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Evaluation of Fixation of Mandibular Angle Fracture by Intraoral External Oblique Ridge with Transbuccal Lateral Cortical Plate

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Introduction

The mandible is one of the most fracture-prone facial bones due to its projection and prominent position[1,3] . The mandibular angle is one of the most frequently fractured areas due to the presence of the mandibular third molar [1] , a thinner cross-sectional area than the tooth-bearing region and biomechanically the angle can be considered a "lever" area [7] . Angle fractures generate more complications than other mandibular fractures, the incidence ranging from 0 to 32%, and the biomechanics of the angle make treatment of fractures in this region difficult [4,5,6] .

Over the past decade, a gradual shift has occurred in the surgical management of mandibular angle fractures. Wire osteosynthesis followed by prolonged periods of maxillomandibular fixation which has been replaced mainly by rigid and semi rigid internal fixation.[8]

Champy et al performed several investigations with a miniplate system to validate the technique. In their experiments, they determined the "ideal lines of osteosynthesis" in the mandible, or the locations where bone plate fixation should provide the most stable means of fixation. For fractures of the mandibular angle, the most effective plate location was found to be along the superior border in the region of the "tension band of the mandible". It can be placed on external oblique ridge using intraoral approach or flat against the lateral border of the mandible using transbuccal approach [1,4,7,10,11,12,13].

The superior border plate technique it allows for a relatively rigid internal fixation of a mandibular angle

fracture that prevents the proximal segment from displacing superiorly yielding a malunion and intraorally gives the good access and less morbidity with the lowest number of complications avoiding any external facial scar, and damage to the facial nerve [4,5,14] .While the lateral border plating done by transbuccal approach requires more periosteal stripping, increased operating time, risk to damage the facial and marginal mandibular nerve and hypertrophic scar formation [9,10].

The purpose of the present study is the evaluation of the treatment results of fixation of mandibular angle fractures at the External oblique ridge via Intra-oral approach and fixation at the lateral border via Transbuccal approach.

Materials and Methods

Source of Data : The study was conducted on 30 patients with clinico-radiographically confirmed angle fracture of mandible who reported to the department of oral and Maxillofacial Surgery, V.Y.W.S dental college and hospital during the period of 2015-2018 with proper routine blood investigation.

This clinical trial was undertaken after the due approval from the institutional ethic committee. Informed consent was procured from the patient after explaining the nature of the procedure.

The parameters for this study were,

1. Time consumed for the procedure.
2. Postoperative occlusion.
3. Postoperative complications like ,

- Infection
- Inferior alveolar nerve injury
- Loosening of plate and screw and exposure of plate
- Wound dehiscence
- Post-operative OPG displacement reduction.

Criteria for Patient Selection

Inclusion criteria

- ASA class I and class II category patients.
- Patients with Unilateral or Bilateral fractures of mandibular angle requiring open reduction with rigid internal fixation for treatment.
- Dentulous patients.
- No contraindications to the drugs or anesthetics used in surgical protocol.
- Patient who are willing to participate in the study and come for the follow up.

Exclusion criteria

- ASA class III and class IV category patients.
- Patients with comminuted fracture.
- Patients with pathology of mandible – cyst, tumor and osteomyelitis
- Edentulous patient.

A pre-structured Proforma was used to collect relevant information like parameters, investigations and pre and post-operative drugs given to individual patient.

Intraoral Approach

After securing general anesthesia under all aseptic precautions. Surgical site was infiltrated with local anesthetic solution containing 2% Lignocaine with adrenaline (1: 2, 00, 000). Fracture site was exposed through the Intra-oral vestibular incision. Incision was taken beginning on the anterior border of ascending ramus at the level of maxillary occlusal plane. It was then carried down just along the lateral portion of anterior ramus and, following the oblique line, continued forward approximately 5mm from the junction of the attached mucosa and vestibule to extend anteriorly to the level of approximately the mandibular first molar. Full thickness mucoperiosteal flap was reflected and the fracture site was exposed .The third molars which were not hindering the fracture reduction were retained and those which were loose or fractured were extracted. Fractured ends were reduced under direct vision, satisfactory occlusion was achieved and held in that position by intermaxillary

fixation. Reduction of fractured segments and maxillo-mandibular fixation was accomplished with wires to achieve occlusion. Fixation of 2mm stainless steel 4-hole with gap Champy's miniplate was done with 2 X 8 mm stainless steel screw on external oblique ridge(superior border). Once adequate fixation was achieved the area was irrigated with betadine and saline, MMF was released. After adequate haemostasis the wound was closed in layers with vicryl (3-0) suture and extra-oral pressure dressing was given.

