

Original Article

Effect of Utilization of the Proximal Fractured Segment as A Guidance for Open Reduction and Internal Rigid Fixation of Unilateral Low Sub-Condylar Fractures on Posterior Ramus Height

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Abstract

Facial asymmetry due to improperly reduced Condylar fractures is one of the Postoperative complications. Accurate reduction and fixation of Condylar fractures with symmetrical postoperative gain of ramus height is mandatory. **Aim:** To assess the efficacy of utilization of the proximal segment as a guidance for Open reduction and internal rigid fixation in low sub-condylar Fractures. **Patients and methods:** For ten patients with unilateral sub-condylar fractures with age ranged from 32-51 years, the proximal fractured segment fixated to the plate was used a guidance for its reduction to the ramal stump. A cone beam CT was ordered for all patients immediate postoperative and the ramus height was measured on the fractured side and compared to the normal contralateral side. The Postoperative restoration of occlusion was reported. **Results:** For all patients, the restored ramus height of the fixated side was less than that of the non-fractured side with significant difference (p value= 0.009) and the postoperative occlusion was restored. **Conclusion:** Proximal condylar segment could be used as a guidance for Open reduction and rigid internal fixation of low sub-condylar fractures with subsequent restoration of the height of the ramus as compared to that of non-fractured side.

Keywords: Sub-condylar Fracture, occlusion, condyle, ramus height, mandibular height

I. INTRODUCTION

Condylar process fractures account for one-third of all mandibular fractures. The condylar region is the most commonly fractured location of the mandible,

accounting for 25%–35% of all mandibular fractures. Gue heong et al., 2017

Various classification systems have been proposed based on the assessment of fracture on the

two-dimensional radiography like panoramic view. Loukota RA et al., 2005, Loukota RA et al., 2010 and Batbayar EO et al., 2022

Based on the fracture level, these fractures can be classified into intracapsular (within Condylar head/ high) and extracapsular (within Condylar neck/ low). Moreover, based on the fracture displacement; There may be medial or lateral displacement and the medial displacement is the most common due to the lateral pterygoid muscle pull. Neff A et al., 2014& Yang et al., 2022

Generally, there are two main modalities for management of these fractures; conservative (closed) or open reduction. The selection of the best modality remains controversial. Selection is based on various factors that include: level, classification and characteristics of the fracture. Batbayar EO et al., 2022

Management of the displaced sub-condylar fractures remains controversial (conservative versus open reduction). MacArthur CJ et al., 1993 If mandibular height is grossly reduced by the displaced segment, then open reduction and internal fixation (ORIF) outweighs the conservative approach. Hackenberg B et al., 2014 & Yang et al., 2022

Moreover, unattainable repeatable occlusion, complete Condylar dislocation out of fossa or associated contralateral or pan- facial fractures; are all indications for ORIF. MacArthur CJ et al., 1993 Moreover, ORIF is indicated when marked reduction of ramus height followed severe condylar displacement, as the fractured Condylar segment determines the posterior ramal height. Yang et al., 2022

The extraoral approach for ORIF is preferred over the intraoral approach because of the limited accessibility of the later. Extraoral approach provides better visualization with subsequent better anatomic reduction of the fractured segments. Krishnan K et al., 2020

Despite the technique for ORIF varies in literature, the results are usually satisfactory. Different methods of fixation have been utilized in literature for ORIF of low sub-condylar fractures. Kang D H et al., 2012, Hackenberg B et al., 2014 & Khaled A et al., 2018

Two 4-hole miniplates with mono-cortical screws are considered the standard practice for management of condylar and sub-condylar fractures. Hammer B et al. 1997& Meyer C et al., 2002 The posterior miniplate is placed along condylar axis at posterior border of ramus to maintain the reduced position and prevent segment rotation. The anterior one is placed along tensile forces following the sigmoid notch rim to protect the posterior plate from mechanical load. Wagner A et al., 2002 Lag screws were also used for Condylar segment fixation. Sugiura T et al., 2001

More recently, 3D rectangular plate was utilized by Meyer C et al., 2006. It is supposed to increase the osteosynthesis stability by the 2.3 profile and the mechanical connection between its two arms. Meyer C et al., 2002& Cortelazzi R et al., 2015 Sub-condylar fractures were also fixated via trans-buccal trocar combined with an intraoral approach. Krishnan K D et al., 2020

However, most articles share the concept of fixating the fracture initially with 2 screws; one on each side of the fracture line before complete fixation. Shakya S et al., 2020

