Endoscopic assisted management of mandibular extracapsular condylar fractures: A prospective randomized controlled study

Original Article

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ABSTRACT

Study design: Endoscopic-assisted open reduction internal fixation (EAORIF) is currently replacing conventional open reduction internal fixation (CORIF). It is claimed that it offers prompt recovery with comparable results while diminishing the risk of facial nerve injury and sparing facial scars.

Objective: The current prospective randomized controlled trial aimed to compare the efficacy of both techniques against their risks.

Methods: Twelve patients suffering unilateral displaced condylar fractures were equally divided into CORIF and EAORIF. Both groups; condylar fractures were fixed using a standard plate 4-hole maxi plate. Clinical assessment compared facial nerve function, occlusion, TMJ functions, and scar visibility. CT scans were used to assess condylar shape abnormalities and condylar measurements preoperatively and 6 months postoperatively.

Results: the mean operative time was a statistically significant reduction in favor of the EAORIF group. Clinical assessment parameters at 6 months were not significant between groups except for scar visibility which showed significant results in favor of EAORIF ($P< 0.05$). CT measurements revealed a non-significant difference between fractured and non-fractured sides within groups as well as between groups.

Conclusion: EAORIF offers faster function regain, superior esthetics and reveals minimal risk of facial nerve injury when compared to CORIF in the treatment of unilateral displaced condylar fractures.

Key Words: Sub condylar fracture, Extracapsular condylar fracture, Endoscopic-assisted trauma, Endoscopic ORIF.

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INTRODUCTION

Closed reduction and fixation for treatment of mandibular condylar fractures survived as a standard protocol for more than 50 years ago. However, critical review of the contemporary literature can easily amend this concept. By the advent of open reduction and internal fixation (ORIF) techniques the enthusiasm of reducing displaced condylar fractures to their normal anatomical positions increased extensively among researchers [1].

When compared to regular conservative techniques, ORIF does not only offer faster healing with better functional recovery, but it also decreases the risk of long-term complications of pain, occlusal instability and degenerative joint changes. These advantages allowed ORIF to replace conservative techniques as a standard treatment option in most cases of condylar fractures [2].

Unfortunately, extraoral approaches used in ORIF are not devoid of disadvantages. They all suffer a high risk of facial nerve injury, in addition to their inherent vulnerability to scar formation [3]. The introduction of endoscopic assisted open reduction and internal fixation technique (EAORIF) offered a satisfactory substitute to regular ORIF with equivalent results and prompt recovery [4]. Recent studies claimed that EAORIF, as a minimal invasive approach, can spare extensive facial incisions, decrease scar visibility and diminish risks of facial nerve injuries [5,6]. In the current prospective randomized controlled trial, we aimed to investigate this claim by comparing the efficacy of both techniques against their risks.

METHODS

The current study was conducted on 12 patients suffering unilateral displaced condylar fractures and classified by a standard preoperative multi-slice CT scan. Condylar fractures in both groups were treated by ORIF using a standard 4 holes maxi-plate osteosynthesis and 2.1 mm fixation screws (Le fort osteosynthesis system, South Korea). Patients were divided according to the applied

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ORIF technique into conventional open reduction and internal fixation technique group (CORIF group), and endoscopic assisted open reduction and internal fixation technique group (EAORIF group). Patients were equally randomized between groups using sealed envelope method. Research protocol was approved by the Ethical Committee of Faculty of Dentistry, Minia University. All patients signed informed consent after all procedures were thoroughly explained to them.

Inclusion criteria:

1. Unilateral displaced condylar fracture, 2.Fracture is classified as either condylar head or sub-condylar, 3. Fracture is either isolated condyle or accompanied by associated single mandibular fracture 4. Adult healthy patient ranging from 18 - 50 years.

Exclusion criteria:

1. Bilateral or non-displaced condylar fractures, 2. Intracapsular condylar head fractures,

3. Isolated condyle accompanied by more than one mandibular fracture, 4. Comminuted condylar or mandibular fractures, 5. Patients suffering from any disease that can adversely affect bone healing.

In both groups the accompanied mandibular fracture, was first exposed via intra oral vestibular incision and treated using regular ORIF. In CORIF group, the condylar fracture was approached via an extended retromandibular incision (Figure1) . In EAORIF group, the condylar fracture was approached using intra-oral vestibular incision and two extra-oral port. The endoscopic port was performed using a 1.5 cm transcutaneous incision and positioned at a point 10 - 15 mm inferior to the mandibular angle. A 300 4 mm endoscope with optical retractor was introduced to visualize the condyle and identify the fracture site (Karl Storz, Tuttlingen, Germany).