Transbuccal Approach

The skin incision was marked with Bonny's blue ink. A small extra-oral stab incision was given in a safety zone triangle for transbuccal trocar placement which was created by the following three lines was determined. **Line 1** (trago-basal line) ran from the tragus to the groove over the body of the mandible at the antero-inferior angle of the masseter (the course of the facial artery on the body of the mandible). **Line 2** (cantho-gonial line) ran from the outer canthus to the angle of the mandible (gonion). **Line 3** (mandibular line) was the border of the mandible, through which fixaton was carried out using trocar instrumentation to permit the insertion of transbuccal canula. Location of the extra-oral stab incision was guided by the location of the fracture line and the position of facial vessels in the safety zone. The trocar was advanced into operative site with blunt dissection through the stab incision perforating the periosteum in the area planned for plate fixation. The cheek retractor was applied which helped to stabilize the trocar assembly during movement towards and away from the fracture site. The Stainless steel plate was then placed in relation to fracture site at the lateral border of the angle region. A drill bit of 125mm length and 1.5mm diameter was inserted through the drill guide. Fixation of 2mm stainless steel 4-hole with gap. Champy's miniplate was done with 2 X 8 mm stainless steel screw were threaded into position till the proper depth and tightness was achieved. Trocar assembly was removed and the intermaxillary fixation was released and occlusion was rechecked. Once adequate fixation was achieved the area was irrigated with betadine and saline, MMF was released. Intraoral wound was closed using 3-0 vicryl and extra-oral stab incision with 4-0 prolene.

Statistical Analysis

Method of data analysis

SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc software was used to analyse the data. Statistical analysis was done by using tools of descriptive statistics such as Mean, and SD for representing quantitative data like mean time consumed for the procedure of mandibular angle fixation

Qualitative /Data in proportion like presence or occurrence of post - operative complication like infections, loosening of plates, wound dehiscence etc. are expressed in percentages.

Student unpaired t test / Independent t test between two samples are used to compare means of experimental group and control group in relation to age , sella dimensions respectively.

Probability of accepting alpha error was set at 5%, $p < 0.05$ considered as significant. Power of the study set at 80%.

Chi square test was used to find out difference between Group A (on external oblique ridge) and Group B (on lateral border) in relation to post-operative complications at different time interval (1 week, 3 week, 3 month) respectively

Observation and Results

The results of our study showed that both ORIF via an intraoral and transbuccal approach , are satisfactory methods of fixation. There was no significant differences in the complication rates between the two approaches.

Although the functional outcomes like infection, wound dehiscence, exposure of plate are found with the higher incidence in group A as compared to group B. At the same time the extraoral scar, risk of damage to the inferior alveolar nerve, duration of surgery was more in group B as compared to group A. Even the postoperative occlusion recorded was satisfactory in group B with that of group A. Both the approaches have their own distinct advantages and disadvantages.

In patients having high gonial angle, deep bite, acute massetric hypertrophy in which intraoral approach was difficult, transbuccal approach was considered to be a suitable choice which reduces the infection,wound dehiscence, scar formation and morbidity. Whereas in young patients where transbuccal approach is not suitable due to scar formation, intraoral approach is to be used.

Table 1: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to time consumed for the procedure of fixation of mandibular angle (Using unpaired t test)

Groups	Mean	S.D	Unpaired t test	p value, Significance
Group A (n=15)	38.66	5.49	-6.753	< 0.001, Highly significant difference
Group B (n=15)	56.0	8.28		

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant.

