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Original Research

Evaluation of hybrid arch bars using ultra lock screws in treatment of mandibular fracture: An original research

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ABSTRACT:

Introduction- Mandible is most common fractured bone after nose in the maxillofacial trauma and most commonly used methods to manage mandibular fractures are either closed reduction or open reduction & internal fixation. Whichever method surgeon chooses to perform, some method of mandibulo-maxillary fixation is required. Methods of past have various shortcomings. **Objective-** The aim of this study was to evaluate the hybrid arch bars using ultra lock screws in treatment of mandibular fractures. **Material and methodology-** Total of 20 patients of mandibular fractures were treated. Patients were randomly divided into two groups, Group-A and Group-B, having 10 patients each. Group-A: Patients underwent management with Hybrid arch bars using ultra lock screws. Group-B: Patients underwent mandibular fracture management with Erich arch bars. Every patient was appraised clinically to check operative time, wire stick injuries/glove perforations, mucosal coverage on screws, screw loosening, oral hygiene, root fracture/ perforation. **Results-** Operative time taken, oral hygiene index-simplified values and glove perforations were significantly lower in hybrid arch bar group Potential complications associated with hybrid arch bars were mucosal coverage on screws and screw loosening. **Conclusion-** It was concluded that Hybrid arch bars using ultra lock screws were better than Erich arch bars for IMF in management of mandible fractures in terms of less time required for the fixation, considerably lesser chance of glove perforation hence much decreased danger of sero-transmission of blood borne viruses and health of periodontium could be preserved, however cost of hybrid system was much more than erich's hooked arch bars.

Key word- Hybrid arch bar, ultra lock screws, ehrich arch bar, IMF

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INTRODUCTION

Mandibular fractures remain the most common facial fractures encountered in maxillofacial trauma after nasal fractures. The treatment modalities of mandibular fractures can be accomplished with either closed reduction (C.R) or open reduction and internal fixation (ORIF). The choice depends on many factors including the complexity and anatomical location of the fractures, presence of teeth, surgeon experience and patient preference. The use of some form of intermaxillary fixation (IMF) is required for C.R and for the majority of ORIF. The most common contemporary approaches to IMF include traditional Erich arch bars, IMF screws, which differ from most

method of IMF in that they are attached directly to the alveolar bone rather than using teeth for anchorage. Closed reduction with Erich arch bars for IMF is most widely accepted method for mandibular fractures. However, circumdental wires used with Erich arch bars cause injury to the periodontium. There is always the fear of inadvertent injury by wire ends and chances of serotransmission of blood born viruses to the operator thus we wanted to use the safest method of intermaxillary fixation avoiding use of circumdental wires, ie., Hybrid arch bars using ultra lock screws.

A minimum of 5 screws per arch is required. Lugs are easily bent to ensure that screws are placed between the roots of adjacent teeth.

MATERIAL AND METHOD

Patient selection criteria:

Total of 20 patients of mandibular fractures were randomly divided into two groups, Group-A and Group-B, having 10 patients each.

- **Group-A:** Patients underwent management of mandibular fractures requiring mandibulo-maxillary fixation with Hybrid arch bars using ultra lock screws.
- **Group-B:** Patients underwent mandibular fracture management with Erich’s hooked arch bars.

INCLUSION CRITERIA

1. Presence of 1 or more fractures involving the subcondyle, ramus, angle, body, parasymphysis or symphysis of mandible.
2. Age above 14 years.
3. Adequate reduction achieved with mandibulo-maxillary fixation

EXCLUSION CRITERIA

1. Presence of comminuted fractures.
2. Infected fractures.
3. Previously treated fractures.
4. Complete edentulism.
5. Gunshot wounds.
6. Patients not willing for close treatment.

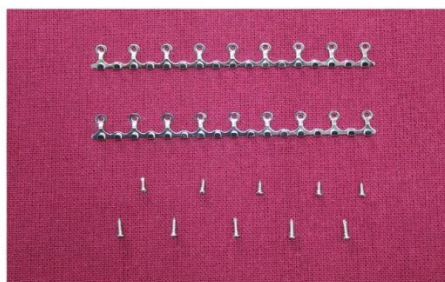
PRE-SURGICAL PREPARATION

An informed consent of procedure was filled and signed by the patient. Pre-operative oral prophylaxis was done in every patient.

