ORIGINAL RESEARCH PAPER

Dental Science

A COMPARATIVE STUDY OF THE TREATMENT OF MANDIBULAR FRACTURES USING LOCKING PLATES AND CONVENTIONAL MINI PLATES ON PATIENTS TREATED IN ERITREA.

KEY WORDS: Mandibular fractures, Locking plates, Conventional mini plates, Efficacy , Eritrea.

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ABSTRACT

Objectives: The study aims to assess the efficacy of locking mini plate and screw system in the treatment of mandibular fractures in comparison to the conventional system.

Materials and Methods: The present study was conducted in The Department of Oral and Maxillofacial Surgery, Orotta School of Dental Medicine and Orotta Medical and Surgical Referral Hospital, Asmara, Eritrea, East Africa during the period of January 2013 to December 2015. A total of 46 patients with mandibular fractures meeting the inclusion criteria were included in the study. They were divided into two groups of 23 patients each. One group (group 1) was treated with 2.5mm conventional miniplates and the other (group 2) with 2.0mm locking plates. The time required for each system was noted and the groups were subsequently evaluated for post operative occlusion, the need for MMF and its duration, neurosensory deficit, incidence of screw loosening and plate fracture as well as the development of any hardware infections requiring plate removal.

Results: In this study RTA emerged as the major cause of mandibular fractures (52.2%). There was statistically significant difference in the operating times of the two systems, the need for postoperative MMF and screw loosening. However in matters of post operative occlusal derangement, neurosensory deficit, plate fracture and hardware infection and plate removal, no significant variation was observed.

Conclusion: Locking plate system has several advantages over the conventional miniplate system and can serve a superior option in the treatment of mandibular fractures. The only problem with the system however is the increased working time required for its adaptation which may be ignored considering the other benefits it can provide.

INTRODUCTION:

When we glance in to the past we recognize a plethora of changes and advancements that has taken place in the management of craniomaxillofacial trauma, right from the use of simple stainless steel wires to newer rigid, non rigid and resorbable fixation methods. Of these, an epoch making invention was that of miniplates, which was first introduced by Michelet in 1973 and later developed by Champy in 1975 [1]. Use of miniplates became a standard treatment option for maxillofacial trauma since they were small and easily adaptable and can be applied monocortically using intraoral and extraoral approaches. It also provided functional stability since the system is biomechanically balanced. Although conventional miniplates are widely used, it also has a few demerits. The miniplates need proper adaptation to the surface of the bone prior to fixation to yield the desired surgical result. To overcome the shortcomings of conventional miniplates, locking plate system was introduced. A locking plate acts as a stable internal fixator and does not need proper adaptation to the bone surface like conventional miniplate because of its structural design which prevents hardware loosening.

The current study aims to compare and assess the effectiveness and postoperative complication rates of conventional miniplates and locking plates in patients with mandibular fractures who reported to the Department of Oral and Maxillofacial Surgery, Orotta School of Dental Medicine and Orotta Medical and Surgical Referral Hospital, Asmara, Eritrea, East Africa. This is the first ever study conducted to evaluate the efficacy of the two plating systems in the country of Eritrea, after getting the approval of the ethical committee of the Orotta School of Medicine and Dental Medicine.

MATERIALS AND METHODS:

Of all the patients who reported to the Department of Oral and Maxillofacial Surgery, Orotta School of Dental Medicine and Orotta Medical and Surgical Referral Hospital, Asmara, Eritrea, East Africa during the period of January 2013 to December 2015, a total of 46 patients with mandibular fractures were included in the study. Patients with a recent history of fracture not extending two weeks in duration, Patients in the age group of 18-50 years, Non comminuted mandibular fractures, Absence of any underlying systemic diseases, Non infected fracture sites were included in the study.

Exclusion criteria included patients above 50 years, Geriatric edentulous patients, Ramus and condylar fractures, and immunocompromised patients. The patients were divided into two groups of 23 patients each. One group was treated with 2.5mm conventional miniplates (Group 1), while the other group was treated with 2.0mm locking plates (Group 2).

