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Evaluation of Efficacy of Slot Head Screw with Philips Head Screw in Maxillofacial Fixation - A Comparative Study

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Abstract: ***Aim & Objective: The aim of this study was to compare the efficacy of Slot head screws and Philips head screws in maxillofacial fixation - a prospective case control study. Methods- This study was performed on 20 patients with clinical and radiological evidences of mandibular parasymphysis fractures randomly divided into 2 groups where Group A was case group, treated with open reduction and internal fixation using 2mm Titanium plates secured with Philips head screws whereas group B was control group, treated with open reduction and internal fixation using 2mm Titanium plates secured with slot head screws. Parameters assessed were time taken for loading of screws, tightening of screws, detachment of screw driver, total time taken for placement of screws, number of slippage of screwdriver, and iatrogenic damage to surrounding tissues. Results: It was seen that the time required for loading of screws, tightening of screws detachment from screw driver and placement of screws was significantly less in Group A than Group B. No significant difference was observed with respect to parameters like wound dehiscence and occlusion. Conclusion: It was concluded that Philips head screw performed significantly better than slot head screw in above evaluated areas as well as operating time and operator fatigue were found to be less with Philips head system than Slotted head system.***

Keywords: Philips head screw, slot head screw, mandibular parasymphysis fracture, open reduction and internal fixation, trauma.

1. Introduction

The face is crucial and injuries to face results in divesting physical and emotional sequelae.As the individuality of a man is represented by his face. His identity is the key to his personality and interactions.[1]Trauma to face involving soft and hard tissues are most common. And fractures of mandible occur most commonly than any other facial skeleton where it is reported to account for 36-70% of all maxillofacial fractures. Injuries of the maxillofacial area can be psychologically disturbing for all patients with functional impact.[2]

When it comes to management of facial trauma, the proper reduction and fixation of fractured segments is most important in achieving its normal form, esthetics and functions with adequate occlusion which reduces the patients' post traumatic morbidity. In literature, many treatment modalities are discussed by the authors where Champy et al. in early 1970s proposed the intraoral application of monocortical miniplates to treat mandibular angle fracture. It was found to be effective in following ways: eliminating the need of intermaxillary fixation, stable anatomic reduction, and immediate return to function, less palpable, less risk of facial nerve damage, ease of adaptation.[3]

As per the principle given by Champy during normal mastication, masticatory muscles produces tension at the superior border of mandible with the compressive forces that act at inferior border. In addition, torsional forces are produced in the area anterior to the canine. Ideal lines of osteosynthesis describe monocortical "tension banding" osteosynthesis that results in neutralisation of distracting and torsional forces exerted on the fracture during physiological stress, while the normal compressive forces at the basilar aspect of the mandible are restored.[3,4]With the semi- rigid and rigid fixation of bone, good stability was achieved and there was ease of application. But there were certain difficulties encountered during the process that the screw had to be held securely in the driver and to be fastened as much as possible to prevent movement between the miniplate and the screw. Moreover, the torqueing of the screw had the tendency for the head or at worst the shaft to fracture.[5]

To ensure efficient placement and ease of fastening of the screw, currently, various head designs are available. The screw head design should provide: good stability with less

placement time, cost effective, operator fatigue, no slippage, no damage to surrounding tissues or loosening of screws and easy attachment to the primary driver. Some popular screw head designs available are: single slot head, Philips head, modified Philips head, centric hexagonal screw, star shaped design, etc.[6]

So, in this study we are comparing the efficiency in handling and ease of placement of slot head with Philips head screws in semi-rigid internal fixation of isolated Parasymphysis fracture in the mandible, with main focus on slippage tendency of screwdrivers and time taken for fastening the screws.

2. Aim & Objectives

To compare the efficacy of slot head screws with Philips head screws in maxillofacial fixation.

Objectives

To compare and evaluate the placement of slotted screws and Philips head screws in following parameters:

1) Time taken for screws
   - to attach with primary driver
   - to disengage from primary driver
2) Ease of placement
3) Operator efforts in placing the screws
4) Slippage of screwdriver during procedure
5) Damage to surrounding tissues
6) Tightening of screws
7) Fracture of screws

3. Materials and Methods

This prospective comparative clinical study was performed in the Department of Oral and Maxillofacial Surgery in People's College of Dental Sciences and Research Centre, Bhopalon 20 patientsrandomly divided into 2 groups (10 patients in eachgroup), diagnosed with isolated parasymphysis fracture following road traffic accidents from January 2019 to October 2020, after getting approval from IRB/ IEC with IEC no.- EC201805 and written informed consent duly signed.

