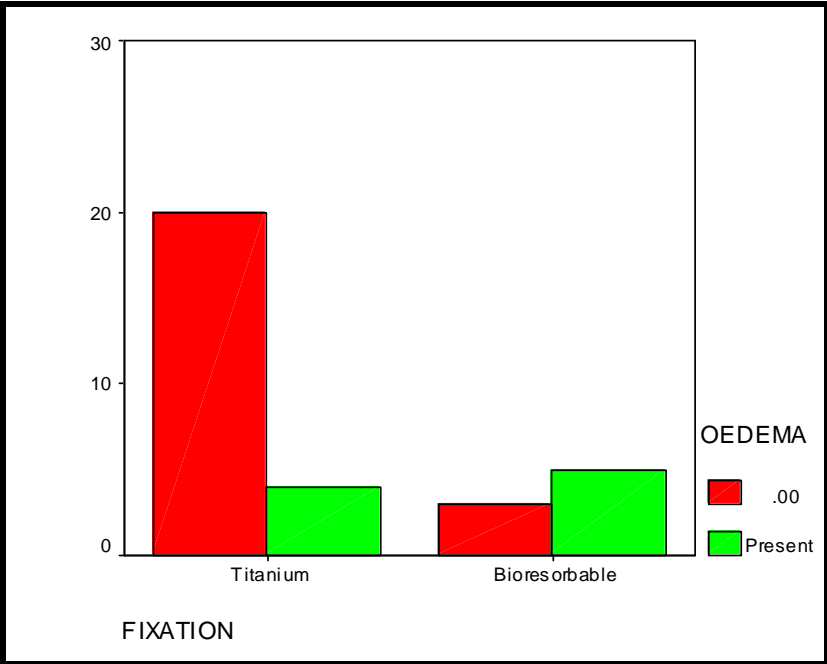
GRAPH- 11: STATISTICAL ANALYSIS OF OCCLUSION



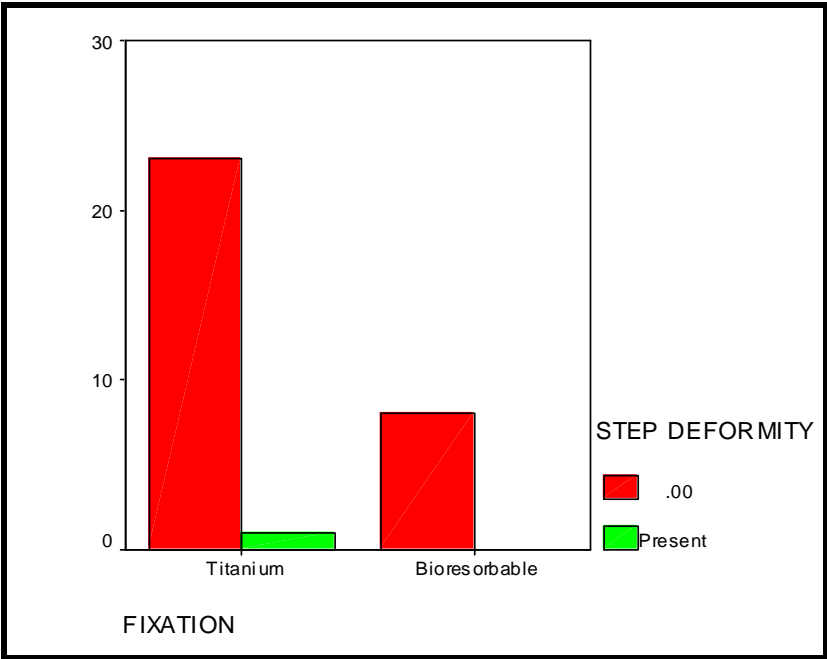
GRAPH -12: STATISTICAL ANALYSIS OF INFECTION