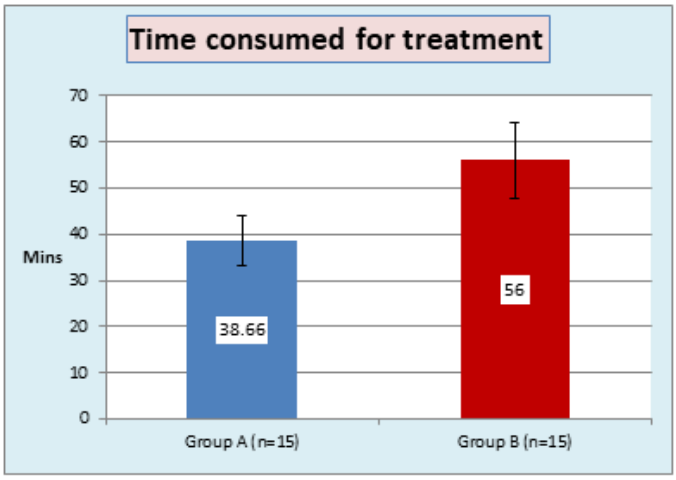

Table 2: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to post – operative infection at different time interval (1 week, 3 week & 3 month) after the procedure of fixation of mandibular angle

Study groups	1 week	3 week	3 month
Group A (n=15)	5/15 (33.3%)	1/15 (6.7 %)	1/15 (6.7 %)
Group B (n=15)	0/15 (0%)	0/15 (0%)	0/15 (0%)
Pearson Chi-square test	6.00	1.034	1.034
P value	0.014	0.309	0.309
Difference	Significant difference	No significant difference	No significant difference

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

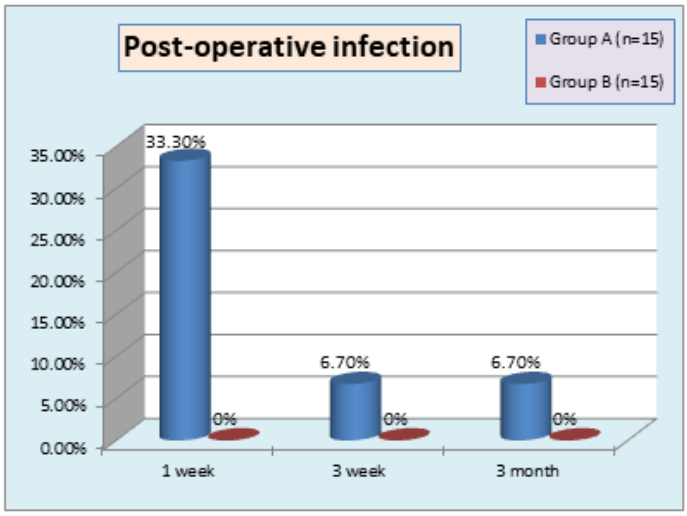

Table 3: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to post – operative inferior nerve injury at different time interval (1 week, 3 week & 3 month) after the procedure of fixation of mandibular angle

Study groups	1 week	3 week	3 month
Group A (n=15)	0/15 (0 %)	0/15 (0 %)	0/15 (0 %)
Group B (n=15)	1/15 (6.7 %)	1/15 (6.7 %)	0/15 (0%)
Pearson Chi-square test	1.034	1.034	0.0
P value	0.309	0.309	1.0
Difference	No Significant difference	No Significant difference	No significant difference

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

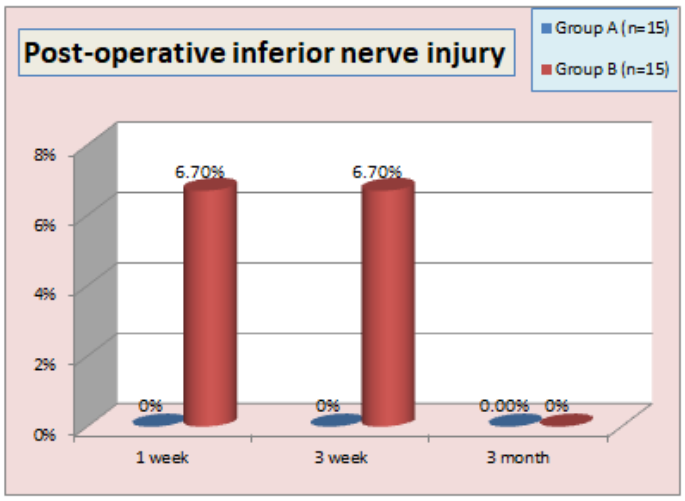

Table 4: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to post – operative loosening of plates and screw at different time interval (1 week, 3 week & 3 month) after the procedure of fixation of mandibular angle

