Evaluation of the Efficay of Computer Guided Lag Screw Fixation in Comparison to Conventional Lag Screw Fixation in Anterior Mandibular Fractures. Randomized Clinical Trial (RCT)

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Abstract

Background and Objective: This study aimed to compare the use of computer guided technology to place lag screws in anterior mandibular fracture in comparison to convectional technique

Materials and Method: This study included twenty-six patients divided into two equal groups, where fixation in group A utilized computer guided patient specific guide to fix anterior mandibular fractures using lag screws. In group B anterior mandibular fractures were fixed using lag screws in the conventional way. Both groups were compared in terms of stability and the need of auxiliary fixation devices.

Results: Both techniques showed uneventful healing and showing insignificant difference between them concerning stability and the need for auxiliary fixation device.

Conclusion: Although the use of computer guided technology didn't offer significant advantage over the conventional technique yet it provides more easy and reliable way especially for beginners introduced to the technique.

Keywords: *Lag screw, computer guided, anterior mandibular fracture.*

Introduction

Several authors favor lag screws over other fixation systems due to its advantages which outweigh bone plates in several aspects, due to presence of compression generated by the use of lag screw which is not the case with mini plates, as a result more fracture gap reduction can be achieved. The extensive use of the lag screw technique have not been recommended due to complication either temporary or permanent due to its technical sensitivity, hence a lot of surgical skill is demanded to benefit from such technique without it's complication.[1,2]

With experiencing different fixation devices, the use of lag screws saves time during fixation, hence reducing intraoperative time when compared to different types of plates especially compression and reconstruction plates since no time is wasted to accurately adapt bone plates.[3]

Concerning interference with reduction upon fixation in anterior mandibular fracture it is proved that lag screws do not interfere while compression and reconstruction plates do, due to failure to achieve perfect plate bends to comply to the irregular complex mandibular lateral surface.[4,5]

Unless the insertion of either lag screws or bicortical bone plate screws are carefully planned in mandibular

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fractures the pathway of the screw or the drill bit might endanger the intramedullary structures like invisible roots of teeth and inferior alveolar canal, this risk is much more realized in lag screws than in bone plates screws due to the long distance and oblique fashion of the lag screws in dentate area.[4,6,7]

Not to mention that failure of inexperienced surgeons to use a proper drilling angel while performing the osteotomy in the anterior mandibular fracture result in increased pressure on the drill bit farther above its shear strength limit ending up with a fractured bit imbedded in the bone, needing excessive bone removal to access the bit for removal.[4,6,8]

Materials and Method

Study Population: 26 patients were selected suffering from anterior mandibular fracture. The history and detailed medical examination data for each patient was collected in a chart prepared specially for this study. Standard preoperative patients' photographs were taken. Pre-operative and post-operative computed tomography were done for each patient.

Pre-operative planning and surgical procedure: In both groups pre-operative computed tomography was performed and DICOM (Digital Imaging and Communications in Medicine) files were inserted in specialized software for surgical planning and simulation"Mimics innovation suite 15.0".

Group A (Computer guided lag screw fixation group): Pre-operatively on the surgical planning software the mandibular fractures were separated, manipulated into pre-fracture position (virtual reduction) and then three-dimension drill guide (patient specific surgical guide) is virtually constructed to guide the drills intra operatively to the planned position of the lag screws. The design of the surgical guide was then exported to a three-dimensional printer to print the surgical guide using printing material medical grade Acrylonitrile butadiene styrene (ABS) a thermoplastic amorphous material.

Before surgery the Surgical guide was immersed in Cidex 2% for 10 hours for sterilization and rinsed with saline prior to surgical procedure.

Intra operatively under general anesthesia mandibular anterior vestibular incision was done and fracture exposed. Inter maxillary fixation was achieved then bone reduction clamp was used to reduce the bone fracture and maintain it until the lag screws are placed. Then the surgical guide to placed and adapted to the anterior mandibular surface and fixed with two mini screws. Drilling the osteotomy for the lag screws were done through the surgical guide. After the osteotomies were completed the surgical guide were removed and counter sinking was done and the lag screws were inserted, then the bone reduction clamp was removed and intermaxillary fixation was released and bimanual manipulation was done to check stability (if instability was found mini plate as an addition fixation device were used). Then the surgical wound was sutured back.

Fig. 1: Bone reduction by bone clamp and lag screws placed

Group B (Conventional lag screw fixation group): Pre- operatively on the surgical planning software the same steps performed for group A was done except for the designing of the surgical guide.

Intra operatively under general anesthesia the same surgical steps for group A was done except that no surgical guide was used to determine the position and angulation of the osteotomies. Instead two osteotomies were done, one as a tension band and the other as stabilization band and both osteotomies were placed as much as possible perpendicular to the fracture plane.

