

## A comparative study of the outcomes of mandibular fractures treated with and without per operative maxillo-mandibular fixation.

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### Abstract

**Background:** Mandible being prominent and mobile gets fractured commonly. Fracture healing is important for restoring chewing abilities and aesthetic appearance. The fracture healing in mandibles is painful and maintaining reduction is difficult due to the action of various the muscles attached to mandible. There are few reports about fixing mandible fracture with intraoperative manual maintenance of occlusion without applying traditional arch bars and MMF. **Aims:** to study the outcome following rigid fixation of mandibular fractures without per operative or post operative maxillo-mandibular fixation and immediate mobilisation. **Materials and methods:** This is a prospective study conducted in the Department of Plastic and Reconstructive Surgery in a Government tertiary care centre over a duration of 18 months in 30 patients with anterior mandibular fractures in which each 15 patients belonging to Group I and Group 2 received ORIF with MMF. **Results:** Mean time of fixation in Group 1 (ORIF without MMF) was 22.27 minutes whereas in Group 2 (ORIF with MMF) it was 38 minutes which is statistically significant. There was statistically no significant difference in occlusal disturbances in both groups compared in the study. There was no significant difference after fixation with or without MMF in stability of fracture segment. There was no statistically significant difference between both groups in terms of neurosensory deficits and masticatory efficiency. Patients of both groups were kept on soft diet for a period of 1 month. Mouth opening in patients in both the groups showed a gradual recovery till 1 month after which it stabilized. There was gradual decrease in pain in patients of both groups. **Conclusion:** Maxillomandibular fixation reduces the operative time and aids in early mobilisation and better intake of diet. Mandible fractures can be managed by Open reduction and internal fixation with intra operative manual maintenance of occlusion and satisfactory results can be obtained.

**Keywords:** Anterior mandibular fractures, Maxillomandibular fixation (MMF), Open reduction and internal fixation (ORIF).

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### Introduction

Traditionally, mandible fractures are treated with maxillo-mandibular fixation (MMF) to maintain reduction and occlusion. In patients treated with open reduction and internal fixation with interosseous wiring MMF is applied for 2-3 weeks. Even for fractures fixed with plates and screws, intra operatively MMF is applied prior to plating to maintain proper occlusion. With MMF patient cannot open his mouth and has difficulty in speaking and eating and also he has to take only fluid diet. The presence of stainless steel wire and arch bars between jaw and lips is cumbersome for the patient causing mechanical irritation and difficulty in maintaining oral hygiene, inability to return to work and social events. Also, there is the chance for the surgeon to get injured

by stainless steel wires while applying the MMF. Application of arch bars and MMF consumes time. Our aim is to study the outcome following rigid fixation of mandibular fractures without per operative or post operative maxillo-mandibular fixation and immediate mobilisation[1-5]

#### Materials and Methods

This is a prospective study conducted in the Department of Plastic and Reconstructive Surgery at Osmania General Hospital attached to Osmania Medical College, Hyderabad over a duration of 18 months during 2019-2021. Sample size of a minimum of 30 patients fulfilling the inclusion criteria were a part of this study. Data was collected from patients who were admitted in Plastic surgery wards of Osmania General Hospital with a diagnosis of isolated anterior mandibular fracture. The patients were divided into 2 groups randomly with 15 patients in each group. Group I comprised of those patients planned for treatment using only open reduction and internal fixation and Group II of those in whom open reductions with MMF were performed[6-8].

#### Inclusion criteria

Patients with fairly good general health (ASA-I & II) without any contraindication for oral surgery or anesthesia (local/general) patients indicated for rigid internal fixation for mandibular fractures. Isolated anterior mandibular fractures, Patients of mandibular fracture having permanent dentition.

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**Exclusion criteria**

Patients with head injury affecting the motor and / or sensory response, with pre-existing motor paralytic disease, concomitant dento-alveolar fractures, edentulous patients in whom occlusion was not assessable and grossly displaced fractures, multiple mandibular fractures, comminuted fractures and patients of mandibular fractures having mixed dentition to avoid damage to developing permanent tooth germs, i.e. age less than 12 years.

