

Comparison of Microplate and Arch Bar with 3D Microplate in the Management of Pediatric Anterior Mandibular Fractures

Saeed Ahmad¹, Muhammad Adnan Akram², Armghan Israr Mirza³, Kiran Nayyar¹, Irfan Ahmad Shah¹ and Usman Tariq¹

ABSTRACT

Objective: The purpose of this study was to compare treatment outcomes using conventional titanium microplate and arch bar with 3- Dimensional titanium microplate in the management of pediatric anterior mandibular fractures.

Study Design: Comparative / Prospective study

Place and Duration of Study: This study was conducted at the department of pediatric Oral & Maxillofacial Surgery, The Children's Hospital & Institute of Child Health, Lahore in 2018.

Materials and Methods: A total number of 44 pediatric patients were included in this study. Patients were randomly categorized into 2 groups. Group A comprised of patients with standard titanium microplate and arch bar while Group B patients were treated with 3-dimensional plate alone. Clinical parameters observed were, infection and assessment of intraoperative time for each plate fixation and infection.

Results: After 1st week in Group A, infection was 32%, in Group B, only two (9%) patients showed infection. On 4th week infection rate was 18% in Group A and 4.5 % in Group B. At 12 weeks there was no sin of infection in both groups. Bony union was observed clinically by pain and tenderness and bridging of fracture gap on OPG. At the end of 12th week there was complete bridging of gap in both groups. Malocclusion was 13.6% in Group A. In Group B no case of malocclusion was observed. Mean intraoperative time for Group A was 109.5 ± 9.6 minutes and that of Group B was 53.5 ± 19.9 minutes ($p < 0.05$).

Conclusion: 3- Dimensional plate is a convenient and time saving alternate to conventional microplate and arch bar.

Key Words: 3D titanium miniplate , titanium miniplate, anterior Mandibular fracture

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INTRODUCTION

Globally, Trauma is the leading health problem in children¹. Craniofacial Trauma is more common in children². Among facial trauma, the mandible is the facial bone most often fractured in children³. Mandibular symphysis and parasymphysis fractures (Fig.1,2) are most frequent after mandibular condylar fracture⁴. The presence of thick adipose tissue with added bone elasticity and tooth buds renders mandible.

¹. Department of Oral & Maxillofacial surgery, Children Hospital & Institute of Child Health, Lahore.

². Department of Pediatrics & Maxillofacial surgery, Azra Naheed Medical & Dental College, Lahore.

³. Department of Oral & Maxillofacial Surgery de'Montmorency College of Dentistry, Lahore.

⁴. Department of Pediatrics

Correspondence: Dr. Saeed Ahmad, Department of Oral & Maxillofacial surgery, Children Hospital & Institute of Child Health, Lahore.

Contact No: 0300 4252958

Email: drsaeed47@gmail.com

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resistant to fracture and more frequently they are minimally displaced⁵. The most predictable cause of pediatric symphysis and parasymphysis fractures is fall and road traffic accidents followed by sports related injuries, assaults and child abuse. These etiological factors depend upon age, gender, geographic circumstances, socio-economic status and cultural uniqueness of people⁶.

Pediatric mandibular symphysis and parasymphysis fractures are managed on the same basic principles applied to adult fractures⁷. The main focus of mandibular fracture management is to re-establish the former normal anatomy, function and interdigitation of teeth⁸. Two treatment modalities are in practice for the management of pediatric anterior mandibular fractures that is conservative approach and open reduction and internal fixation⁹. The conservative methods included soft diet and observation, closed reduction with splints or intermaxillary fixation by arch bars¹⁰.