Study groups	1 week	3 week	3 month
Group A (n=15)	0/15 (0 %)	0/15 (0 %)	0/15 (0 %)
Group B (n=15)	0/15 (0%)	0/15 (0%)	0/15 (0%)
Pearson Chi-square test	0.0	0.0	0.0
P value	1.0	1.0	1.0
Difference	No significant difference	No significant difference	No significant difference

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

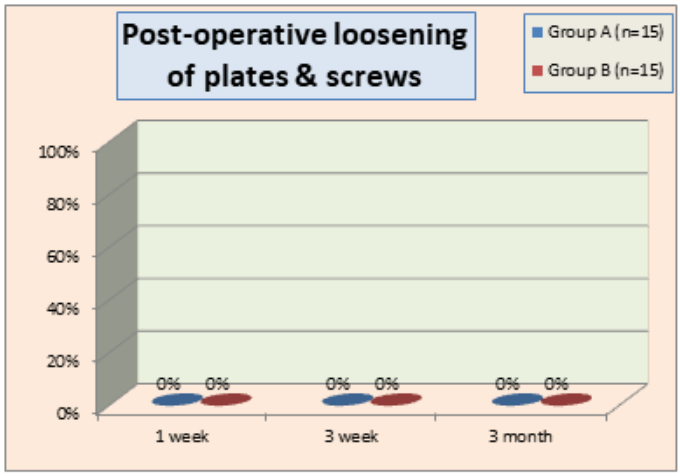

Table 5: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to post – operative exposure of plates at different time interval (1 week, 3 week & 3 month) after the procedure of fixation of mandibular angle

Study groups	1 week	3 week	3 month
Group A (n=15)	1/15 (6.7 %)	1/15 (6.7 %)	1/15 (6.7 %)
Group B (n=15)	0/15 (0%)	0/15 (0%)	0/15 (0%)
Pearson Chi-square test	1.034	1.034	1.034
P value	0.309	0.309	0.309
Difference	No significant difference	No significant difference	No significant difference

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

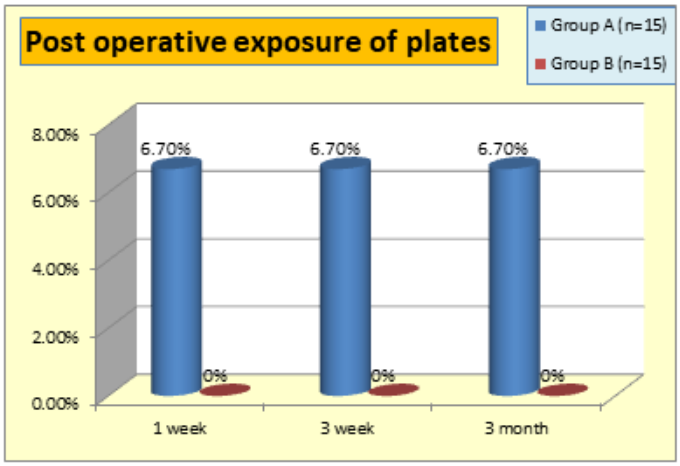

Table 6: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to post – operative wound dehiscence at different time interval (1 week, 3 week & 3 month) after the procedure of fixation of mandibular angle

Study groups	1 week	3 week	3 month
Group A (n=15)	1/15 (6.7 %)	1/15 (6.7 %)	1/15(6.7 %)
Group B (n=15)	0/15 (0 %)	0/15 (0 %)	0/15 (0 %)
Pearson Chi-square test	1.034	1.034	1.034
P value	0.309	0.309	0.309
Difference	No Significant difference	No Significant difference	No Significant difference

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

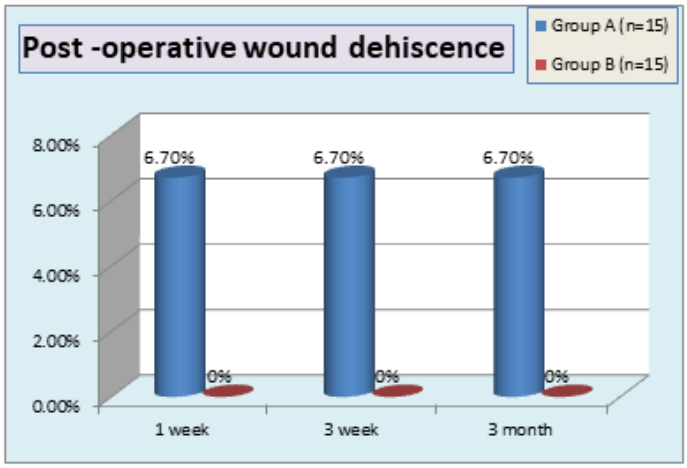

Table 7: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to presence of non-satisfactory post –operative OPG displacement reduction at different time interval (1 week, 3 week & 3 month) after the procedure of fixation of mandibular angle