Groups were treated as-

1) Group A- Open reduction and internal fixation using 2mm Titanium plates secured with Philips head screws.
2) Group B- Open reduction and internal fixation using 2mm Titanium plates secured with Slot head screws.

Inclusion criteria

1) Patients diagnosed with isolated parasymphysis fracture requiring ORIF.
2) All patients who are fit for surgery under LA/GA and indicated for ORIF
3) Patients' availability to meet the follow- up schedule.

Exclusion criteria

1) Parasymphysis fracture contraindicated for ORIF.
2) Parasymphysis fracture associated with other mandibular fractures.
3) Patients under the age of 18 years.

Apparatus and Materials

Standard surgical armamentarium for surgery **(Fig. 1)**2 mm philips head Titanium screws with screw driver **(Fig. 2).**2 mm slothead Titanium screws with screw driver **(Fig. 3)**

Figure 1: Standard surgical armamentarium for surgery

Figure 2: Philips head titanium screws with screw driver

Figure 3: Slot head titanium screws with screw driver

Operative Procedure

After administration of general anaesthesia, standard painting and draping was done under all aseptic measures. Maxillo-mandibular fixation was done with 26 gauge, stainless steel wire. Lox 2% with adrenaline was administered at the surgical site. The fracture site was exposed and debridement was done with saline. **(Fig. 6 & 7**) Fracture segments were reduced manually and kept in place. Fixation was done following the Champy's ideal line of osteosynthesis. One, 2mm - 4 holes with gap titanium miniplate was adapted across the fracture line near the inferior border of mandible and the other plate was adapted 5mm above **(Fig 8 & 9).** Screws were placed in the holes nearest to the fracture line on either side in the plate which was placed at superior border of mandible with screws of 2mm × 8 mm to avoid injury to roots of teeth and the second plate was placed at the inferior border of mandible using screws 2mm×10 mm. This procedure was followed in all the patients respective of screw heads in both groups. Occlusion was checked and closure was done with simple interrupted sutures using 3-0 vicryl suture**.** Postoperative radiographs were taken for radiographic evaluation **(Fig 10 & 11).**

GROUP-A GROUP-B

Figure 4 (Group A) & 5 (Group B): Pre- operative radiographs

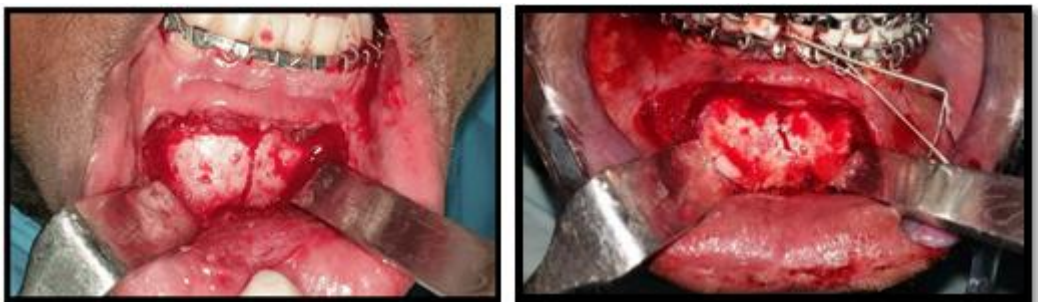


Figure 6 (Group A) & 7 (Group B)-Exposure of fracture sites

Figure 8 (Group A)- Fixation of fractured segments with miniplates and Philips head screws