A detailed history and clinical examination of each patient was carried out and appropriate radiographs were taken to arrive at a final diagnosis. A complete blood profile of each patient was taken and thereafter all patients were assessed for surgical fitness to undergo the procedure under general or local anaesthesia. Surgical procedure was performed under aseptic conditions with similar techniques being used in both the groups, apart from for the use of a drill guide in the case of locking plates. The duration of each procedure was noted from the time of incision to wound closure. All patients were then given the necessary post operative instructions with special emphasis on oral hygiene maintenance and placed on antibiotics and analgesics for 7 days. They were then followed up after the 1st week, 1 month, 3 months. The parameters assessed during these follow up visits included occlusion, the need for MMF and its duration, neurosensory deficit, incidence of screw loosening and plate fracture as well as the development of any hardware infections requiring plate removal.

The analysis of the collected data was carried out using a Pearson chi-square test with the help of the Statistical Package for Social Sciences (SSPS, Version 18.0).

RESULTS:

The present study was carried out among a total of 46 patients who were divided into two groups (Group 1 and 2) of 23 patients each. All of the patients in group 1 were treated with 2.5mm miniplates while those in group 2 were treated with 2.0mm locking plates. The patients included in the study had ages ranging from 18-50 years with an average age of 31.76 years.

The number of males involved in the study was 39. Female cases were only 7 in number. There was no significant sex difference between the two groups with 19 males and 4 females in group 1 and 20 males and 3 females in group 2. When the etiology was evaluated, RTA emerged to be the leading cause with 24 cases which constituted (52.2%) of the cases. It was followed by cases attributed to falls standing at 9 (19.6%) cases and 8 (17.4%) cases of injuries related to sports (extend more).Parasymphysis appeared to be the most common site to be fractured with (32.6%) 15 cases. This was followed by the body of the mandible with 11 (23.9%) cases respectively. When the mean of the operating time was calculated it turned out to be lesser in group 1 lasting for a mean of 44.13 minutes but greater in group 2 which took a mean of 55.37 minutes to complete. This was statistically very highly significant (p- <0.001).

Post operatively when the occlusion of the patients was assessed there were 7 (30.4%) cases in group 1 which showed derangement whereas only 2 (8.7%) such cases was seen in group 2. All the 7 cases in group 1 required MMF, 3 required it for 2 weeks while the remaining 4 cases required MMF for 1 week (34.8%). In group 2 however only 1 case (4.3%) required MMF which lasted for 1 week.

This requirement of MMF was highly significant statistically (p=0.009). There appeared to be no significant difference between the two groups while assessing for post operative neurosensory deficit as only 2 cases (8.7%) in group 1 and 1 case (8.7%) in group 2 emerged with signs of any shortfall in neurosensory function. Statistically significant results (p=0.018) were noted with regards to post op screw loosening which was noticed in 5 cases of group 1(21.7%) while none of the cases in group 2 showed any evidence of the same. Although of no noteworthy difference but there was 1 (4.3%) case of plate fracture in group 1 whereas group 2 showed no such complication. Lastly hardware infection developed in 2 (8.7%) cases of group 1 and 1 (4.3%) case in group 2 which ultimately required plate removal for management.

DISCUSSION:

Miniplates are widely used as a treatment modality for various oral and maxillofacial surgical procedures since the last few decades. The use of miniplates has become a standard treatment option for maxillofacial trauma since they are small and easily adaptable and can be applied monocortically using intraoral approaches. They can also provide functional stability since the system is biomechanically balanced. Studies of JL Cawood [2] in 1985 and Frans HM Kroon et al [3] in 1991 suggested the stability of osteosynthesis using miniplates. The stability in conventional miniplates is accomplished by the screw head compressing the plate to the underlying bone which requires perfect adaptation to the bone structure. This unfortunately is a reason for a major disadvantage of this system since it causes cortical bone resorption leading to screw loosening and loss of stability of the fractured segments [4]. The torsional force on the mandible is responsible for the failure of the friction lock between the plate and the bone that is needed for the primary stability. This was reported in the study of Cordey et al [5] in the year 2000. To overcome the shortcomings of conventional miniplates, locking plate system was introduced. A locking plate acts as an internal fixator and derives its strength by a double threaded screw that locks the screw to the plate thus stabilizing the segments without compressing the bone to the plate. This design of locking plate prevents deformation of the plate during screw tightening which compensates for any discrepancy in adaptation. Another important advantage is the greater amount of stability derived across a fracture gap [6, 7] and lesser incidence of inflammatory response due to hardware loosening. Ralf Gutwald et al [8] in 2003 compared the internal mini locking systems with 2.0mm miniplates and came to the conclusion that locking plates had a higher stability when compared to conventional miniplates.