All patients were given a dose of cefadroxil 500mg and ibuprofen 60 minutes prior to the procedure. Patient was prepared and draped under strict aseptic protocol. The procedure was performed under 2% lignocaine with 1:200000 adrenaline.

SURGICAL PROCEDURE

ARMAMENTARIUM (Surgical Procedure) Probe, Mouth mirror, Tweezer, a pair of wire holders, Wire cutter, Spacer, Lug bender, Short drill bits 1.5*6/8 mm, Screw driver 2mm, Tongue depressor, Backhaus towel clips and Frazier suction tip



**HYBRID ARCH BAR AND
ULTRA LOCK SCREWS**



LUG BENDER



SPACER



SHORT LENGHT DRILL BITS

FOR HYBRID ARCH BAR WITH ULTRA LOCK SCREWS

Hybrid arch bars made up stainless steel 316L, of thickness 0.7mm and 8.5 mm height. It contained total 9 holed lugs spread over a 110mm length. Diameter of holes present in lug was 2mm and distance between two consecutive holed lugs was 8mm. Hybrid arch bar was adapted to dental arch. It was attached directly to alveolar bone with ultra lock screws rather than taking anchorage from the dentition. Stainless steel of 2mm thread diameter, core diameter of 1.4mm and 3mm

head diameter were used. Drilling in between/above the tooth roots were done with 1.5mm short drill bits under copious amount of irrigating solution. Lugs of Hybrid arch bar were bent with a bender to safeguard that screws were placed without damaging teeth roots. Ultra-lock screws was tightened into place, keeping spacer between the lug of Hybrid arch bar and alveolus. A minimum of 5 screws were placed in each arch. The fixateur-principle of locking system allows the hybrid arch bar to stay stable in presence of few loose screws.



INTRA-OPERATIVE PHOTOGRAPHS



POST-OPERATIVE RADIOGRAPH

FOR ERICH ARCH BAR

Arch bar was adapted to dental arch and stabilized using circumdental wires on each tooth.

Intermaxillary fixation

Occlusion was established using 26-gauge stain-less steel wires.

POST-OPERATIVE MANAGEMENT AND FOLLOW-UP

Every patient was followed-up on 1st, 7th, 21st and 42nd post-operative day. Every patient was evaluated clinically in terms of following:

- Operative time
- Wire stick injuries/ Glove perforations
- Mucosal coverage on screws

- Screw loosening
- Post-operative occlusion
- Oral hygiene
- Root fracture/ perforation