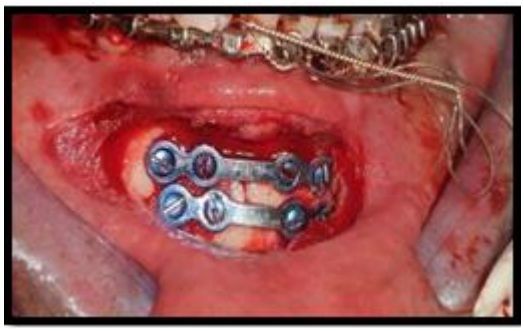


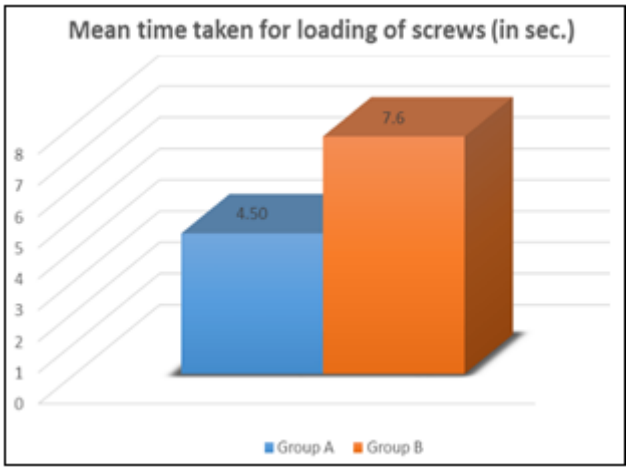
Figure 9 (Group B)- Fixation of fractured segments with miniplates and slot head screws

Figure 10 (Group A) & 11 (Group B)-Post - operative radiographs

4. Results

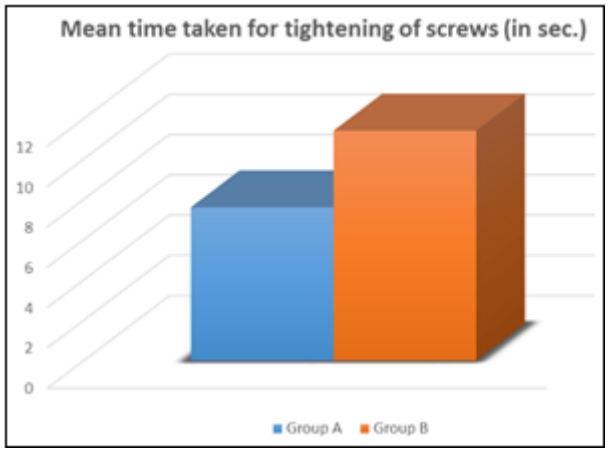
All results were calculated using the mean value and standard deviation for each parameter considered and checked for statistical significance using the unpaired t- test. 20 patients were included in the study, out of which 18 were male (90%) and 2 (10%) were females in common and were randomly assigned to each group. In both groups A &B, out of 10 patients, 9 were males (90%) and 1 (10%) was female**.** Group A age ranges from 18-45 year with mean age and standard deviation of (Mean ± SD = 27.30 + 9.27) and age range from 17-46 with mean age and standard deviation of (Mean ± SD = 30.80 + 8.85) for group B.

Time required for loading of screws was significantly lesser in Group A then Group B. The mean and standard deviation of time taken for loading of screws in the Group A was 4.50 ± 1.27 and in the Group B was 7.60 ± 0.97. **(Graph 1).**



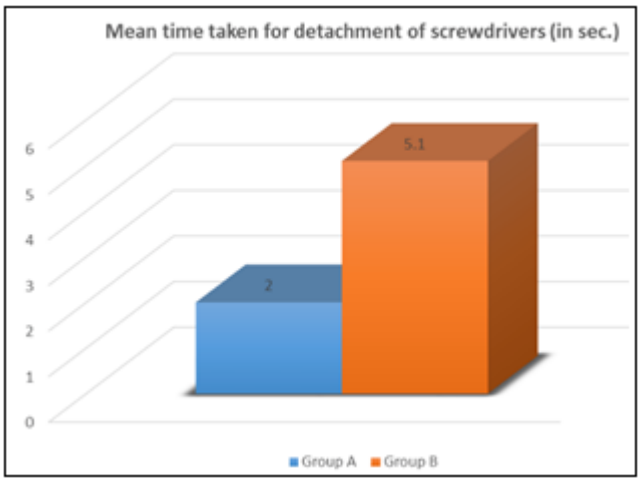
Graph 1: Time taken for loading of screws (in seconds)

The mean and standard deviation of time taken for tightening of screws in the Group A (case group) was 7.60 ± 11.40 and in the Group B (control group) was 11.40 ± 0.97. **(Graph 2).**