In the current study, RTA emerged as the leading cause in both the groups with 24 cases (52.3%). This has been found in various other studies. [9, 10, 11, 12]The patients in the study reported for treatment within 5.2 days of the injury which was more in comparison to the study by Collins et al [13] in 2004 but less than the study by Singh V et al [12] in 2011. Of all the patients that reported for treatment 10 patients were pre operatively put on intermaxillary fixation.Majority of the cases treated in our study were parasymphyseal fractures with 15 cases. This is in agreement with the studies by Moreno JC et al [14] in 2000 and Saikrishna et al [11] in 2009.

In our study the mean operating time was found to be 44.13 minutes for conventional miniplates and 55.37 minutes for locking miniplates. This was less when compared with the time noted by Saikrishna et al [11] in 2009 but in accordance with the study by Nayak SS et al [15] in 2013. Nevertheless in all cases the time taken to place the locking plates is always more than the conventional miniplates. This is because the placement of locking plates is more or less a technique sensitive procedure that requires the use of a drill guide to center the drill hole and precise positioning of the screw 90 degrees to the plate.

Post operative occlusal derangement was seen in 7 cases of conventional miniplates and only in 1 case of locking plates. All the cases of deranged occlusion required postoperative intermaxillary fixation. The duration of this varied with the individual cases. 3 cases in group 1 were put on IMF for 2 weeks while the remaining 4 were on IMF for 1 week. The single case in group 2 which required IMF for 1 week had comminuted fractures of the body of the mandible. Bolourian R et al [16] in 2002 and Chritah A et al [17] in 2005 suggested the use of IMF as a supplement to miniplate fixation for stabilization. In our study 38 of the patients did not need any IMF. Screw loosening was observed in 5 cases of conventional miniplate fixation whereas none of the cases of locking plates showed any signs of screw loosening. This is in agreement with the study of Nayak et al [15] who also found that locking plates showed lesser cases of screw loosening compared to the conventional miniplates. This can be explained by the design principles of the two systems. In case of conventional plates the screw binds only to the bone whereas in locking plates the screw binds to both the bone and the plate. Thus for a screw to loosen in case of locking plates it has to lose its fixation at two points, the plate and the bone, which is highly unlikely.

In the current study post operative neurosensory deficit was observed in 2 cases of group 1 and 1 case of group 2. These patients had notable displacement of the fracture segments and had preoperative paresthesia. Post operatively also the paresthesia was noted but was not related to hardware fixation. This disturbance in neurosensory function can occur due to the involvement of the mental nerve for fractures in close vicinity of the mental foramen. Postoperative paresthesia of inferior alveolar nerve is commonly found with rigid fixation than with other methods and is predominantly associated with edentulism of the mandible where limited amount of space is available for placement of the screw. [18,19] Studies of Tu HK et al [20] in 1985, Izuka T et al [21]in 1991, Lindqvist C et al [22] in 1986, Ardary WC [23] in 1989 and Raveh J et al [24] in 1987 have all reported postoperative neurosensory deficit in the range of 0.9% to 46.6% following rigid fixation.

Our study noticed a case of fracture of the conventional plates in the body of the mandible which is relatively rare in this region. However the same was not noted in case of the locking plates. As per the simple beam mechanics fractures in the body are thought to exhibit tensile forces at the superior border and compressive forces at the inferior border. Plate fracture usually happens at the sites where torsional forces are more, especially in parasymphyseal and symphyseal regions. Plate fractures were also observed in the study by Nayak et al [15] in 2013 where they found significantly

higher incidences of fractures in conventional plates compared to the locking plates.