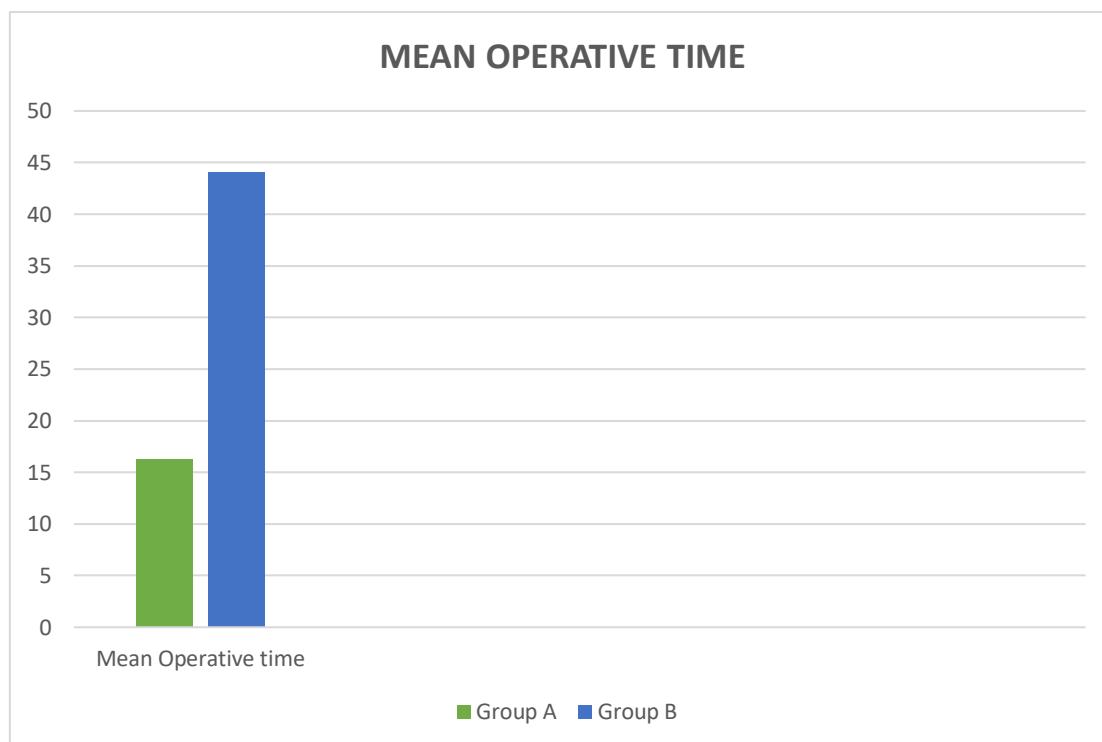
OBSERVATIONS AND RESULT

1. OPERATIVE TIME

The mean operative time in Group-A was 16 minutes 30 seconds and in Group-B was 44minutes 10 second was significantly different with a p value 0.000 ($p < 0.05$)