Under endoscopic visual guidance and using the intra-oral approach a wide dissection was performed to expose the lateral aspect of the mandibular ramus as well as its posterior and inferior borders. Dissection extended to display the condylar capsule and sigmoid notch superiorly and the gonial angle inferiorly to facilitate reduction and widen the optical cavity. The fractured condyle was carefully dissected and retrieved from its anteromedial position using long curved periosteal elevators with a synchronized downward traction of the ramus.

A trocar port was performed using a 10 mm skin incision situated 1cm below and in front of the tragus in a direction parallel to the anticipated buccal branch of the facial nerve. A special trans-buccal trocar without a channel was then used to drill and introduce the fixation screws. The plate was precisely adapted across the fracture line through the intra-oral approach and the first screw was fixed as superior as possible at the condylar head. The plate was then dragged to reduce the condylar segment in place. Occlusion was first checked, and the remaining screws were subsequently fixed in order. The intraoral wound was finally closed followed by the extraoral port (Figure 2).

The operative time was calculated from the beginning of surgical incision up to wound closure excluding the time used for reduction and fixation of associated mandibular fracture. Patients were strictly advised to perform gentle stretch exercise to increase the range of motion and were clinically evaluated at 72 hours, 2 weeks and 1, 3, 6 - months postoperatively. Clinical assessment comprised the following parameters: 1) facial nerve function (using House-Brackmann assessment scale[7], 2) occlusion, 3) TMJ functions (using maximum inter-incisal opening MIO, lateral excursions, and protrusive movements), 4) scar visibility (using patient and observer assessment scale).

Postoperative radiographic assessment included a panoramic view, performed at the third postoperative day to compare the ramus height of both sides and alignment of reduced fracture, while a standard multi-slice CT scans were performed preoperatively and 6 months postoperative (Siemens six emotions scanner with slice thickness 2mm, scan time 20 sec, 70 KV and 250 mAs.). CT were used to assess 2 parameters: a) condylar shape abnormalities (normal, osteoarthritis, flattening and irregularities) and b) condylar measurements (condylar distance, condylar angle, and proximal distal stump angulation (PDSA)[5,6]. (Figures 3 and 4)

The data obtained were processed using SPSS 23 (SPSS, Inc, Chicago, Ill). Univariate analysis was performed using Fisher exact test for categorical variables, independent T test for numerical data and the Mann-Whitney U test for non-parametric continuous variables. Within-group the differences of the clinical findings and radiographic changes between pre-treatment and post-treatment were examined by the Wilcoxon single rank test. Differences were considered significant at $P<0.05$.

RESULTS

Surgery was performed two to eight days following injury with an average of 4.5 days in CORIF group and 5.7 days in EAORIF group without significant difference. The mean operative time was 161.7 minutes in CORIF group and 127.7 minutes in EAORIF group with a statistically significant reduction in favor of EAORIF group ($P<0.05$).

Three cases from CORIF group expressed signs and symptoms of mild to moderate injury of marginal mandibular branch of the facial nerve. They were presented with a conspicuous deformity on mouth opening, smiling or grimacing. The nerve function was spontaneously regained in all cases. Two cases regained function after one month, while the other case regained

function after 6 months. On the other hand, no functional nerve deficits were recorded in EAORIF group. Patients of both groups restored normal occlusion within one week postoperatively without significant difference between groups.

Functional assessment of MIO, lateral excursions and protrusive movements showed a general gradual improvement by time in both groups. Nonetheless, no significant difference was detected between groups (Figure 3). The only significant difference was demonstrated in MIO measurement at the 3rd postoperative day in favor of CORIF group ($P = 0.045$).

However, this significant difference disappeared at the 2nd week until the end of the follow up period. On the other hand, protrusive measures recorded initial decrease within the first 72 hours in both groups, but it gradually increased to reach maximum values at 3 months after surgery with means of 6.5 mm and 6.8 mm in CORIF group and EAORIF group respectively (Figure 3). Scar visibility assessment showed better significant results in favor of EAORIF group in both the observer and patient assessments scales. In CORIF group, observer assessment scores ranged from 26 -31 (mean=28.8) while in EAORIF group it ranged from 7- 12 (mean=10) for trocar scar($P<0.001$) and 12 -15 (mean=13.5) for endoscopic port scar ($P<0.001$). Similarly, in CORIF group patient assessment scores ranged from 24-30 (mean=26.5) compared to 7- 9 (mean=8.3) for trocar scar ($P<0.001$) and 10 -14 (mean=11.8) for endoscopic port scar in EAORIF group ($P<0.001$) (Figure 5).