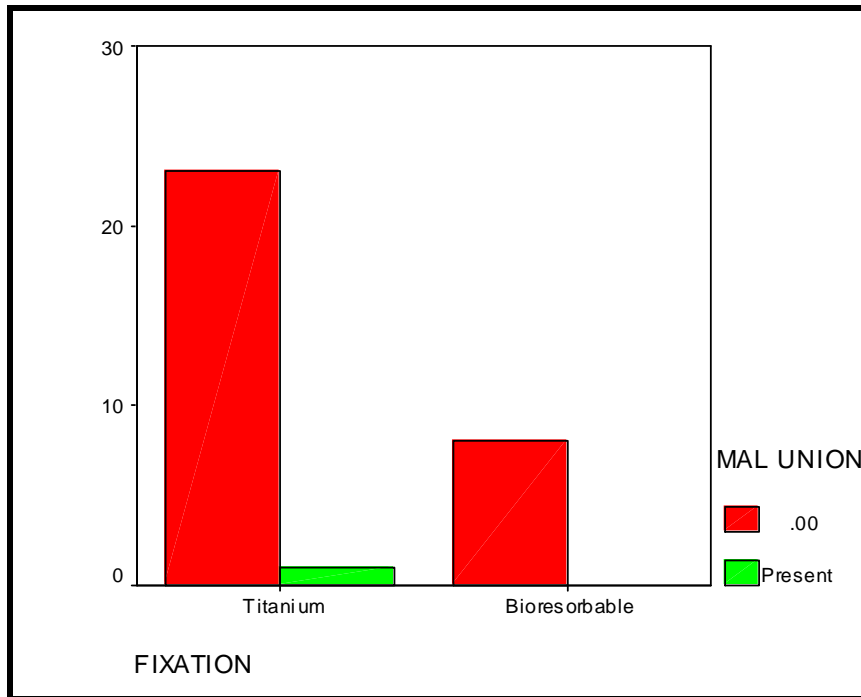
GRAPH – 13: STATISTICAL ANALYSIS OF OEDEMA



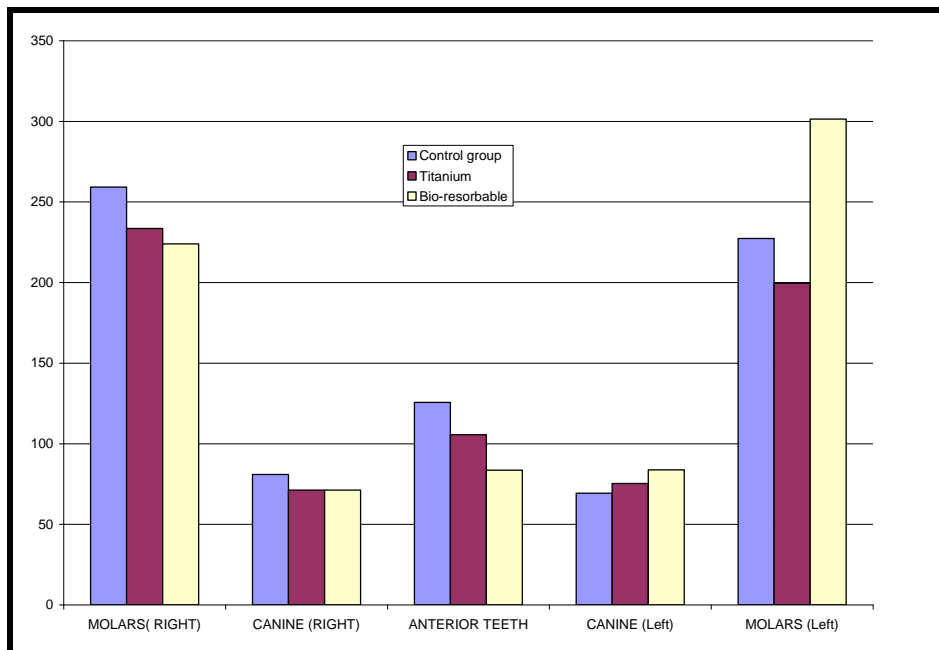
GRAPH – 14: STATISTICAL ANALYSIS OF STEP DEFORMITY



GRAPH- 15: STATISTICAL ANALYSIS OF MALUNION



GRAPH -16: BITE FORCE MEASUREMENT



Discussion

DISCUSSION

The mandibular fracture is plagued by a high complication rate, particularly when treated with open reduction. The fracture type, form of fixation and characteristics of the patient population are all important determinants of treatment outcome¹⁷.

Allan BP et al³ carried out of patients presenting with fractures of mandible over the 35-year period. The male to female ratio was 4.4:1. The highest incidence of trauma was in the 20-29 year age group. Oikarinen K et al⁴³ studied reported 293 cases were males while 78 were females with a mean age of 31.3 years out of 317 mandibular fracture patients. Tanaka N et al⁵⁵ conducted a statistical study of 695 cases of maxillofacial trauma was reported. The male to female ratio noted was 3.2:1^{31,51}. Cases reported within one week of injury were 63.9% while those reported later were being treated for other associated injuries. Road traffic related accidents were the highest (38.4%) and mandibular body region was the commonest site of fracture^{26, 50, 6,51,25}.