**Methodology**

This was a time bound prospective study in which patients fulfilling the inclusion criteria were taken up for the study. The details of the cases were recorded in a pre-texted pro-forma. A diagnosis was made based on the history, clinical examination and radiological findings. Thorough general and systemic examination was done to rule out any co-morbid diseases. Patients fulfilling the inclusion criteria were enrolled for the study. Patients were counselled about the proposed procedure and possible complications and the available alternatives. An informed, written consent for the procedure was taken. Preoperatively all patients underwent routine and specific investigations. An evaluation to assess fitness for surgery and anesthesia was done along with the Anesthesia team. All basic investigations done along with 3D CT Face was taken for all patients prior to surgery and OPG, X-Ray Mandible PA view

**Surgical technique**

Site of the operation was prepared with 5% povidone iodine solution. Patient was draped adhering to the aseptic protocol. Either a vestibular incision or pre-existing lacerations over the fracture were used to expose the fracture site.

**Reduction of fracture in test group (Group 1).**

Intraoperatively, occlusion was established by holding the fracture after reduction by the assisting surgeon while the surgeon fixed the fracture with mini plates and screws. The anterior surface and inferior border of mandible are kept in alignment thus ensuring reduction of the fracture. Mandible had to be exposed very well to achieve good occlusion and reduction.

In case of difficulty, sliding holes with burr are made on either side of fracture line and a bone holding forceps is used to reduce the fracture and occlusion is then maintained by the assistant.

**Reduction of fracture in control group (Group 2).**

Fracture site was exposed. The reduction of the segments to their anatomic position was brought about by achieving occlusion with the help of maxilla mandibular fixation by using either arch bar or eyelet wiring. SS wires were applied to achieve pre-morbid occlusion in control group alone.

**Adaptation & fixation of plate:** One 2.5 mm four hole (bi-cortical) and one 2 hole plate (mono-cortical) with extended bar were used in all patients. Plates were positioned perpendicular to the fracture line in the Champy's line of osteosynthesis.

Two parallel plates were used to neutralize forces acting on the fractures. Lower 4 hole plate with extended bar plate was fixed first followed by the 2 hole plate at the sub-apical level. The distance between two plates was approximately 4-5mm. 4 hole plate with extended bar was adapted at the inferior border of mandible. The drilling was performed through the hole in the plate perpendicular to the bone surface using normal saline as coolant. First screw was inserted in the drilled hole using a drill bit. Similarly the second hole was drilled on the other side of fracture line. Remaining screws were placed in position in similar manner. Then a 2 hole plate with extended bar was adapted at sub apical region and holes were drilled in similar manner. Final tightening was done after insertion of all screws.

Suturing of soft tissues was done after proper irrigation with povidone iodine with saline.

In the control group, Pre operative maxillo-mandibular fixation was removed after the completion of procedure and re-applied after patient recovered from general anesthesia on first post-operative day.

**Post operative follow up:** Clinical and radiological (OPG/Xray Face anterior view) follow up of treated cases was done for a minimum period of 6 months postoperatively regarding the comparison of two systems used by Stability of Fixation, Disturbance in occlusion, Neurosensory Deficit, Masticatory Efficiency, Mouth Opening, Pain (Wong Baker's Scale), Exposure of plate after surgery, Fracture of plate after surgery, Wound Dehiscence, Loosening of Hardware and Surgical Time. Stability of fixation was assessed clinically at regular interval of immediate post-operative, 1 week post-operative, 3 weeks post-operative, 1 month post-operative, 2 months post-operative and 3 months post-operatively as stable & not stable. Stability of fixation was checked manually. Discrepancy in occlusion was checked clinically at regular interval of immediate post-operative, 1 week post-operative, 3 weeks post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operative and 6 months post-operative. Sensory changes were observed throughout the period of study. Neurosensory deficit was assessed as absent or present at regular interval of pretreatment, immediate post-operative, 1 week post-operative, 2 weeks post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operative and 6 months post-operative.

Masticatory efficiency was assessed in all the patients and scored 0 (unable to chew), 1 (able to chew soft food), 2 (able to chew medium hard food), or 3 (able to chew hard food). It was assessed at interval of pretreatment, 1 week post-operative, 2 weeks post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operatively and 6 months post-operative (as assessed by patients to resume normal diet).