MEAN OPERATIVE TIME

Mean Operative Time	Group-A	Group-B
	16 minutes 30 seconds	44 minutes 10 seconds

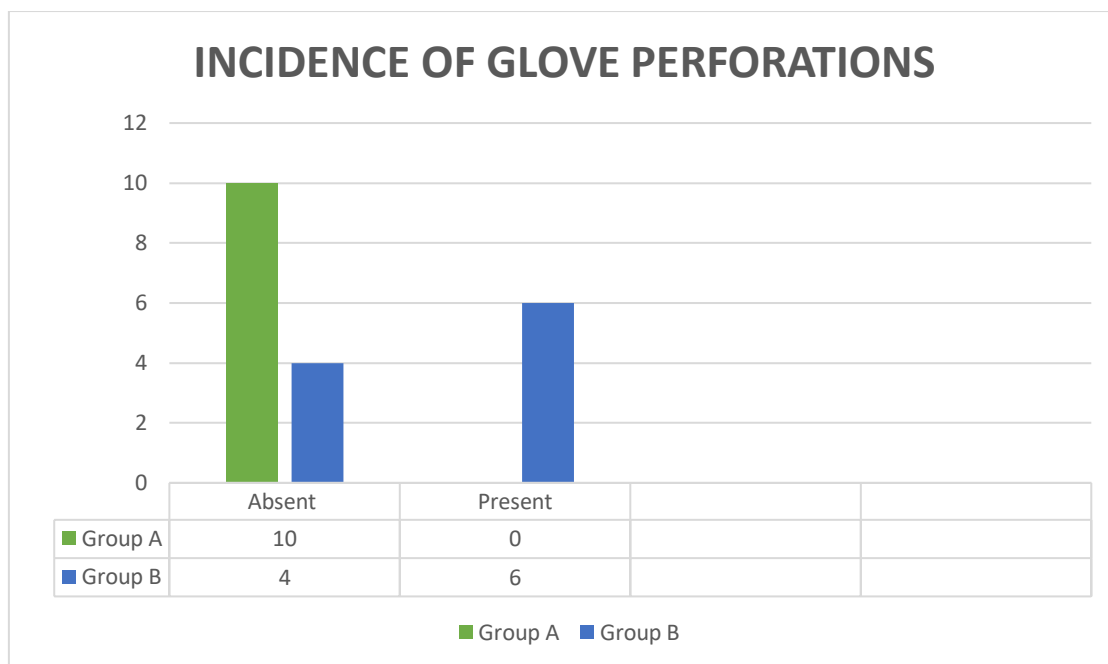


2. WIRE STICK INJURIES/ GLOVE PERFORATIONS

In this study, although there was no wire stick injury in either group yet out of 20 cases glove perforations were encountered in 6 (30%) cases. In Group-A, no glove perforations (0) were encountered however in Group-B, while performing 6 (60%) cases glove perforation were encountered. This difference was statistically significant with a p value 0.003 ($p < 0.05$)

INCIDENCE OF GLOVE PERFORATIONS

Glove Perforations	Total	Group-A	Group-B
Absent	14(70%)	10	4 (40%)
Present	6 (30%)	0	(60%)

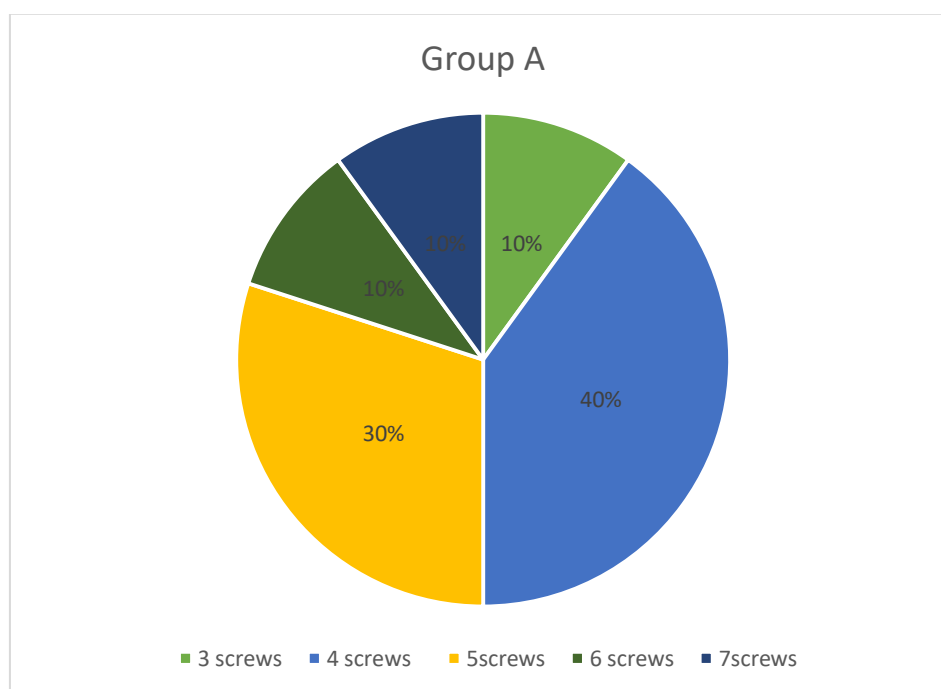


3. MUCOSAL COVERAGE (OUT OF 10)

Number of screws covered by mucosa were noted clinically in Group-A and this variable was not applicable in Group-B. In Group-A, 3 screws were covered in 1 patient (10%), 4 screws were covered in 4 patients (40%), 5 screws got covered in 3 patients (30%), 6 screws got covered in 1 patient (10%). 7 screws got covered in 1 patient (10%).

NUMBER OF SCREWS COVERED BY MUCOSA

Number of screws covered by mucosa	Total	Group-A
3	1 (10%)	1 (10%)
4	4 (40%)	4 (40%)
5	3 (30%)	3 (30%)
6	1 (10%)	1 (10%)
7	1 (10%)	1 (10%)