Study groups	1 week	3 week	3 month
Group A (n=15)	0/15 (0 %)	0/15 (0 %)	0/15 (0 %)
Group B (n=15)	0/15 (0 %)	0/15 (0 %)	0/15 (0%)
Pearson Chi-square test	0.0	0.0	0.0
P value	1.000	1.000	1.0
Difference	No Significant difference	No Significant difference	No significant difference

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

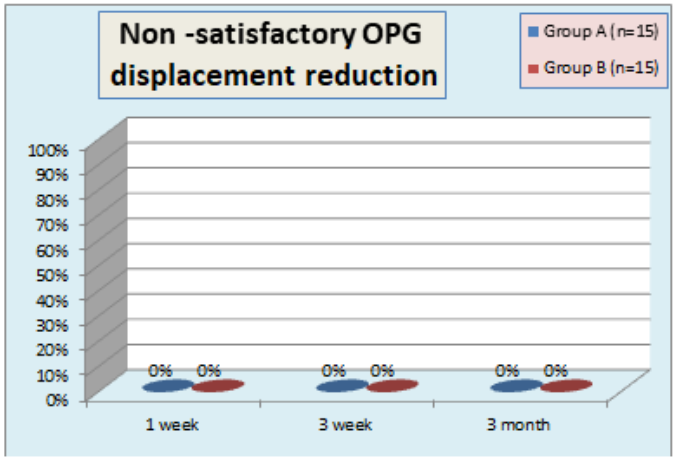

Table 8: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to post – operative occlusion at 1 week time interval after the procedure of fixation of mandibular angle

Study groups	Satisfactory	Non satisfactory	Mild Deranged	Deranged	Chi-square test, p value
Group A (n=15)	14/15 (93.3 %)	0/15 (0 %)	0/15 (0 %)	1/15 (6.7%)	Chi=2.154, P=0.341, No Significant difference
Group B (n=15)	12/15 (80 %)	0/15 (0 %)	2/15(13.3 %)	1/15 (6.7%)	

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

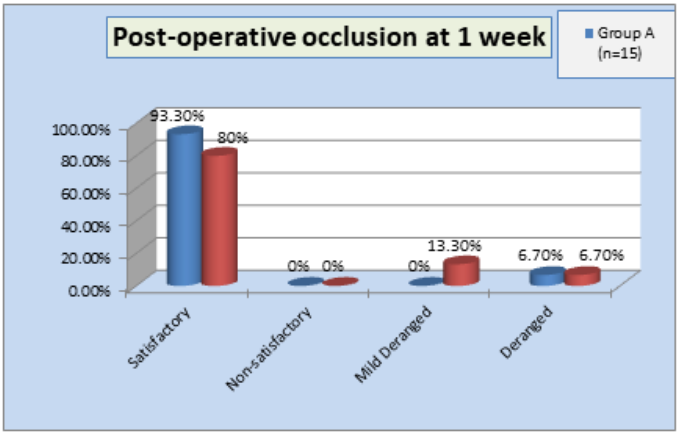

Table 9: Evaluation of group a (on external oblique ridge) and Group B (on lateral border) in relation to post – operative occlusion at 3 week time interval after the procedure of fixation of mandibular angle

Study groups	Satisfactory	Non satisfactory	Mild Deranged	Deranged	Chi-square test, p value
Group A (n=15)	15/15 (100 %)	0/15 (0 %)	0/15 (0 %)	0/15 (0 %)	Chi=2.143, P=0.143, No Significant difference
Group B (n=15)	13/15 (86.7%)	0/15 (0 %)	2/15(13.3 %)	0/15 (0 %)	