The results of our study showed a male preponderance pattern with males accounting for 75% of all mandibular fractures. This study had a male to female ratio of 3:1.

Oikarinen K et al⁴³ studied of 317 mandibular fracture patients treated over a period of 10 years retrospectively. There was a prominent

accumulation of injuries noted at the weekends with 55% of fractures in men to that of 44% in women occurring predominantly in the age groups of 20-29 years or 30-49 years. Tanaka N et al⁵⁵ reported that the most common age group affected was 20-29 years and accounted for 30.7%^{26,1,31}.

In our study, highest incidence of fractures was in the age group between 21-30 years. The possible explanation for the high incidence of fractures in the 21-30 year age group is that people in this age group are energetic, take part in dangerous exercises, drive motor vehicles carelessly, and are more likely to be involved in altercations.

Adebayo et al¹ evaluated a total of 700 fractures in 443 patients and an overwhelming male preponderance was noted with peak incidence during 20-39 years and road rashes was the most common cause of these fractures^{3,55,26,31}. In our study the three most frequent causes for mandibular fractures were road traffic accidents (RTA) in 75%, falls in 21.9%, and assault in 3.1% of patients.

Tanaka N et al⁵⁵ stated that prognosis of facial fractures is influenced by the delay between the time of injury and treatment. Ideally, the management should be undertaken within 7 days of trauma simultaneously with other injuries in order to avoid delay and to prevent complications. In our study 66% of the cases reported to our unit within 7 days of sustaining trauma, the late presentation of the remainder of the cases could be

attributed to unawareness of the treatment facilities, attendant and transportation difficulties.

Iida S et al²⁶ reported Condylar fractures were most common and was around 33.6%, followed by angle region being 21.7%. Khaled Sakr et al³¹ reported fractures of the angle was the most common (22%) followed by parasymphyseal fractures (21%) and the lowest was in the coronoid region (1%). While dentoalveolar fracture accounted for 5% of total mandibular fracture.

In our study, a high incidence of Parasymphyseal fractures (63%) was noted in contrast to other studies which showed that the angle or condylar fractures are the most common. The mechanism of injury can provide valuable information in the examination and treatment of patients with mandibular trauma. Interpersonal violence tend to result in a higher incidence of angle fractures, whereas motor vehicle accidents are associated with parasymphyseal fractures. The second most frequently involved site was the condylar region (38%) amongst the trauma victims. Amongst the various combination patterns noted the Condylar - parasymphyseal region was frequently fractured.

Persistent attempts have been made to develop equipment that can minimize complications by fixing the bone fragments after fracture and induce solid bone union with stabilized fixation. The requirements for such a bone fixation device include sufficient strength and rigidity to induce bony union,

the absence of a tendency to produce a foreign body reaction or infection within the body, no interference with the bony union, an inability to be palpated or visualized, and spontaneous absorption.

In our study, all the cases were treated with open reduction and internal fixation using bioresorbable and titanium miniplates. Out of the 32 patients, 24 patients were treated with 2 mm titanium miniplates and screws and 8 patients were treated with 2 mm bioresorbable miniplates and screws. In the above mentioned group intermaxillary fixation was used commonly in fractures involving the condylar region^{36,4}.

Although stainless steel metal plates are often used, biocompatible metal plates made of titanium have been used more frequently. Bioabsorbable plates have been used selectively for internal fixation of mandibular fractures, with the advantage that they need not be removed²⁵.

The advantages of titanium miniplates include the potential for solid fixation, a shortened operative time and the convenience of the surgical procedure. Some of these advantages have been consistently maintained, but in patients with thin skin, the following problems can develop (i) palpability or visibility of the plate (ii) sensitivity to temperature (iii) metal allergy (iv) secondary infection or bone resorption, and (v) possibility of interference with postoperative radiologic assessments. Patients in the growth period can experience restriction of bone growth. The requirement for secondary surgery

to remove the metal plate after bony union is also disadvantageous. Therefore, absorbable bone fixators have been proposed²⁵.