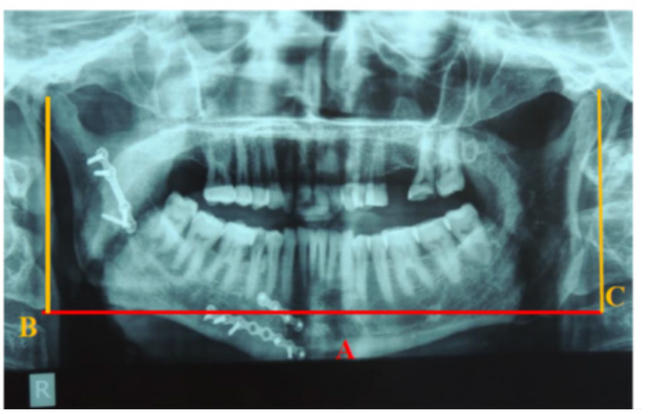
Although the shape of repaired condyles in both groups appeared normal in panoramic radiograph, CT scan detected abnormalities in (66.7% and 50%) of patients in CORIF group and in EAORIF group respectively (Table 1).

Table (1): Comparing incidence of shape abnormalities in repaired condyles at 6 month postoperatively.

Condylar Shape abnormality	CORIF (n=6)	EAORIF (n=6)	P value
Normal	2(33.3%)	3(50%)	
Osteoarthrosis	0(0%)	0(0%)	1
Flattening	1(16.7%)	1(16.7%)	
Irregularities	3(50%)	2(33.3%)	

Figure (1): Retromandibular skin marking b; maxi plate fixed in place c; final skin closure (CORIF group)

Figure (2): a; intra oral approach b; endoscopic port c; driver tightening a screw via trocar port d; maxi plate fixing condylar segment in place e; Intraoral wound after closure. (EAORIF group)



Figure(3) : Panoramic view showing how to measure ramus height. (A)Line denoting to horizontal reference line between the two gonial angle, (B) & (C) lines denoting the two perpendicular lines in the repaired and sound sides.

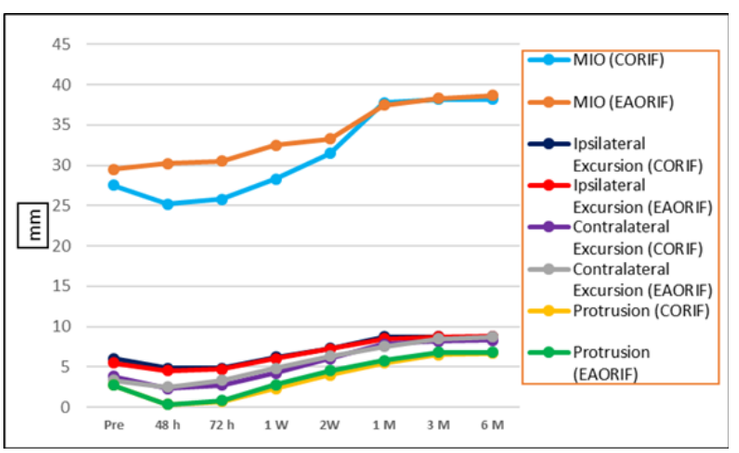


Figure (4): comparison of TMJ function between groups, MIO; maximum interincisal opening

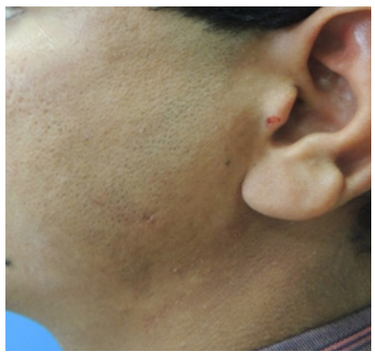


Figure (5): postoperative scars appearance at 6 month. a) CORIF group b) EAORIF group

DISCUSSION

ntroducing ORIF in treating condylar fractures provided faster healing with superior functional results when compared to former conservative methods. Those achievements enabled the ORIF techniques to replace the closed reduction and fixation methods in many situations[8-9-10-11]. However, the surgical approaches used in ORIF launched a higher risk of facial nerve injury as well as inevitable scars with poor esthetics[4,5]. Later, EAORIF was conceived to overcome visible scars by offering surgical ports rather than incisions which was claimed to offer superior esthetics with comparable functional results[12,13,14]. We planned the current prospective randomized controlled trial (RCT) to investigate those claims.