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

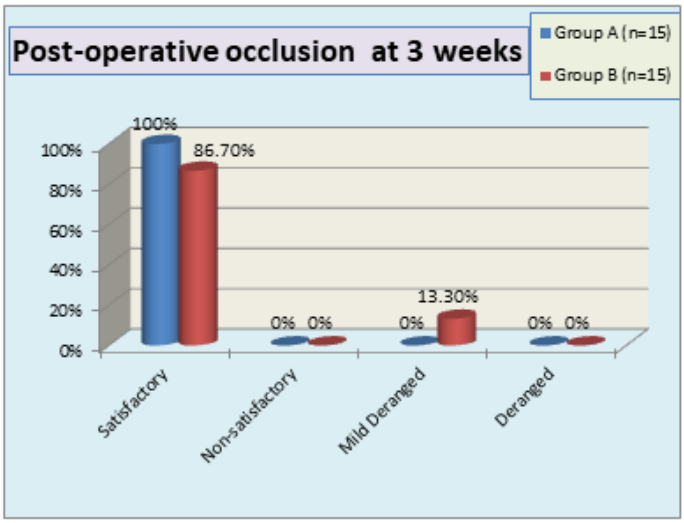

Table 10: Evaluation of group A (on external oblique ridge) and Group B (on lateral border) in relation to post – operative occlusion at 3 month time interval after the procedure of fixation of mandibular angle

Study groups	Satisfactory	Non satisfactory	Mild Deranged	Deranged	Chi-square test, p value
Group A (n=15)	15/15 (100 %)	0/15 (0 %)	0/15 (0 %)	0/15 (0 %)	Chi = 0.0, P = 1.00, No Significant difference
Group B (n=15)	15/15 (100 %)	0/15 (0 %)	0/15 (0 %)	0/15 (0 %)	

p> 0.05 – not significant, p < 0.05 – significant, p< 0.001 – highly significant

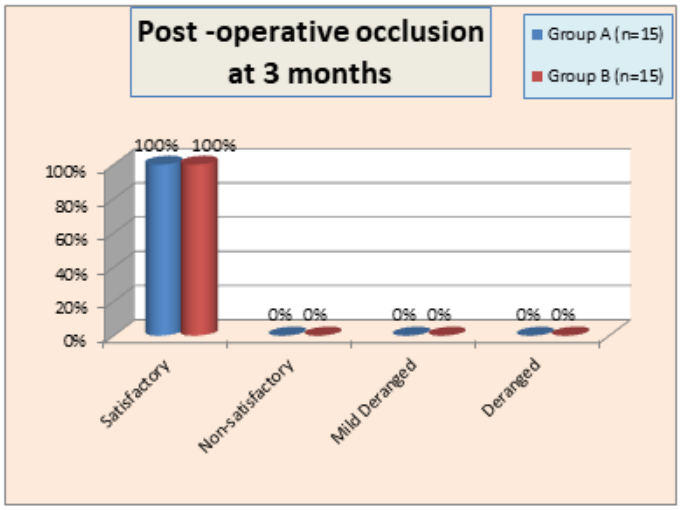

Fig.1: Pre-opt OPG for Intraoral approach

Fig. 2: Fracture site exposed

Fig.3 : Intra-oral Plating

Fig 4: Post-opt OPG Intraoral approach

Fig. 5: Pre-opt OPG for Transbuccal approach

Fig. 6 : Marking of Transbucaal approach

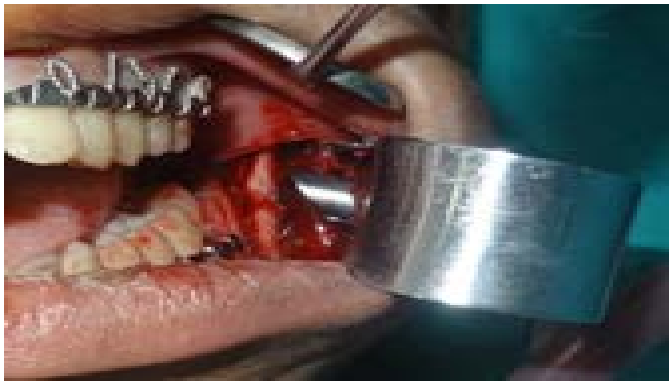

Fig. 7: Placement of Transbuccal trocar

Fig. 8 : Plating

Fig. 9: Post-operative OPG for Transbuccal Approach

Discussion

Fractures of the mandibular angle deserve particular attention because they represent the highest percentage of mandibular fractures, and have the highest postsurgical complication rate, making them the most challenging and unpredictable mandibular fractures to treat [34,7] .