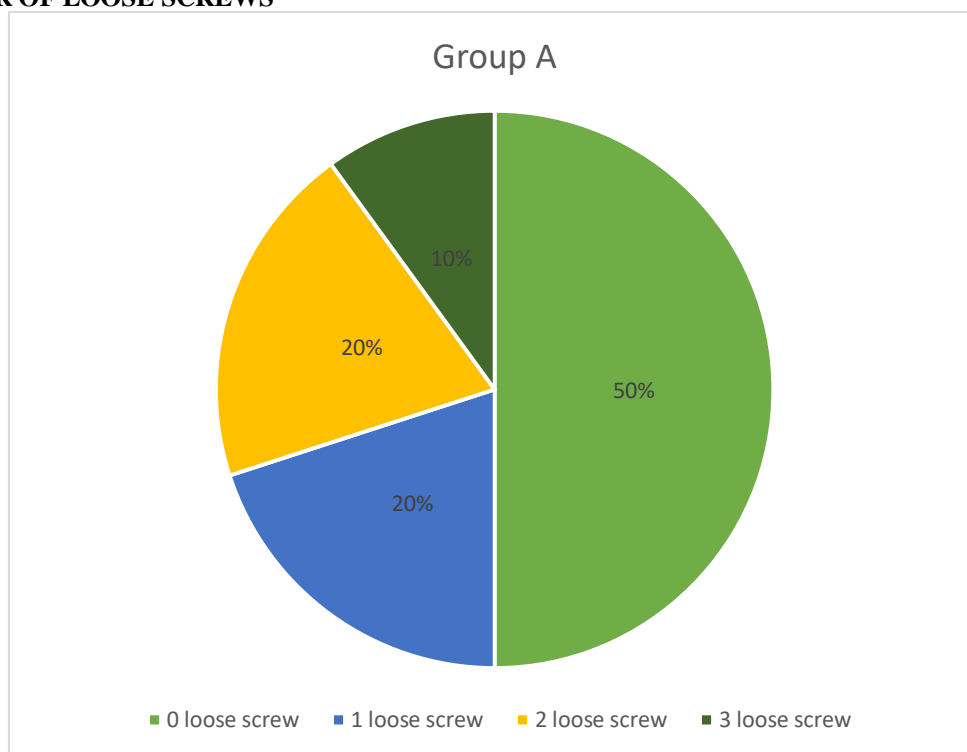
4. SCREW LOOSENING (OUT OF 10)

Number of loose screws were noted clinically in Group- A and this variable was not applicable in Group-B. In Group A, No loose screw was present in 5 patients (50%), 1 loose screw was present in 2 patients (20%), 2 loose screws were present in 2 patients (20%) and 3 loose screws were present in 1 patient (10%).

NUMBER OF LOOSE SCREWS

Number of Loose screws	Total	Group-A
0	5 (50%)	5 (50%)
1	2 (20%)	2 (20%)
2	2 (20%)	2 (20%)
3	1 (10%)	1 (10%)