Kulkarni et al first performed an experiment using absorbable bone fixators. Since then, studies of absorbable bone fixators making use of polymers, such as polylactic acid and polyglycolic acid, have been conducted. However, a foreign body reaction and osteolysis occurred in association with use of polylactic acid and polyglycolic acid. To resolve these problems, polymers have been developed using polylactic acid and polyglycolic acid copolymers. Unlike most types of metal plates bioresorbable screws require pre tapping. In cases of insufficient tapping or the use of excessive force in inserting a fixation screw, a screw head can be isolated before it has been completely inserted. Dynamic strength will be maintained for a maximum of 3 to 4 months; however absorbable plates must be absorbed within 6 months to 1 year after bony union has been completed to avoid interference with the proper growth of pediatric patients²⁵.

The data presented clearly show that the INION[®] system gives sufficient support to allow bony healing that is on par with that of titanium miniplates. All fractures in this study healed successfully and there was no clear difference in the duration of inpatient treatment between the two groups³⁴.

Ferretti C et al¹⁷ reported that the complication rate following bioresorbable internal fixation of mandibular fractures is 22% and complication rate following titanium internal fixation of mandibular fractures

is 13.7%-43%. Hyo Bin Lee et al²⁵ assessed the use of biodegradable miniplates and titanium miniplates for the fixation of mandibular fractures. The overall complication rate was 4.41%. In the biodegradable plate group, infection occurred in 2 cases (4.26%) and was resolved by incision and drainage and antibiotics. In the titanium plate group, infection occurred in 1 case and plate fracture in 1 case (4.56%). Robert M Laughlin et al⁴⁸ suggested that resorbable plates are equal to the performance of titanium 2-mm plates, regarding healing of the fracture with bone union and restoration of function. 3 out of 50 fracture sites (6%) were noted to have clinical signs of infection and treated immediately upon presentation; with fracture union by 8 weeks. There was no need for revision surgery in this series of patients; 12 screw heads fractured during screw placement while in our study 5 screw heads had fractured and were immediately replaced without significant fracture sequelae^{46, 22, 34}.

Leonhardt H et al³⁴ found many malocclusions in the INION[®] group during the first week follow up. Disturbances of occlusion were treated by elastic IMF for 1 week, and following that there were no differences in occlusal problems between the groups at 6 weeks. In our study also, 10 patients were noted to have deranged occlusion in titanium group and 3 patients in bioresorbable group during the first week follow up period and were treated with arch bars and elastics for a period of ten days and following that there were no differences in occlusal problems between the

groups at 1 month.

Robert M Laughlin et al⁴⁸ studied that the majority of patients reported mild pain at the first post operative visit with resolution by 2 weeks. Two patients reported moderate pain at 4 weeks. In our study, post operative pain was noted in 12 patients during the first week and was managed successfully with appropriate use of antibiotics and analgesic.

Leonhardt et al³⁴ noted the degradation of the INION[®] plates was responsible for the higher rate of long lasting soft tissue swelling. There was a postoperative oedema after 6 months, which were unsightly and slow to shrink. In our study, 4 patients reported with postoperative oedema in the titanium group and 5 patients in the bioresorbable group which lasted for 1 month. Postoperative oedema exists more in Bioresorbable (62.5%) than in Titanium fixations (16.7%) during the first week of follow up. Also, 4 patients (16.75%) reported with postoperative restricted mouth opening in titanium miniplate fixation and 5 patients (62.5%) in bioresorbable miniplate fixation during the 1st week follow up period. Restriction of mouth opening is more common (62.5%) in Bioresorbable fixation than in Titanium (16.7%) during the first week of follow up.

Hyo Bin Lee et al²⁵ stated that post operative infection occurred within 1 month after surgery , and all affected patients underwent antibiotic therapy. In 2 patients who had received absorbable fixation plates, incision and drainage was performed. The fixation plates were not removed and the

infections had resolved within 5 to 7 days. In our study 2 patients (8.3%) reported with postoperative infection in titanium miniplate fixation and 1 patient (12.5%) in bioresorbable miniplate fixation within 6 months after surgery and all affected patients underwent antibiotic therapy. In our study also fixation plates were not removed and the infections had resolved within 5 to 7 days.

Tuovinen V et al⁵⁷ noted neurosensory disturbances in 26.9 % of the patients postoperatively and in the 12th post operative month 1.4 % of the patients had neurosensory disturbances. In our study paresthesia (12.5%) was noted in one patient who belonged to the bioresorbable group. Step deformity and malunion (4.2%) were also noted in one patient in the titanium group.

Complications occurred in 21.4% of all patients in our study. The incidence of complications was 15.6% in patients with titanium metal plates and 29.6% in those with absorbable fixation plates during the 1 week follow up period. Complication rate was reduced to 4.1 % in patients with titanium metal plates and 6.3 % in those with absorbable fixation plates during the 6 months follow up period, but the difference was not significant.