Champy(1975)[16] mentions three different zones in the mandible for application of the plates. First, a so-called neutral zone subapical to the dentition in the lateral portion of the mandible, in this location one plate is sufficient. Secondly, a two-level zone between the mental foramina in which two plates have to be applied to resist the torsional forces. In the angle region the tensile forces are generated on the upper border of mandibular angle and compressive forces are generated on the lower border , the fixation can be performed with one plate, applied buccally to the external oblique ridge to give support to the fracture fragments .The plate should be positioned in the region of the 'tension band' of the mandible, the upper border. It can be placed on around the external oblique ridge using an intraoral approach, or flat against the outer surface of the mandible using a transbuccal approach[16,31].

The present study evaluated and assessed the treatment outcomes of placement of champys miniplate on external oblique ridge via intraoral approach with lateral border via transbuccal approach in terms of time duration, infection, inferior alveolar nerve injury, loosening of plate and screws, exposure of plate, wound dehiscence, post operative displacement reduction and postoperative occlusion.

Edward Ellis III(2004)[18] Multiple studies report a 2 - 3 fold increased risk for mandibular angle fractures when third molars are present as it weakens the angle by decreasing the bone mass in the region.

Twenty eight patients in our study have shown association between 3rd molar in the line of fracture. Which correlates with studies of Kumar et al.[32] in which 92% cases were associated with 3rd molars in the line of fracture, and study by Edward Ellis III [26]showed 90.3% cases. In a study by Elavenil etal[52] an increased incidence of angle fracture due to impacted third molars has been mentioned with an increased predisposition in mesioangular class I position. A impacted tooth and 10 times increased tendency of angle fracture when height of mandible is less than 19mm. This can fairly be correlated with our study as majority of the cases were having partially erupted mesioangular third molar.

In present study the mean operation time from incision to wound closure was 38.66 minutes (range 30 min to 45 min) for group A and 56 minutes (range 50 min to 65 min) for group B.

According to D. W. Patton et al [24] S. Laverick et.al[31] Kenneth Wan et.al[41] the transbuccal approach did not

require a significantly longer operating time than the conventional ridge plate. This is a controversial and can be justified by the fact that in intraoral approach only intraoral incision is required and on other hand 3 dimentional bend has to be given during plate placement on external oblique ridge, but in transbuccal approach intraoral as well as extraoral incision is required and placement of plate on flat surface of lateral border is done intraorally and transbuccal trocar along with screw is inserted extraorally which may increase its time duration and closure has to be done intraorally and extraorally. Keeping in mind all these criterias our study has concluded that intraoral approach requires less operating time than transbuccal approach.

In present study postoperatively signs of infection were checked after 1 week, 3 weeks and 3 months. In group A in the first week infection was encountered in five patients out of fifteen(33.3%). In the same group, one patient out of fifteen(6.7%)in the third week of follow up. Infection was persistent which was subsequently followed for three months regular follow-up with irrigation of betadine was done and 10 days antibiotics course and 0.1%chlorhexidine rinses were given for 2 weeks Albert j fox et.al [56] and finally the decision for removal of the implants was executed to control the infection. No sign of infection was seen in any patient in group B. The difference was found to be statistically significant in first week (p value 0.014) (Table 2).

This is also in accordance with the study by S. Laverick et.al[31] D. W. Patton et.al[24] Kenneth Wan et.al[41] Conor P. Barry et.al [12] V. Singh et.al [5] found infection in a patient who was treated intraorally on external oblique ridge.

The infections in group A were treated with antibiotics and resolved uneventfully S. Laverick et.al[31] D. W. Patton et.al[24] Kenneth Wan et.al[41] Conor P. Barry et.al [12] V. Singh et.al[5] .

In our study one patient in group B(6.7%)without any post-trauma sensory deficit reported with paraesthesia in the post operative phase which persistent upto three week. Statistical analysis did not show any significant difference between the two groups (p value 0.309) (Table 3).

According to Conor P. Barry et.al [12] V. Singh et.al [5] Albert j fox et.al [56] did not found any significant findings intraorally and inferior alveolar nerve injury which was identified after surgery were likely the result of manipulation at the fracture site during surgery.