NUMBER OF LOOSE SCREWS

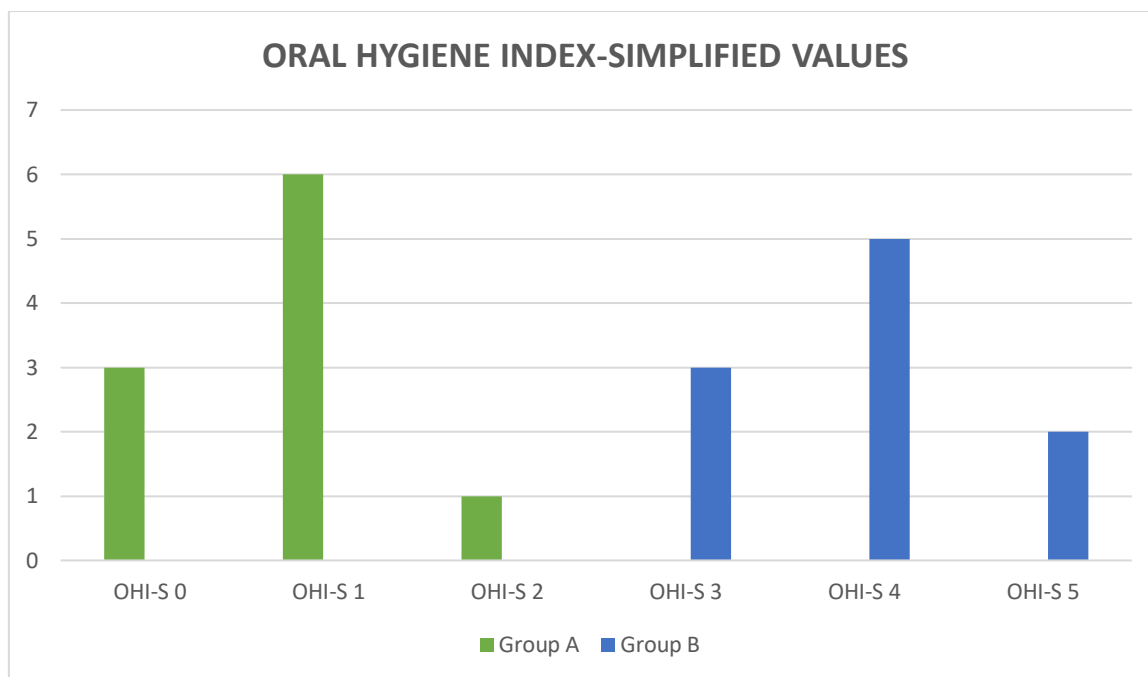


5. ORAL HYGIENE

Mean oral hygiene index-simplified value in Group-A was 0.8 and in Group-B was 3.9. Difference in two groups was statistically significant with a p value 0.001 (p<0.05).

ORAL HYGIENE INDEX-SIMPLIFIED VALUES

OHI-S	Total	Group-A	Group-B
0	3 (15%)	3 (30%)	0
1	6 (30%)	6 (60%)	0
2	1 (5%)	1 (10%)	0
3	3 (15%)	0	3 (30%)
4	5 (25%)	0	5 (50%)
5	2 (10%)	0	2 (20%)



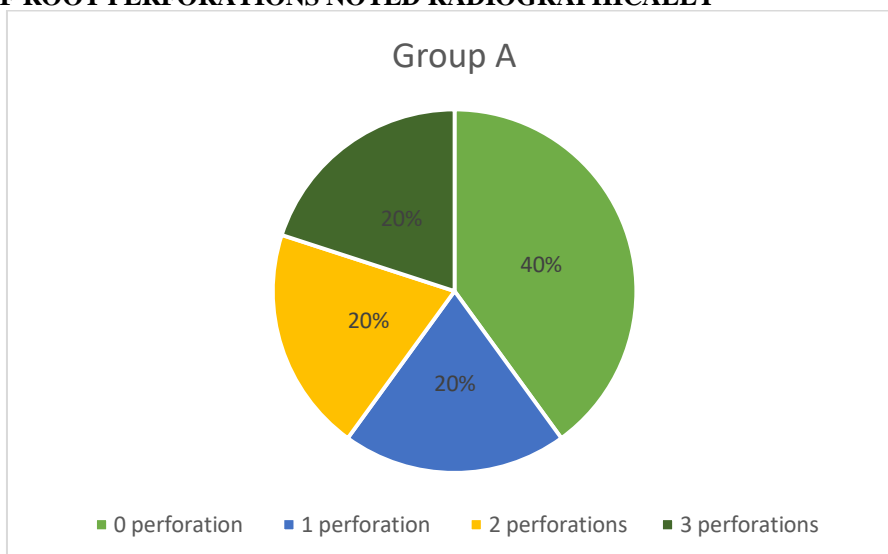
6. ROOT PERFORATION

Number of root perforations were noted radiographically after the removal of hardware in Group-A and this variable was not applicable in Group-B. In Group-A, 0 root perforation was present in 4 patients (40%), 1 root perforation was present in 2 patients (20%), 2 root perforations were present in 2 patients (20%) and 3 root perforations were present in 2 patients (20%).