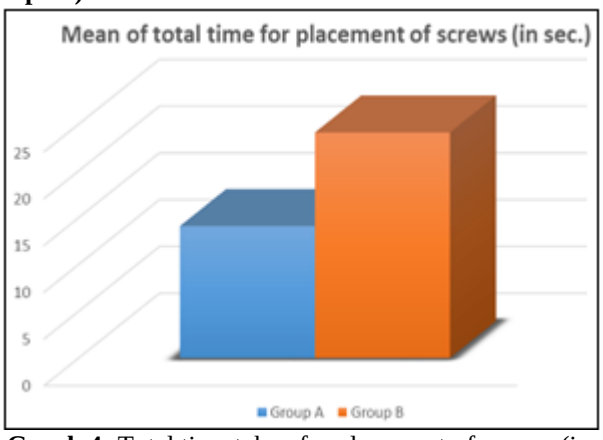
Graph 2: Time taken for tightening of screws (in seconds)

The mean and standard deviation of time taken for detachment of screwdriver to screw in the Group A (case group) was 2.00 ± 0.67 and in the Group B (control group) was 5.10 ± 0.74. **(Graph 3).**



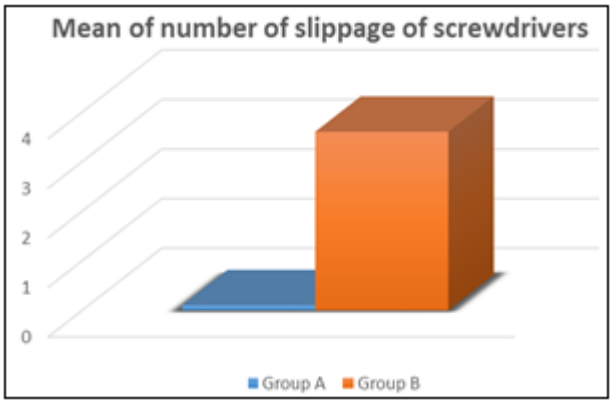
Graph 3: Time taken for detachment of screwdrivers (in seconds)

The mean and standard deviation of total time taken for placement of screws in Group A (case group) was 14.10 ± 2.08 and in the Group B (control group) was 24.10 ± 1.52. **(Graph 4).**



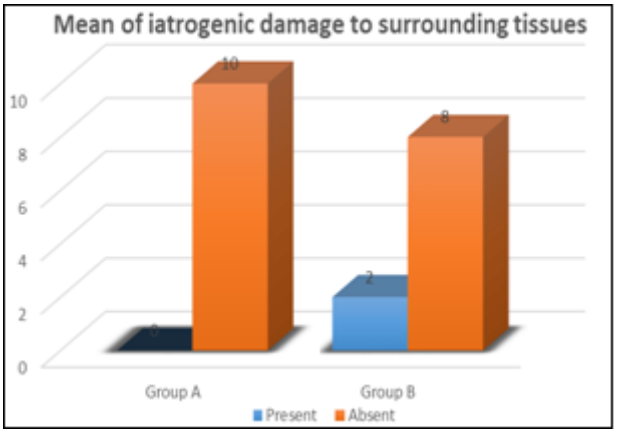
Graph 4: Total time taken for placement of screws (in seconds)

The number of slippage of screw driver was higher in Group B patient when compared with Group A. The mean and standard deviation of number of slippage of screwdriver in the Group A (case group) was 0.10 ± 0.32 and in the Group B (control group) was 3.60 ± 0.97. **(Graph 5).** For all these parameters P value was less than 0.0001 which was considered to be statistically significant.



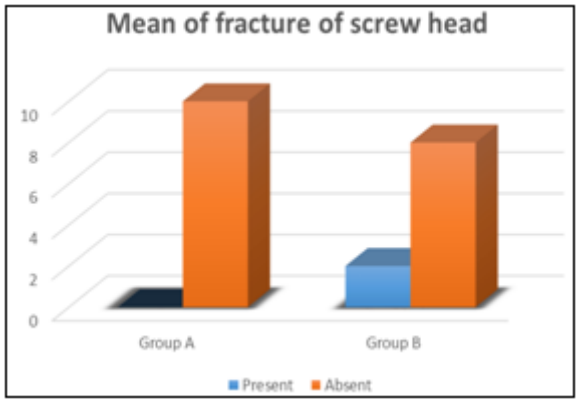
Graph 5: Number of slippage of screwdrivers