One patient was prescribed multivitamin supplements and associated paraesthesia resolved after three weeks

In the present study no loosening of plates and screws was seen in either of both the groups. Statistical analysis did not show any significant difference between the two groups (p value 1.0) (Table 4).

According to Kenneth Wan et.al[41] the incidence of screw loosening was higher in the intraoral group(14.1%)compared with the transbuccal group(7.6%).

In our study one patient consistently reported with the complain of exposure of plate and wound dehiscence in group A. No patient in group B reported with the exposure of plate and wound dehiscence. Statistical analysis did not show any significant difference between the two groups(p value 0.309)(Table 5,6).This incidence in the intraoral group was consistent with the studies by Kenneth Wan et.al[41] Conor P. Barry et.al [12] E.A.Al-moraissi[39] .It was higher in the intraoral group (15.7%) than in the transbuccal group (2.7%).This was an expected result and it can be explained by the anatomic position of the intraoral plate, which sits over the external oblique ridge of the mandible, where soft tissue coverage is thin mucosa or gingiva. In addition, a plate inserted intraorally sits closer to the dentition, allowing an easier and shorter path

of bacterial pathogens to transgress from the periodontal sulcus to the fixation hardware. Conversely, transbuccal plates are fixed on the lateral aspect of the mandible in a sagittal plane, where it is covered by a greater bulk of soft tissue. After the antibiotic treatment , the infection resolved, however despite continued local wound care, the incision site failed to heal. The miniplate was subsequently removed, the mandible was stable at the time of the plate removal without further event Albert j fox et.al [56]

All radiographs were assessed for the presence or absence of bone gap and displacement after the interval of one week, three weeks and three months. Stable results were found in both the groups (Table 7).

S. Laverick et.al[31] Pushkar Mehra et.al[22] they obtained no significant difference in postoperative OPG displacement reduction outcomes. V. Singh et.al [5] found four cases intraorally in whom a gap was visualized on the radiographs at the lower border.

One case from group A reported with deranged occlusion at the interval of one week follow-up. With guiding elastics, experienced no further disturbances at follow-up's. Three patients from group B reported with deranged occlusion at the interval of one week in one patient and mild deranged occlusion in two patients at the interval of one week follow-up and two patient reported with mild deranged occlusion at the interval of three week follow-up. Guiding elastics and correction of selective occlusal grinding prematurities helped the patients with mild derangement to eventually settle the occlusion. The patient who had fully deranged occlusion had to be kept on IMF for one week and then was shifted to guiding elastics and experienced no further disturbances at subsequent follow-up. Statistical analysis did not show any significant difference between the two groups (Table 8,9,10)

Conor P. Barry et.al [12] V. Singh et.al [5] S. Laverick et.al[31] compared the occlusal discrepancy between both the groups and the result showed statistically significant association with both groups. All the patients in both groups had satisfactory postoperative occlusion at the end of three months.

Summary and Conclusion

The results of our study showed that both ORIF via an intraoral approach with application of a single monocortical miniplate on external oblique ridge according to champy's ideal line of osteosynthesis and ORIF via transbuccal approach with application of miniplate on lateral border, are satisfactory methods of fixation. There was no significant differences in the complication rates between the two approaches. Although the functional outcomes like infection, wound dehiscence, exposure of plate are found with the higher incidence in group A as compared to group B. At the same time the extraoral scar, risk of damage to the inferior alveolar nerve, duration of surgery was more in group B as compared to group A. Even the postoperative occlusion recorded was satisfactory in group B with that of group A. Both the approaches have their own distinct advantages and disadvantages.

Presence of un-erupted molar in the fracture line do play an important role in the biomechanics of angle fracture. We preferred not to remove third molar in line of fracture unless strongly indicated. On the contrary, the third molar proved to be a guiding point for proper angle reduction in majority of the cases and loosing it on the time of surgery can complicate anatomic reduction on table.

In patients having high gonial angle, deep bite, acute massetric hypertrophy in which intraoral approach was difficult, transbuccal approach was considered to be a suitable choice which reduces the infection,wound dehiscence, scar formation and morbidity. Whereas in

young patients where transbuccal approach is not suitable due to scar formation, intraoral approach is to be used.

Furthermore, Surgeons should consider the best suitable approaches for the treatment of particular type of fracture based on severity and location, ability to adequately visualize and reduce the fracture, and personal experience with the technique.

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