NUMBER OF ROOT PERFORATIONS NOTED RADIOGRAPHICALLY

Number of root perforations	Total	Group-A
0	4(40%)	4(40%)
1	2(20%)	2(20%)
2	2(20%)	2(20%)
3	2(20%)	2(20%)

NUMBER OF ROOT PERFORATIONS NOTED RADIOGRAPHICALLY



DISCUSSION

Maxillofacial trauma is being widely reported on account of an increased incidence because of road traffic accidents, increase in sports activities and

interpersonal violence. Mandible is a vulnerable bone of face, being prominent and mobile.

The important points in management of mandibular trauma are aimed at three-dimensional reduction to re-

establish normal pre-trauma occlusion along with maintenance of facial symmetry and restoration of normal movements of temporomandibular joint.

Reduction of fractured mandible can be achieved with either closed reduction or open reduction and internal fixation. In either case some form of mandibulo-maxillary fixation is required for the control of dental occlusion.

The three main principles of mandibulo-maxillary fixation are to establish occlusion, provide stability and immobilization of the jaws. There are also additional characteristics of an ideal mandibulo-maxillary fixation system, i.e. no risk to patient no risk to surgeon, minimize operating room time, minimize orthodontic force, cost effective, simple to use and have universal application. To satisfy these criteria numerous means have been used in past.

The traditional methods of mandibulo-maxillary fixation are Gilmer's, Risdon's, Erich's hooked arch bars, Ivy eyelets and many others. Although time tested and inexpensive, these techniques have various inherent drawbacks, being time-consuming and possessing significant risk to operating team owing to their potential for wire stick injuries from the contaminated environment of the oral cavity. Another major drawback of Arch bar systems were movement of teeth in lateral and extrusive direction, difficulty in adequacy of fixation in isolated posterior teeth, injury to periodontium and difficulty in maintaining oral hygiene. The disadvantages of Ivy eyelet was, as the eyelet was drawn into inter-dental space on tightening the wire, difficulty is encountered on inserting mandibulo-maxillary wires through the eyelet and inability to accept elastics.

In 2012 Stryker introduced a bone supported bar system (**Smartlock Hybrid MMF, Stryker Corp**), which was soon followed by **Synthes MatrixWAVE MMF System (2014) (De-Puy Synthes Co) & Biomet Microfixation Omni-Max MMF System (2015)**. This hybrid system was proposed to provide occlusal stability of Erich's hooked arch bars and ease of application of mandibulo-maxillary fixation screws.

Till date Erich's hooked arch bars are gold standard method of mandibulo-maxillary fixation, therefore we undertook study to comparatively evaluate use of hybrid arch bars using ultra lock screws with Erich's hooked arch bars for management of mandible fractures.

As we known operative time is a chief factor for surgeon and patient. Mean time consumed to place Erich's hooked arch bars was 37 mins and hybrid bars was 14 mins (**Gary F. Bouloux 2018**). This outcome was common to present study, mean operative time in Group-A was 16 minutes 30 seconds and in Group-B was 44minutes 10 seconds and was different (significantly) with p value= 0.000 (p<0.05).

Erich's hooked bars have proven to be most stable form of mandibulo-maxillary fixation system, however the alternative proposed in past did not

possess this quality. In a study (**Kendrick et al 2016**), there was incidence of 7% loose skeletally supported arch bars. However in present study, fixation device's stability was adequate in every cases. It can be clarified by ultra lock mechanism possessed by the hybrid arch bars. The fixateur-principle of the locking system allows the hybrid arch bar to stay stable in presence of few loose screws. Another advantage of hybrid arch bars noted in study was ability to achieve stability in presence of isolated posterior teeth.

Most frequent complication linked to hybrid system of arch bar was mucosal overgrowth which happened in 38% patients in study by **Kendrick et al 2016**. In present study this problem was encountered in all patients. In 40% patients 4 screws (out of 10) got draped by mucosa, in 30% patients 5 screws got covered, in 10% patients 3 screws got covered, in 10% patients, 6 screw and in 10% patients 7 screws got draped by mucosa. Overgrowth of mucosa did not seem to have any unwanted effect except for making removal a little difficult. When there was mucosal overgrowth, local anaesthesia was administered and a small incision with a no. 15 blade was given and screws was retrieved.