Hardware infection requiring plate removal was seen in 2 cases of conventional plates and 1 case of locking plates in our study. According to the study of Tu HK et al [20] in 1985 the post operative infection rate is between 3%-27% when using metallic plates for rigid fixation. Although there are various causes of post operative infection, the mobility of the fractured segments is the most common cause according to Spiessl B (1989) [25] and Shetty V et al (1989) [26]. The other causes are placement of screws in the line of fracture, improper irrigation, inappropriate plate adaptation, delayed treatment, concomitant substance abuse, poor patient compliance and lack of surgical expertise. [27,28,29] The locking plates show a lower rate of postoperative infection because the mobility of the screw in the bone is unlikely to make the entire system unstable as it still retains its fixation to the plate. This was confirmed by the study of Herford et al [30] in 1998 where he found a complication rate of only 7% associated with locking plates. This is in line with our finding of lesser postoperative complications for locking plates compared to the conventional miniplates. Studies of Iizuka T et al [19] and Kerns GJ et al [31] shows that the proximal part of the body and angle of the mandible have more inclination towards developing an infection owing to the reduced cross sectional area of the bone. In our study the post operative infections were seen in the fractures of parasymphysis and angle of the mandible in group 1 which required plate removal after 2 months and 1 month respectively. In group 2, fracture of the parasymphysis was associated with infection and plate in this case was removed after 3 months.

Follow up of all the patients was done on the 1st week, 1 month and 3 months postoperatively which in our experience was most favourable to assess the healing of the fracture sites radiographically. The same duration has also been noted in studies by Kawai et al [32] and Saikrishna et al [11].

CONCLUSION

In the present study we found locking plates to be more efficacious than the conventional mini plate in the treatment of mandibular fractures. It proved to provide greater stability to the fractured region compared to mini plates. The only negating factor with locking plates which we observed was the increase in working time and that it was more technique sensitive. This shortcoming is of course of not much significance taking into account the other benefits the locking plates offer.

TABLE-1 AGE GROUPS INCLUDED IN THE STUDY

Age Group	Frequency	Percentage
18 – 25 Years	14	30.4
26 – 35 Years	16	34.8
More than 35 Years	16	34.8
Total	46	100.0

TABLE 2: OPERATING TIME (MINUTES)

Operating time	Mean	SD
Group 1	44.130	3.2011
Group 2	55.370	2.8828

t - test = 12.512, p – value < 0.001 (very highly significant)

TABLE 3: REQUIREMENT OF MAXILLOMANDIBULAR FIXATION (MMF)

Post OP MMF	Group					
	Group 1		Group 2		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
No	15	65.2%	22	95.7%	37	80.4%
Yes	8	34.8%	1	4.3%	9	19.6%

Chi Square = 6.769, df = 1, p – value = 0.009 (Highly Significant)

TABLE 4: POST OPERATIVE SCREW LOOSENING

Post OP SCR	Group					
	Group 1		Group 2		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Absent	18	78.3%	23	100.0%	41	89.1%
Present	5	21.7%	0	.0%	5	10.9%

Chi Square = 5.610, df = 1, p – value = 0.018 (Significant)

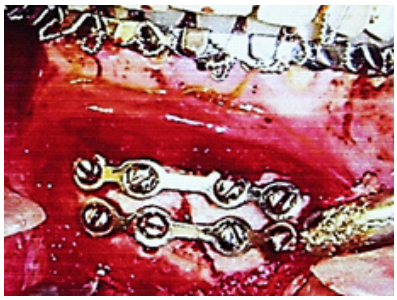

Fig-1 Open reduction and internal fixation using locking plate

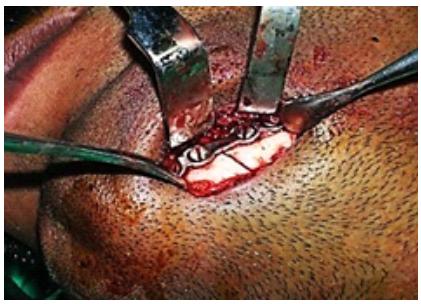

Fig-2 Open reduction and internal fixation using mini plate

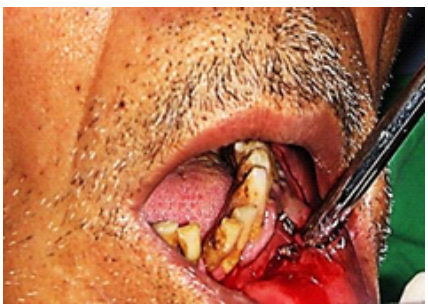

Fig-3 Loosening of Conventional mini plate in one of the patients

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