Mouth opening was measured as inter-incisal opening at interval of pretreatment, immediate post-operative, 1 week post-operative, 2 weeks post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operative and 6 months post-operative. Pain was measured on Wong bakers faces rating Scale 0 to 5 at interval of pretreatment, immediate post-operative, 3<sup>rd</sup> day post-operative, 5<sup>th</sup> day post-operative, 7<sup>th</sup> day post-operative, 10<sup>th</sup> day post-operative, 12<sup>th</sup> day post-operative, 15<sup>th</sup> day post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operative and 6 months post-operative. Exposure of the plate, fracture of the plate, loosening of the hardware was assessed at 1 week post-operative, 2 weeks post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operative and 6 months post-operative. Surgical time was assessed for adaptation of SS plates in two groups. Wound Dehiscence was assessed as absent or present at regular interval of immediate post-operative, 1 week post-operative, 2 weeks post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operative and 6 months post-operative. Any other complication was also observed at immediate post-operative, 1 week post-operative, 2 weeks post-operative, 1 month post-operative, 2 months post-operative, 3 months post-operative and 6 months post-operative. All these observations were recorded on a predesigned Proforma (Annexure) and further analysis was carried out.

**Results**

Mean age in Group 1 was 28.6 years whereas mean age in Group 2 was 29.86 years. Overall in this study mean was 29.23 years.

**Table 1: Demographic details in study**

Sex	I	II	Total(percentages)
F	1	2	3(10%)
M	14	13	27(90%)
Total	15	15	30
<b>Diagnosis</b>			
Body	2	1	3(10%)
Symphysis	5	6	11(36.7%)
Right Parasymphysis	6	5	11(36.7%)
Left Parasymphysis	2	3	5(16.7%)
<b>Cases of fall</b>			
self fall	1	2	3(10%)
RTA	11	11	22(73.3%)
Assault	3	2	5(16.7%)

Overall in this study 10 % (N=3) patients were females and 90% (N=23) patients were males. Overall in this study, 10% (N=3) were cases of anterior body, 36.7% (N=11) cases were of left parasymphysis fracture, 36.7% (N=11) were right parasymphysis fracture & 16.7% (N=5) were cases of symphysis fracture.

Overall in this study, the cause of fracture/ injury was assault in 16.6% (N=5) cases, 73.3% (N=22) cases were of road traffic accident and 10% (N=3) cases were of self-fall.

#### Stability of fixation

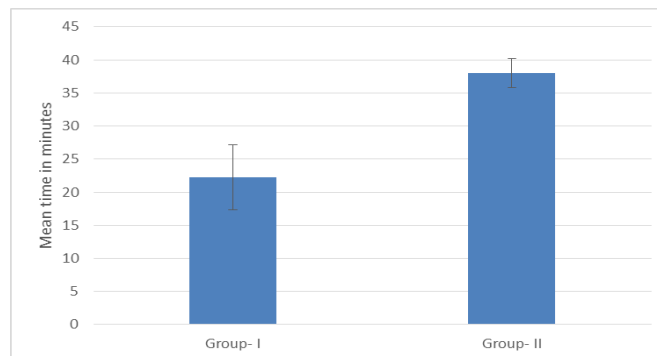
In this study, after open reduction and internal fixation with or without inter-maxillary fixation, the fracture segments were stable at their location in all patients of Group 1 (100%) & Group 2 (100%). This observation was consistent immediate post-operatively, at 1<sup>st</sup> week, 3<sup>rd</sup> week, 1<sup>st</sup> month, 3<sup>rd</sup> month & 6<sup>th</sup> month post-operatively.

#### Disturbance in occlusion

In this study, pre-treatment disturbance in occlusion was present in 73.4% cases of Group 1 (n=11) & 73.4% Group 2 (n=11) whereas, it was absent in 26.6% cases of Group 1 (n=4) & 26.6% Group 2 (n=4).

Immediate post-operatively, no disturbance in occlusion was noted in any case in both Groups.

At 1<sup>st</sup> week post-operatively, disturbance in occlusion was present in 6.6% (n=1) cases of Group 1 & 13.2% cases (n=2) of Group 2 whereas it was absent in 93.4% (n=14) cases of Group 1 & 85.8% cases of Group 2 (n=13). This observation was consistent at 3<sup>rd</sup> week, 1<sup>st</sup> month, 3<sup>rd</sup> month & 6<sup>th</sup> month post-operatively.