More recently, 3-D titanium micro plates have been developed. 3-D microplates also follow the Champy's ideal lines of osteosynthesis for mandibular symphysis and parasymphysis. These plates are like a two-plate system with two microplates bonded together by interconnecting crossbars¹¹. The screws are arranged in

the configuration of a cube on either side of the fracture, a broad-band platform is created, increasing the resistance to twisting and bending of the long axis of the plate¹². One of the advantages of this technique is the concomitant stabilization of the tension and compression zones and alleviating the need for additional arch bar making the 3-D microplates a time-saving alternative to conventional microplate and arch bar¹³.

Currently 3-D miniplates are being used in adult patients and no published data is available in our country for use of 3-D microplates in pediatric mandibular symphysis and para-symphysis fractures. This study was conducted on pediatric anterior mandibular fractures to evaluate use of 3-D microplates without arch bar in mixed dentition stage as a convenient and time saving

The objective of this study was to compare treatment outcomes using conventional titanium microplate and arch bar with 3- Dimensional titanium microplate in the management of pediatric anterior mandibular fractures (between mental foramina).

MATERIALS AND METHODS

Forty-four patients with mandibular symphysis and para-symphysis fractures were recruited. All 44 Patients were divided into two group A and B. Group A consisted of patients treated with titanium microplate and screws with arch bar while in Group B 3-Dimensional microplate alone was used. A standard 1.6mm microplating system with 5mm monocortical screws was used for both groups.

All patients were treated under general anesthesia and nasal endotracheal intubation was passed. A standard intra oral vestibular incision was given in both groups to expose the fractured site. In Group A, an arch bar was applied to mandibular dentition after manually reducing the fractured segments. This arch bar was not only used for Temporary IMF but also used to counteract the tension band in the upper border according to Champy's principle. In Group B eyelets were used for temporary IMF. After IMF and manually reducing the fracture, internal fixation was done with

titanium microplate measuring 1.6mm x 5 holes' plate and 1.6mm monocortical screws of 5mm in Group A. The plate was applied on the inferior border of the mandible and upper border was secured using arch bar. Four screws were used to secure plate 2 on each side of the fractured plate. Fixation of 3-D micro plate in Group B was done in such a way that a horizontal bar was perpendicular and vertical bar was parallel to the fracture line. The upper bar was placed in the sub apical position. Tooth buds were bypassed on the basis of radiographic assessment. 4 monocortical screws were used on corners of plate¹⁴. The wound was closed and tight using 3/0 resorbablepolyglactin sutures. IMF was released at the end of the surgical procedure in both groups. Duration of the procedure was noted in both groups. Patients then placed on standard 7 days' antibiotic regimen. Patients were reviewed after intervals of 1 week, 4 weeks and then after 12 weeks. Infection was noted on the basis of erythema, edema, and pus discharge¹⁵. Bone union was assessed both clinically and radiographically. Malocclusion as failure to achieve proper interdigitation of teeth was categorized as abnormal. Impressions were taken and models were obtained from impression to check for any occlusal discrepancy¹⁶. The arch bar and eyelets were removed after 4 weeks. Both Micro and 3-dimensional micro plates were removed after 3 months. OPG radiographs were carried out 1 day after treatment and after 12 weeks postoperatively to limit the exposure to radiation. Total time for each procedure was noted. Data was entered using IBM-SPSS (V-23) for analysis. Fisher's Exact test was employed to compare the outcomes; student's-test was also applied to compare the time duration. A p-value less than 0.05 was taken for statistical significance.

RESULTS

Out of 44 patients with age range was 6-12 years and mean age of 8.5 years. Male patients were 26 and female was 18. Road traffic accident (63.6%) was the most common cause of fractures followed by falls (36.4%).