Iatrogenic damage to surrounding tissue during procedure in Group A (case group) was 0 (0%) and in Group B (control group) was 2 (20%). Fracture of screw head during procedure in Group A (case group) was 0 (0%) and in Group B (control group) was 2 (20%). **(Graph 6)**



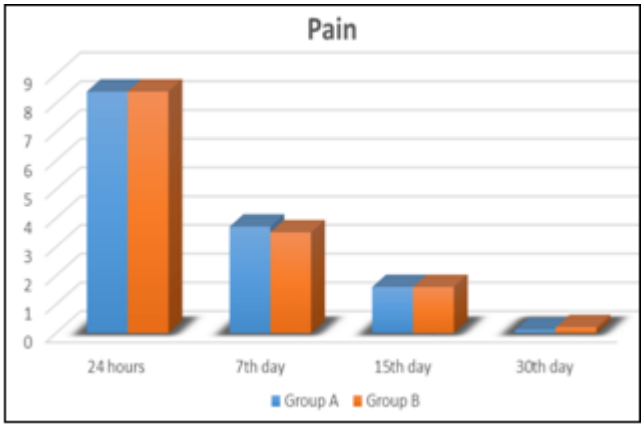
Graph 6: Iatrogenic damage to surrounding tissues.

Fracture of screw head during procedure in Group A was 0 (0%) and in Group B was 2 (20%).**(Graph 7)**



Graph 7: Fracture of screw head

Pain was evaluated by a visual analogue scale (0 to 10) postoperatively noted at 24 hours, 7th day, 15th day, 30th day interval. The mean and standard deviation of VAS score at 24 hours in group A was 8.4 ± 0.69, on 7th day was 3.70 ± 0.95, on 15th day was 1.60 ± 0.52, after 30 days was 0.10 ± 0.32, in group A and in group B at 24 hours 8.4 ± 0.52, on 7th day was 3.50 ± 0.53, on 15th day was 1.60 ± 0.52 after 30 days was 0.20 ± 0.42, which significantly decreased when compared with different time interval VAS score. **(Graph 8).** There was no significant association between pain and groups.



Graph 8: VAS score at different time periods

There was no significant association between wound dehiscence, occlusion within groups. Wound dehiscence in Group A was 1(10%) and in Group B was 1 (10%).Occlusion was found satisfactory in Group A was 8 (80%) than in Group B was 7(70%).

5. Discussion

Parasymphysis fractures one amongst the most frequent fractures of the mandible, According to **Fonseca RJ et al**[1] Open reduction and internal fixation is the most preferred treatment. **Okoturo eyituoyo et al.**[7]conducted a study to compare the clinical outcome of treating mandibular fractures with miniplate osteosynthesis and maxilla-mandibular fixation. The results revealed that miniplates fixation results in better clinical outcome with good clinical stability and better adaptability with early return to function.

In our study we used 2 mm Ti miniplates in order to achieve stable fixation of fractured fragments in parasymphysis fracture. **Champy et al.**[3]advised use of two miniplates for parasymphysis fractures due to high torsional forces in the anterior region of the mandible. **Chatterjee M A et al.**[8]evaluated efficacy of Ti miniplates and screws (implants) clinically and radiographically and revealed that Ti plates were a good fixation for the fractures of anterior region of mandible. The patients in the group A were treated with 2 mm titanium Philips head screws and Group B was treated with 2 mm titanium slot head screws according to Champy's line of ideal osteosynthesis.

In this study group male: female ratio was compared and it was found that the gender prediction in both groups were found to be insignificant, in both group A and group B there were 9 males:1 female and mean age in both groups were 17 -46 years. This went in accordance with the study by **Prabhakar C et al.**[9]which reported patients with mean age of 28.8 years.

The mean and standard deviation of time taken for loading of screws in the Group A was 4.50 ± 1.27 and in the Group B) was 7.60 ± 0.97, the P value is less than 0.0001 and statistically significant. In a similar study by **Spencer RK et al.**[5]where they studied influence of screw head design on angle of application of screwdriver which may result into failure of engagement, stripping or distortion of screw head. This lead to increased operating time and frustration for the

operator. The reduction in time for loading of screws could be attributed to the fact that the assistant needed less time in orienting the blade of the screwdriver and the groove of the screw head.