**Fig 1: Time for fixation (in minutes)**

The mean time of fixation in Group 1 was 22.27 minutes whereas in Group 2 it was 38 minutes. This result was statistically significant as p value was calculated to be <0.005

**Table 2: Disturbance in occlusion in both the groups**

Pre-treatment disturbance in occlusion	Number of cases	Percentage
<b>Present</b>		
Group-1	11	73.4%
Group-2	11	
<b>Absent</b>		
Group-1	4	26.6%
Group-2	4	26.6%
<b>Immediate post-operatively</b>		No Disturbance
<b>Disturbance in occlusion 1,3 week, 1rd ,3 nd, and 6 th months week post OP</b>		
<b>Present</b>		
Group-1	1	6.6%
Group-2	2	13.2%
<b>Absent</b>		
Group-1	14	93.4%
Group-2	13	85.8%

In this study, after open reduction and internal fixation with or without inter-maxillary fixation, the fracture segments were stable at their location in all patients of Group 1 (100%) & Group 2 (100%). This observation was consistent immediate post-operatively, at 1st week, 3rd week, 1st month, 3rd month & 6th month post-operatively. In this study, pre-treatment disturbance in occlusion was present in 73.4% cases of Group 1 (n=11) & 73.4% Group 2 (n=11) whereas, it was absent in 26.6% cases of Group 1 (n=4) & 26.6% Group 2 (n=4). Immediate post-operatively, no disturbance in occlusion was noted in any case in both Groups.[10-14]

At 1st week post-operatively, disturbance in occlusion was present in 6.6% (n=1) cases of Group 1 & 13.2% cases (n=2) of Group 2 whereas it was absent in 93.4% (n=14) ,cases of Group 1 & 85.8% cases of Group 2 (n=13). This observation was consistent at 3rd week, 1st month, 3rd month & 6th month post-operatively.

In this study, there was no significant difference in neurosensory deficit observed in both groups at any point in the study.

At all points peri-operatively and during follow-up, there was no statistically significant difference between both groups in the study in post-operative pain and trismus

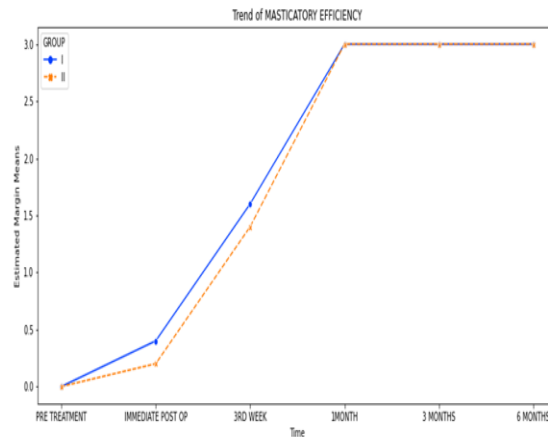


Fig 3: Masticatory Efficiency in both groups

Patients of both groups were kept on soft diet for a period of two weeks. The patients of both Groups 1 and 2 were unable to bite soft food (100%) before treatment. 39.6% (N=6) patients in Group 1 and 19.8% (N=3) of Group 2 were able to bite on soft food immediately after the surgery. At 3<sup>rd</sup> week follow up masticatory efficiency was 1 in 6 cases (40%) & 2 in 9 cases (60%) of Group 1. 3rd week follow up masticatory efficiency was 1 in 9 cases (59.4%) & 2 in 6 cases (39.6%) of Group 2. After follow up of 1 month all the patients were able to chew hard food in both groups. There was no statistically significant difference between both groups at any point in the study. There were no problems of wound dehiscence, exposure of plate after surgery or loosening of screws, fracture of plate, or other complications post-operatively in either group in the study[15-20]

**Discussion**

Open reduction and internal fixation with mini-plates is the current treatment for mandibular fractures as it meets the treatment goals of achieving optimal occlusion with minimal discomfort and complications to the patient. This study to evaluate the outcome of mandibular fractures following open reduction and internal fixation without pre or post-operative MMF included 30 patients divided into two groups randomly. Group 1 included 15 patients who did not receive MMF peri-operatively and Group 2 had 15 patients who underwent ORIF with MMF. The following is a discussion of the various parameters studied.