Figure No.1: Preoperative picture of 11 years old male patient with Rt. Parasymphysis. Preoperative OPG showing displaced anterior mandibular fractured segments

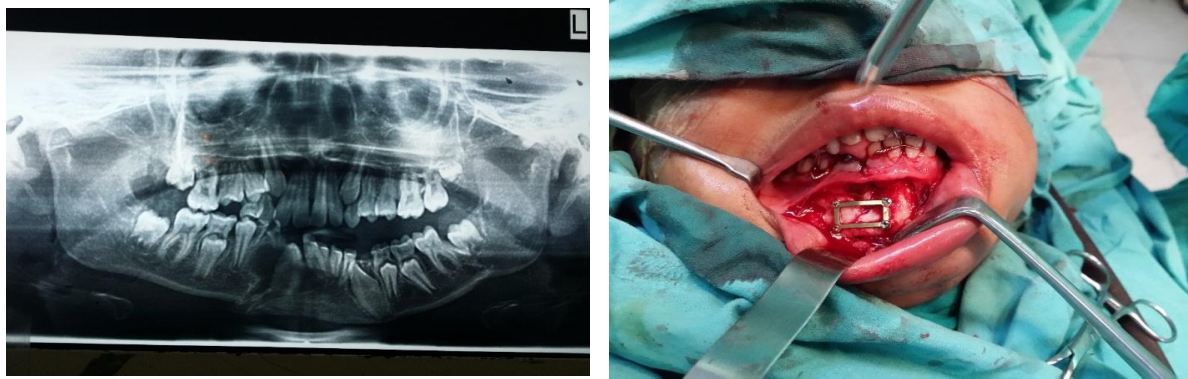
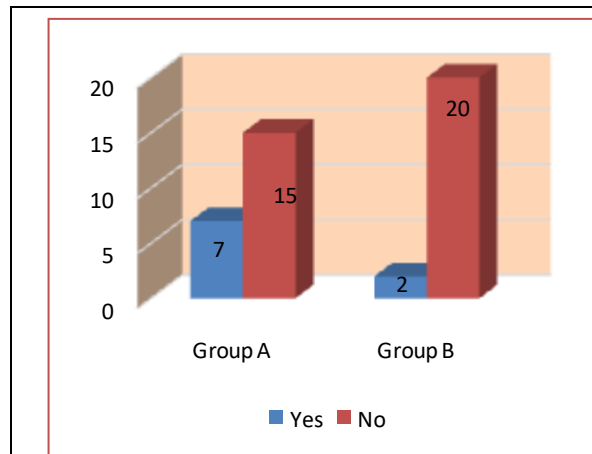
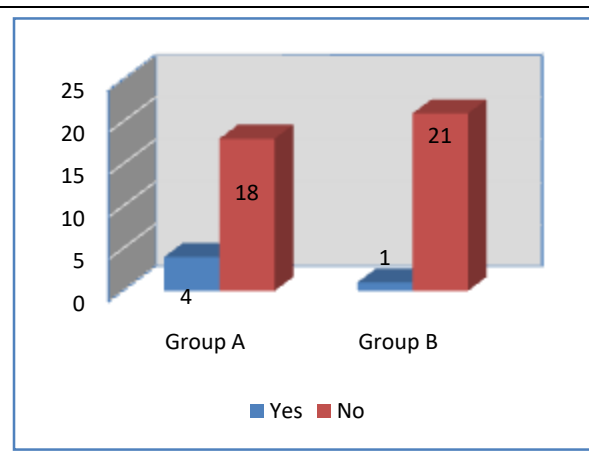


Figure No.2: Preoperative OPG of an 8 years old male patient showing fracture at Rt. Parasymphysis



Graph No.1: Comparison of infection after first week in both groups



Graph No.2: Comparison of infection after fourth week in both groups

The incidence of symphysis fractures was found as 20.5%, while for right parasymphysis as 45.5% and for left parasymphysis as 34.15%. The mean operation time for Group A was 109.5 ± 9.6 minutes and for Group B mean operation time was 53.5 ± 19.9 minutes which showed a statistical difference in time duration ($p < 0.05$).