The mean and standard deviation of time taken for tightening of screws in the Group A was 7.60 ± 11.40 and in the Group B was 11.40 ± 0.97**.** P value is less than 0.0001 which is statistically significant and for detachment of screwdriver to screw in the Group A was 2.00 ± 0.67 and in the Group B was 5.10 ± 0.74, P value is less than 0.0001 and statistically significant. This may be assumed to be that the slot head had a screw device which required to be loosened and the screw released from its inferior side where the retention part is located. The Philips head was attributed by a sliding friction grip. Total time required for placement of screws was significantly lesser in Group A then Group B. The mean and standard deviation of total time taken for placement of screws in the Group A was 14.10 ± 2.08 and in the Group B was 24.10 ± 1.52, P value is less than 0.0001 and statistically significant.

The number of slippage of screw driver was found to be higher in Group B patient when compared with Group A. The mean and standard deviation of number of slippage of screwdriver in the Group A was 0.10 ± 0.32 and in the Group B was 3.60 ± 0.97, P value is less than 0.0001 and statistically significant. There were less slippage while tightening the Philips head screws as the screws have 2 slots in which the screw driver locks and thus prevents it from slipping while tightening, whereas in slot head screws, the driver slips while tightening due to the increase in the angulation of the screw and screwdriver to the bone and to each other. This was due to the fact that the cross slot prevented slippage.

Iatrogenic damage to surrounding tissue during procedure in Group A was 0 (0%) and in Group B was 2 (20%), it was due to more number of slippage in group B (slot head). Fracture of screw head during procedure in Group A was 0 (0%) and in Group B (control group) was 2 (20%). **Spencer RK et al.**[5]studied influence of screw head design on angle of application of screwdriver and found that the failure to seat the plate against the bone, caused the screw head to deform or strip before the screw is fully seated. In our case, when ungrounded screw driver was used in slot design, it had a tendency to slip along the slot. In the Philips head design the cross slot prevented such slippage.

Pain was evaluated by a visual analogue scale (0 to 10) postoperatively noted at 24 hours, 7th day, 15th day, 30th day interval which significantly decreased when compared with different time interval VAS score. There was no significant association between pain and groups. There was no statistical significant difference at any time interval observed between the two groups ($p>0.05$)

Wound dehiscence was observed in only 2 (10%) patients, in Group A was 1(10%) and in Group B was 1(10%). there was no significant difference between two groups**.** It was 0% in a study by **Jain et al.**[10]whereas 6.6% was reported by **Parmar et al.**[11]

Satisfactory occlusion was seen in patients, in Group A was 8 (80%) and in Group B was 7(70%). This is in contradiction in the studies by **Bui et al.**[12]and **Jain et al.**[10]Malocclusion was not observed in any case.

The intra- operative findings (like stability of fractured segments, types of plates, number of screws) and post-operative complications (like swelling, palpable implant, iatrogenic damage to the teeth, breakage of screws, loosening of screws, plate infection and plate loosening) were not encountered in any of the two groups and conclusions or results drawn between the groups were irrespective of the above issues.

As of palpability of implants, they were palpable but that did not cause any irritation or discomfort to the patients. Also, the post – operative radiographs showed proper placement of miniplates and screws following Champy's principles of osteosynthesis and the appropriate alignment of fractured segments.

6. Conclusion

It was evident from the results of the study that Philips head screw performed significantly better than slot head screw in areas related to time taken of loading of screws, tightening of screws, detachment of screwdriver to screw. Due to these factors, the total time taken for placement of screw was lesser with Philips head than slot head. The ease of application of Philips head screw was found better, as this device had 2 slots and only single screw driver was used for loading and tightening of the screw in which the blade of screw driver locks perpendicular to the grooves of screw head thus preventing it from slipping whereas in slot head screws, 2 screwdrivers were required, one for loading and placement of screws while positioning and other for tightening the screws and it may cause over tightening. Sometimes during detachment of screwdriver from the screw caused pull-out or change in the angulation of the screw making it difficult for replacement and tightening. Repeated slippage of screw driver in slot head device caused iatrogenic damage to surrounding soft tissues like muscles, mucosa and most importantly mental nerve bundle and vessels. Philips head screw can be preferred over slot head screw in maxillofacial fractures in-spite of its high costs.

7. Conflicts of Interests

No conflicts of interest.

8. Funding

NA

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