Another major concern regarding usage of hybrid arch bar system is screw loosening. This accounted for 3.1 % of screws encountered in 17% patients (**Kendrick et al 2016**). In present study this problem was observe in 50% patients i.e.20% had 1 loose screw, another 20% had 2 loose screws and 10% had 3 loose screws. In spite of this encountered problem, no patients had loose arch bar or had ingested any screw owing to ultra- locking mechanism of the hybrid system.

Though arch bars provide a non-invasive fracture reduction method but adversely affect the periodontal health of patients. The rounded wire edges collect food debris and cause gingival inflammation and difficulty in maintaining oral hygiene which results in fetid breath, as per study by **Chandan et al. (2010)** oral hygiene status was poor in patients of Erich's hooked arch bar group arch group and was good in patients with wireless, bonded arch bar group. We, in present study evaluated oral hygiene status of patients with OHI-S index. The mean oral hygiene index-simplified value in Group-A was 0.8 and in Group-B was 3.9. This difference in two groups was significant (statistically) with p value = 0.001 (p<0.05).

Another insinuation noted during the course of study was hybrid arch system not only provided reduction at occlusal level, the holed lugs of arch bars provided skeletal stability. Their function being analogous to the monocortical plates screwed on the outer cortex designed to be solid sufficient to support strain developed by masticatory muscles.

Shortcoming common to all bone supported mandibulo-maxillary fixation systems is chance of root perforation. Based on two dimensional projection in panoramic x-rays or dental films, dental root defects are categorized according to location, size and prognosis for survival of injured tooth. **Fabbroni et al**

distinguished major from minor defects amounts to be 50% intersection between screw and dental root. It was found, occurrence of major lesion was not dependable in predicting sequelae (in terms of vitality check or need for root canal treatment, apicetomies or extraction). The explanation of this unpredictability was limitation of the radiographic assessment technique, which cannot reveal the actual depth of penetration or involvement of dental pulp. **Asscherickz et al. (2005)** revealed that grooving, scoring, or scratching surface of dental roots peripherally at the cemental lining have innocuous consequences. Their histological investigation in experimental root defects induced with mini screws (1.7mm diameter) in dogs confirmed a nearly whole repair of periodontal structures from 12 weeks post removal of screw. In present study, in 40% patients receiving hybrid arch bars had no root perforation. 1 root perforation was present in two patients (20%), 2 root perforations were present in two patients (20%) and 3 root perforations were present in two patients (20%). However all these cases of dental root perforation had only minor root defect and none required any consequential treatment.

Other limitation of hybrid arch bars were, their contraindications in milk dentition age due to presence of buds of the permanent teeth, fixing arch bars with help of screws could injure the permanent teeth buds and their limited use in highly comminuted fractures. However in older age, application of hybrid arch bar system can prove to be a boon. In denture using patients, hybrid arch bar system can be fixed to dentures and then secured to maxilla & mandible using screws or circum-mandibular wiring to achieve mandibulo-maxillary fixation (**Carlson et al, 2017**). Another limitation noted with the use of hybrid arch bars with ultra lock screws was, cost, which was much more than erich's hooked arch bars.

CONCLUSION

The following conclusions were drawn from our study.

- Operative time consumed for hybrid arch bars using ultra lock screws was significantly less than that required for Erich's hooked arch bars.
- Incidence of glove perforation was 60% with usage of Erich's hooked arch bars and 0 when using hybrid arch bars using ultra lock screws.

- The oral hygiene index simplified values were significantly less in patients with hybrid arch bars using ultra lock screws than with that of patient's with Erich's hooked arch bars.
- Few complications of hybrid arch bar systems were, mucosal coverage of screws, risk of screw loosening, root perforation.
- Another limitation noted with the use of hybrid arch bars with ultra lock screws was, cost, which was much more than erich's hooked arch bars.

Complications of hybrid arch bar system can be avoided with proper case selection and comprehensive surgical planning.

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