All the patients were followed-up for infection on 1st, 4th and 12th week postoperatively. After 1st postoperative week (Graph.1) in Group A only 7 patients showed signs of infection while in Group B 2 patients showed erythema (p -value= 0.1324). On 4th week in Group A only 4 (18%) patient showed signs (Graph.2) of infection while in Group B one patient (4.5%) showed sign of infection (p -value =0.3449). On 12th week postoperatively none of the patients in both groups had evidence of infection.

DISCUSSION

The current work equates clinical outcomes of 3-dimensional micro plate osteosynthesis with conventional micro plate osteosynthesis. The clinical outcomes were operating time and postoperative

complications in terms of infection, bony union and occlusal stability. In micro plate system upper border reduction was achieved with additional mini arch bar while in 3-dimensional plate no additional arch bar was used. It was assumed that addition of vertical bars to form a geometrically stable form will provide enough stability so that the need for the additional arch bar can be omitted and thus a time saving procedure. The results obtained under defined parameters were quite encouraging.

The main etiological factor in this study was RTA (Road Traffic accident) followed by falls. The incidence of road traffic accidents is being increased because of the use of 3 wheeled auto rickshaws which are used to pick and drop children from schools. Many other studies also discussed that RTA to be the main cause of mandibular fractures^{17,18}. The site distribution in this study was restricted to anterior mandible only. Parasymphysis fractures was found more prevalent than symphysis. Site distribution in this study was very much confined by other studies^{19,20}.

Among postoperative complications infection was observed in each group on 1st, 4th and 12th weeks. On 1st postoperative week infection was shown in both groups, but results were statistically insignificant. On 4th

postoperative week both groups also reported with infection. On 12th postoperative week none of the patients showed any infection. The results were more promising in Group B. The infection rate in 4th week might be explained by the fact that oral hygiene maintenance in the presence of arch bar in pediatric patients is especially difficult where compliance is already an issue in children²¹. Various researches showed a comparable infection rate in patients treated with conventional micro plate after 1st postoperative week and our results were also supported²². No published data is available for infection rate with the use of 3-dimensional plate in pediatric population. In this study infection rate with 3-dimensional plate was 9.1% in 1st postoperative week.

Bone union was assessed clinically and radiographically thru OPG on 1st and 12th postoperative week. The radiograph taken on 1st week was more related to general examination and obtaining a radiograph as reference. In all the patient's bony union was uneventful by the end of 12th week. All exposure was obtained from a single machine to standardize them. This finding is in line with other studies which state that incidence of nonunion is very scarce in pediatric patients^{3,7}.

Malocclusion was observed in 3 patients in Group A while in Group B none of the patients showed any malocclusion. The results obtained in this study thus confirm the supremacy of 3-Dimensional microplate alone over titanium microplate and arch bar in terms of stability. Malocclusion is common finding in mixed dentition phase and accepted in many other studies^{2,4}. This complication in Group A may be attributed to the fact that the arch bar applied during mixed dentition phase to counter tension band in a fracture line does not provide enough anchorage to keep the fractured segments firmly in position.

The mean time duration in Group A was and Group B was found statistically different. No published data is available with reference to time comparison which makes this study unique. This study ascertains that applying arch bar with microplate is laborious and cumbersome job which can be bypassed by using 3-Dimensional plates as a time saving alternate.

CONCLUSION

Although titanium microplate with arch bar is still a standard treatment option for displaced pediatric anterior mandibular fractures, but the factors like less rate of infection, no malocclusion, freedom from the use of arch bar and the less total operation time make 3-Dimensional microplate not only a viable alternate but also a superior treatment option for managing pediatric mandibular fractures.

Author's Contribution:

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|----------------------------|---|
| Concept & Design of Study: | Saeed Ahmad |
| Drafting: | Muhammad Adnan Akram, Armghan Israr Mirza |
| Data Analysis: | Irfan Ahmad Shah, Usman Tariq |
| Revisiting Critically: | Kiran Nayyar |
| Final Approval of version: | Saeed Ahmad |

Conflict of Interest: The study has no conflict of interest to declare by any author.

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