Our study included 30 patients, the age range was from 19-40 years. The minimum age of patient was 19 years and the maximum age was 40 years. Maximum patients were in the range of 21-30 years followed by the range of 31-40 years which is similar to the findings of Rangaswamy G et al[2], V Singh et al[3], Barde D et al[4], Morris C et al[5], Afroz et al[6] & Alexander J. Sojat et al [17]. In Group 1, 6.7% (n=1) of patients were females and 93.3% (n=14) were males. In Group 2, 13.4% (n=2) of patients were females and 86.6% (n=13) were males. Overall in this study 10% (n=3) patients were females and 90% (n=23) patients were males. Our study showed male preponderance which is similar to study done by Madhusudana et al[8], Subodh et al[9], El-Anwar et al[10], Lee K H[11], Elgehani R A[12] and Rabia Zulfiqar et al[13]. In Group 1, 13.3% (n=2) were cases of body of mandible fracture, 33.3% (n=5) were cases of left parasymphysis fracture, 40% (n=6) were right parasymphysis fracture & 13.3% (n=2) were cases of symphysis fracture. In Group 2, 6.6% (n=1) were cases of body fracture, 39.3% (n=6) were cases of left parasymphysis fracture, 33% (n=5) were right parasymphysis fracture & 13.3% (n=3) were cases of symphysis fracture. Overall in this study, 10% (n=3) were cases of body, 36.7% (n=11) cases were of left parasymphysis fracture, 36.7% (n=11) were right parasymphysis fracture & 16.7% (n=5) were cases of symphysis fracture. Our results were similar to studies by Madhusudhana et al[14], El-Anwar et al[10], Chaurasia A[14], Arun A et al[16] and Subodh et al[17]

Table 4: Most common cause of fracture/ injury in comparison with other studies

Study	Most Common Site (Region) %
<b>This Study</b>	Parasymphysis(73.4%)
Madhusudhana et al[8]	Parasymphysis(70.5%)
El-Anwar et al[10]	Symphysis&Parasymphysis(70%)
Chaurasia A et al[14]	Parasymphysis(40.3%)
Arun A et al[16]	Parasymphysis(36%)
Pasupathy S et al[17]	Parasymphysis(37.7%)
Subodh et al[9]	Parasymphysis(31.4%)

Overall in this study, the cause of fracture/ injury was assault in 16.6% (N=5) cases, 73.3% (N=22) cases were of road traffic accident and 10% (N=3) cases were of self-fall. In Group 1, the cause of fracture/injury was self fall in 6.6% (N=1) and 19.8% (N=3) was assault and 72.6% (N=11) were cases of road traffic accident. In Group 2, the cause of fracture/ injury was assault in 13.2% (N=2), 72.6% (N=11) cases were of road traffic accident & 13.2% (N=2) were of cases self-fall. These results were similar to studies by Guhan D et al[18], Atilgan S et al[19] and Simoni P et al[20]. In our study none of the patients in either group had complications of non- union or mal-union. No radiolucency was seen in any of the

radiographs of both the groups. The fracture segment was stable throughout the post-operative period. Similar results were noted in the studies conducted by Dimitroulis[21] and Bell R B et al[22]. The mean time of fixation in Group 1 was 22.27 minutes whereas in Group 2 it was 38 minutes. This result was statistically significant as p value was calculated to be <0.005. in patients of groups I and II proved the difference to be highly significant (P < 0.01). These results were similar to those reported by El-Anwar et al[10] and Hsu et al[15].

**Table 5: Mean time of fixation in both groups in comparison with other studies**

Study	Mean Time – without MMF (Minutes)	Mean Time – with MMF (Minutes)
<b>This Study</b>	22.70	38
El-Anwar et al	24	49
Hsu et al	44	65.6

Sensory changes were also observed throughout the period of study as paresthesia in the region of miniplates fixation. It was marked as present if sensory changes were found to be positive & absent if sensory changes were found to be negative. In this study, there was no significant difference in neurosensory deficit observed in both groups at any point in the study. Neurosensory deficits are commonly seen in mandibular trauma as noted by multiple studies. A seven year study conducted by Song Q et al[23] concluded that fracture displacement of more than or equal to 5 mm, miniplate fixation using 2 plates and operator inexperience were associated Inferior Alveolar or Mental Nerve neurosensory status after treatment of mandibular fracture. Masticatory efficiency was graded 0-3 based on patients ability to chew foods of different quality. Patients not able to bite even soft food were scored 0. Those able to chew on soft food were scored 1. Those able to chew on medium hard food like breads were scored 2 and those able to chew hard foods like nuts were scored 3. Patients of both groups were kept on soft diet for a period of two weeks. After follow up of all the patients were able to chew hard food in both groups. This was supported by Bhatnagar A et al[24] where patients treated with mini-plates were able to chew medium hard food which included vegetables and breads immediately postoperatively and after a follow up of 2 months, patients were able to eat hard food like nuts.