Post-operative: During the follow up visits (1-week post-operative, 4-weeks post-operative, 6 weeks post-operative form day of surgery) patients were checked for stability, occlusion, wound healing, and inferior alveolar nerve paresthesia in addition to other complications as infection were evaluated for each patient.

Results

For all patients, the surgical procedures were performed without any major complications.

Clinical Results: The early postoperative period for all patients went uneventful with no significant complications. All patients showed postoperative edema with variable degrees which resolved completely by the end of the follow up period.

Table 1 Post-operative stability assessment

	1-week post-operative	4-month post-operative	6-weeks post operative
Group 1	All case stable	All cases stable	All cases stable
Group 2	11 out of 13 was stable 2 unstable: managed by IMF	All 11 cases were stable	All 11 cases were stable

According to student T-test the p value for primary stability at 1st week post-operative equals 0.07632616 which is greater than 0.05 indicating that the observed results are due to chance and there is no significant difference between both groups.

Concluding that we accept the null hypothesis that there is no difference between the group A (computer guided lag screw placement) and group B (conventional lag screw placement) concerning the achievement of primary stability.

There was no difference between both groups at one month post-operative to perform statistical difference.

In Group A 4 out of 13 cases required supplemental fixation in the form of mini plate with screws.

In Group B 5 out of 13 cases required supplemental fixation in the form of mini plate with screws.

According to the student T test the P value for neurosensory disturbance equals 0.20789246 which is greater than 0.05 indicating that the observed results are due to chance and there is no significant difference between both groups. Concluding that we accept the null hypothesis that there is no difference between the group 1 (computer guided lag screw placement) and group 2 (conventional lag screw placement) concerning the need for supplemental fixation intra operative

Discussion

This study aimed to compare the efficiency of computer guided lag screw fixation in comparison to conventional lag screw fixation. All cases in the study in both groups showed uneventful healing with bone union at the end of the follow up period.

In comparing the efficiency of the intervention (computer guided group) to obtain primary stability in comparison to the control group (conventional lag screw fixation) it was found that the intervention group is more superior over the control group, however this superiority was statistically insignificant. In our opinion the fact that all of the cases in the intervention group achieved stability thorough out all of the follow-up period is due to the fact that the use of computer guided ensured precise placement and engagement of the tip of the screw to the far cortex offering enough resistance to designment under function. The instability found in the control group during the follow-up period wasn't found intraoperative after fixation although resistance was found upon tightening the screws and stability was checked by bimanual manipulation. In our opinion this may be due to failure of the conventional technique to engage the far cortex and leaving the tip of the lag screw only engaging the spongiosa which is quite enough to maintain stability intra operative, however upon function in the post-operative period the engagement of the spongiosa only offer little resistance to maintain stability resulting in the two cases of instability post-operative out of thirteen patients.

In this study the need for supplemental fixation devices was noted to be insignificant between both groups. The need to apply an auxiliary fixation device was due to either failure to achieve mechanical stability using lag screws only or due to the limited area anatomically leading to substituting the superior lag screw by a mini-plate.

In the computer guided group, the angulation of the lag screw in respective the fracture line was controlled effectively to be nearly at right angle to the fracture line, hence sliding of the fracture segments over one another leading to inaccurate anatomical reduction upon tightening. The achievement of a perpendicular placement of the lag screw to the fracture line is not always reliable during drilling in the conventional way

as illustrated before and requiring a lot of skills by the surgeon and quite experience with the lag screw technique.

In this study during tension band fixation in the control group we refrained in a lot of instances to use a superior lag screw due to the presence of long mandibular canine. Our result concur with the results of Ellis and Ghali 1991 and with the results of Emam and Stevens 2012.[7,9]

In our current study we did not experience drill bit fracture in any of the cases of both groups, this contradict with results of kallela et al 1999 who had one broken bit out of 11 patients and with the results of Tiwana et al 2007 who had 6 broken bits in 6 patients out of 102 patients.[6,8]

In our study we did not experience injury to teeth roots or collision with mental foramen as experienced by previous authors including Assael 1993 and Ellis 2012.[7,10]

It was noted that after drilling through the surgical guide and its removal in the intervention group debris was found from the material of the surgical guide on the bone, they were washed off by saline solution and no tissue reaction was observed during the follow-up period

Conclusion

In the current study the use of computer guided technology was used in placement of lag screws in anterior mandibular fractures and was compared to the conventional technique. The study yielded that the use of the computer guided technology didn't offer any statistically significant advantage over the conventional technique in terms of stability, avoiding complications and the need for additional fixation devices.

However, the use of computer guided would offer a significant advantage for beginners in using the lag screw technique, since the technique requires a lot of experience, skills

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Ethical Approval: The Ethics and research committee, Faculty of Dentistry, Cairo University approved the study and patients' consent was obtained.

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