We included only unilateral condylar fractures to provide a base line for accurate comparison between fractured and normal condyles. We also used reliable assessment methods by employing House-Brackmann Scale 7 to test facial nerve function, the patient observer scale to evaluate the scar visibility and the CT scan to evaluate the condylar shape and position. The House-Brackmann Scale provided an effective numerical grading system that accurately measured and compared the facial nerve function. The scale showed a (50%) adverse effect on the marginal mandibular nerve function in CORIF group.

Despite that nerve deficit was temporary and regained functional recovery after 6 months, it presented a considerable disadvantage when compared to EAORIF technique which did not exhibit any risk in all patients. The patient observer scale also provided an effective scar evaluation method. It showed a significant scar visibility in CORIF group in comparison with EAORIF group. Although EAORIF used facial ports, they were extremely shorter in length and hence they rated the least score in scar visibility test.

The trans buccal trocar was reported to cause potential damage to facial nerve branches as well as difficulties in positioning distal screws. Conversely, Osman etal[5] reported that it allowed a wider view and enabled the whole procedure to be visualized through the endoscope. In our study we didn't face such complications because we used a small non channel trocar. The trocar allowed a perpendicular drilling direction on the plate especially in the most superior hole. An angulated intra-oral screwdriver was used instead of the extra-oral trocar when difficulties were encountered in positioning the screwdriver for fixation of distal screws.

Finally, we selected both panoramic view and CT scan in comparing radiographic results. The panoramic view enabled us to measure the ramus height immediately post-operative, while CT scans offered an accurate determination of the condylar shape abnormalities as well as condylar measurements[5,8,9]. The CT results of the condylar shape abnormalities exhibited significant postoperative changes in condylar shape in both groups. These changes did not show osteoarthrosis during the 6 months follow up period and had no influence on clinical outcome. However, it should be followed up as those changes may adversely affect TMJ function in the future. Regarding the CT measurements results were comparable between and within groups indicating that EAORIF is equivalent to CORIF in reduction and fixation accuracy. Both techniques showed excellent compar able results in TMJ functions in 6 months. However, the EAORIF showed a faster significant regain at MIO in 3 months. This may be attributed to the earlier disappearance of reflex contraction of masseter and medial pterygoid muscles due to decreased surgical trauma in the EAORIF technique. Both techniques showed a delayed regain of normal protrusive movement at 3 months with re-achievement of normal movement at 6 months. This may be due to delayed lateral pterygoid healing either from the trauma itself or due to surgical intervention. Our results were comparable to those reported by Venkatesh et al[2] regarding operative time and duration of surgery, both were in favor of EAORIF group.

The use of single maxi-plate will provide stable fixation of the condylar fracture due its thick profile which is fixed with long bi-cortical screws that compress the fracture segments against rotational mussels pull and loading function, so single maxi-plate is enough for rigid fixation of condylar fracture than mini-plate which is week and easily bended during fixation.

for either small or large condylar segment, the handle manipulation is the same starting with the first superior drill hole and subsequent bicortical screw & plate into the condylar head itself which will act as the dragging and manipulation tool whatever is the segment size

the bending was performed directly on the patient which really represents a real challenge in the endoscopic approach. but that could be overcome somehow with a well trained, synchronized team, Howeve nur, Using 3d printed Models are considered in our further workflow and subsequent publications. The used maxi plates presented a drawback by its large size in the EAORIF group however, it provided a good control over the condylar segment after the placement of first screw.

CONCLUSION

The study showed that EAORIF technique was comparable to CORIF technique in the treatment of displaced condylar fractures with faster function regain, superior esthetics and minimal risk of facial nerve injury. Moreover, the limited number of patients presented a shortcoming. Finally, The usage of patient specific plates that are pre-adapted and contoured would have refined the technique and decreased the operative time with yielding more accurate reduction and fixation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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