Pre-treatment trismus (interincisal distance) mean was 27mm in Group 1 whereas it was 23.6mm in Group 2. Immediate post-operatively trismus (interincisal distance) mean was 28.07mm in Group 1 whereas it was 25.8mm in Group 2. At 3<sup>rd</sup> week post-operatively, trismus (interincisal distance) mean was 30.53mm in Group 1 whereas it was 39.33mm in Group 2. At 1<sup>st</sup> month post-operatively, trismus (interincisal distance) mean was 34.73mm in Group 1 whereas it was 33.87mm in Group 2. At 3<sup>rd</sup> month post-operatively, trismus (inter-incisal distance) mean was 35.2mm in Group 1 whereas it was 34.6mm in Group 2. At 6<sup>th</sup> month post-operatively, trismus (interincisal distance) mean was 35.47mm in Group 1 whereas it was 35.67mm in Group 2.

At all points peri-operatively and during follow-up, there was no statistically significant difference between both groups in the study. In contrast a study conducted in 2015 by El-Anwar[10] et al showed a statistically significant improvement in intrinsic vertical mouth opening in the first post-operative week when MMF was not applied in a similar study. Pain was assessed in all the patients on a Wong Baker's Scale of 0-5. In this study, pre-treatment pain was at a mean of 3.93 in Group 1 and 4 in Group 2. Immediate post-operatively, pain was at a mean of 3.80 in group 1 and 3.67 in group 2. At 3<sup>rd</sup> day post-operatively, pain was at a mean of 2.73 in group 1 and 2.87 in group 2. At 1<sup>st</sup> week post-operatively, pain was at a mean of 1.93 in group 1 and 1.87 in group 2. At 3<sup>rd</sup> week post-operatively, pain was at a mean of 0.20 in group 1 and 0.47 in group 2. At 1<sup>st</sup> month post-

operatively, pain was at a mean of 0.0 in group 1 and 0.07 in group 2. At 3<sup>rd</sup> month & 6<sup>th</sup> month post-operatively pain in both groups was 0.

At all points peri-operatively and during follow-up, there was no statistically significant difference between both groups in the study. This finding was similar to a study conducted in 180 patients by I. Kumar et al between November 2006 and May 2009.

At 1<sup>st</sup> week post-operatively, disturbance in occlusion was present in 6.6% (n=1) cases of Group 1 & 13.2% cases (n=2) of Group 2 whereas it was absent in 93.4% (n=14) cases of Group 1 & 85.8% cases of Group 2 (n=13). This observation was consistent at 3<sup>rd</sup> week, 1<sup>st</sup> month, 3<sup>rd</sup> month & 6<sup>th</sup> month post-operatively. Similar findings were noted in studies by Dimitroulis[21] and I. Kumar et al[25].

Complications studied were infection, exposure of the hardware, fracture of the hardware & any other complication associated with placement of miniplates. None of the patients reported with infection post-operatively. None of the patients in either group reported with fracture of the hardware and loosening of the hardware. None of the patients in either group reported with exposure of the hardware. No other complication was observed in any patient. In this study, complications immediate post-operatively was absent in all cases of both Group 1 (100%) & Group 2 (100%). This observation was consistent at 3<sup>rd</sup> week, 1<sup>st</sup> month, 3<sup>rd</sup> month & 6<sup>th</sup> month post-operatively. Similar results were reported in studies by R Bell et al[26], El-Anwar et al[10].

#### Conclusion

In the present study Mean time of fixation in Group 1 (ORIF without MMF) was 22.27 minutes whereas in Group 2 (ORIF with MMF) it was 38 minutes which is statistically significant. Mouth opening showed a gradual recovery, decrease in pain in patients of both groups. There was statistically no significant difference in occlusal disturbances in both groups compared in the study. There was no significant difference after fixation with or without MMF in stability of fracture segment. The complication like exposure of plate after surgery, fracture of plate after surgery, wound dehiscence and loosening of hardware after surgery was not reported in the entire study. Advantages of ORIF without MMF were Less time and Less Hardware required. Disadvantages are skilled assistance is required, multiple fractures cannot be treated simultaneously and complex fractures cannot be treated without MMF.

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