Gerlach KL et al²⁰ evaluated maximal biting force in 22 patients with mandibular angle fractures treated with miniplate fixation according to Champy's line of osteosynthesis. This revealed that after fixation 1 week postoperatively only 31% of the maximal vertical loading found in controls was registered. These values increased to 58% at the 6th week postoperatively.

In our comparative study maximal vertical bite forces in 11 patients after treatment of parasymphysis fractures using titanium and bioresorbable miniplates according to Champy's line of osteosynthesis was evaluated. Out of 11 patients 7 patients were treated with 2 mm titanium miniplates and screws and 8 patients were treated with 2 mm bioresorbable miniplates and screws. An electric test procedure for evaluating the load resistance between the incisors, right and left canines and right and left molars (5 bite points) was carried out after 6 months following the treatment and additionally in 10 controls too. This revealed that there is no significant difference between bioresorbable miniplate and titanium miniplate on bite force for parasymphysis fracture.

Summary & Conclusion

SUMMARY AND CONCLUSION

This comparative study of mandibular fractures fixation between titanium and bioresorbable miniplates was conducted in the Department of Oral and Maxillofacial surgery, Sri Ramakrishna Dental College and Hospital, Coimbatore. This study evaluated mandibular fractures under various parameters such as Age, Sex, Etiology, Time elapsed, Anatomic site fractured, fixation of titanium and bioresorbable miniplates and its Complications, Bite force measurement after fixation. 32 patients who had sustained injuries to Mandible over a period of two years were studied. (2009-2011).

In our study, mandibular trauma predominantly affected males commonly involving the second and third decades of life pointing out towards the active period of life when they tend to be more energetic and thus involve themselves in high-speed transportation related injuries, which are the leading causes of maxillofacial trauma. Causes of mandibular fractures are constantly changing with changes in life style, industrialization, transportation and legislative measures. There appears to be a shift in the trend of the cause of mandibular trauma from Traffic accidents to violence in most developed countries; on the contrary, our study indicates that Road traffic accidents related injuries to be the primary cause in the patients treated in the unit for mandibular fractures.

The issue of time lapse from the moment of injury to the initialization of the treatment could be due to transportation difficulties, socioeconomic conditions and delay due to treatment of associated injuries by various specialties. Mandible, being a mobile bone and having fractures, which are usually of compound types, communicate intraorally, are prone for infections. Majority of cases (66%) referred to our unit were seen within a week following trauma and rest of the patients reported a week later. The reason was that the patients were being treated for their concomitant injuries while a few were unaware of the treatment facilities offered.

The most common fracture site involved in the mandible region was the parasymphyseal region (63%) followed by the condylar region (38%) and which were commonly seen with road traffic accidents with the impact occurring at the chin region with forces that were transmitted poster superiorly.

Goals in treatment of mandible fractures include restoration of normal function and achievement of normal occlusion with adequate union of fracture segments, maintaining facial symmetry, and an aesthetic balance of the face. The treatment outcome depends on many factors such as type, the location of fractures, single or comminuted fractures, as well as general and local systemic conditions. In our study all the cases were treated as open reduction with titanium and bioresorbable miniplates.

Pain, paraesthesia, oedema, occlusion, mouth opening, infection, step deformity and malunion were evaluated during the 1st week, 1st month and after 6 months postoperatively. Oedema and malocclusion were seen more common during the 1st postoperative week in bioresorbable plate fixation than when compared to titanium miniplate fixation. Bite force were evaluated in parasymphysis fractures by using indigenous bite force equipment in anteriors, canines, molars (5 bite point) and no significant change in bite force was noted among bioresorbable, titanium and control group.

Complication rate was reduced to 4.1 % in patients with titanium miniplates and 6.3% in those with bioresorbable miniplates during the 6 months follow up period, but the difference was not significant.

This comparative study concluded that both titanium and bioresorbable miniplates has both its own advantages and disadvantages. The disadvantages of biodegradable materials include cost, breakage of screws, difficult intraoperative handling, and swelling of the plate during degradation. In case of titanium miniplate fixation there is a potential risk of removing the titanium plates at a later stage resulting in additional cost, time, and a relatively high morbidity. In some places titanium plates are removed routinely, in which case these drawbacks cannot be considered. However the question of long-term titanium toxicity should be borne in mind.

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