Many parameters were used for assessment of Postoperative success of the reduction procedure in literature. They include ramus height, angle between the condyle and ramus, occlusion and maximal mouth opening postoperative. Gue heong et al., 2017, Batool A and Areej A 2019 & Yang et al., 2022

Ramus height assessment is a useful assessment tool as it becomes usually compromised with condylar segment displacement. Assessment of ramus height is also critical in the selection of

conservative versus the ORIF plan. Yang et al., 2022 Assessment of mandibular height as a treatment success tool was described in literature. Loukota RA et al., 2005

In the current study, Authors present a different technique of achieving fracture reduction. This is to be correlated with the restoration of postoperative occlusion and mandibular height assessment on postoperative CBCT. Lack of evidence regarding the use of this technique and the outcome of ramus height assessment encouraged the researchers for development of this research.

II. PATIENTS & METHODS

Patients with unilateral low sub-condylar fractures were selected from the outpatient clinic of the oral and maxillofacial surgery department of faculty of oral and dental medicine, Cairo University. After informing the patients about the nature and possible complications of the procedure, a written consent was obtained. The present study was approved by the institutional ethical committee that follows the Declaration of Helsinki guidelines.

To be included in the sample, patients had to meet the following inclusion criteria. All candidates were required to have unilateral sub-condylar fracture with no local pathosis that might interfere with bone healing. Patients with bilateral sub-condylar fractures or with a history of delayed or previous surgery were excluded.

a. Patient allocation

Ten patients (eight males and two females) suffering from unilateral low sub-condylar fractures (with mean age of 42.6 years) were selected in this study. Preoperative orthopantomogram was ordered for all patients to assess the fracture type and displacement and exclude any local pathosis.

b. Surgical procedure

Retromandibular approach was used to expose the fractured segments. For the retromandibular

approach, local anesthesia (Articaine 4% with 1:100 000 epinephrine) was infiltrated along the skin incision that started just below the earlobe to end behind the angle of the mandible 0.5 cm behind the ramus. Following subcutaneous tissue dissection, blunt dissection completed over the parotid gland. Then, identification and sparing of the facial nerve, dissection completed parallel to the nerve. Finally, pterygomandibular sling was incised and ramus was exposed till the fracture line located.

Following fracture exposure, (2.3 four-hole plate) was fixated to the proximal segment along the Central axis of Condyle with 2 (9mm) screws. Then both (condyle and plate fixed to it) was used as a guiding arm for reduction of segment to the ramal stump. Following reduction, intraoral screws were utilized for intermaxillary fixation (IMF). Then, at the fracture line, another 2 screws were drilled to the ramal stump for rigid internal fixation (**Figure 1**).

The Retromandibular incision was then sutured in layers and the intraoral IMF was released. Postoperative antibiotics (Amoxicillin/clavulanic acid 625 mg tab., tid for 7 days) and analgesics (Ibuprofen 400 mg capsule) were prescribed to the patients.

c. Radiographic assessment

CBCT was ordered for all patients 1 week and 3 months postoperative to measure the ramus height and assess the bony healing.

d. Study variables and measurement of posterior ramal height (standardization of calculations)

Ramus height was measured by tracing a line connecting the highest point of condylar head and the lowest point of ramus (**Figure 2**). Batool A and Areej A 2019

e. Statistical analysis

Data was represented as mean and standard deviation (SD) values. They were tested for normality

using Shapiro-Wilk test. They were normally distributed and were analyzed using paired t-test. The significance level was set at $p < 0.05$ within all tests.

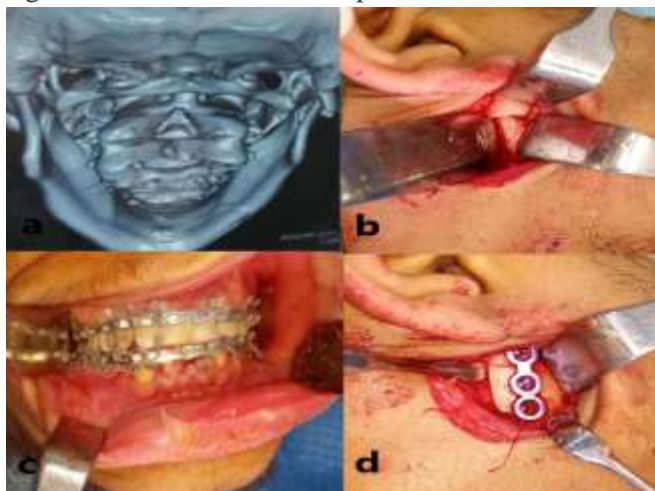


Figure (1): Surgical management: a) Preoperative 3D CT showing the displaced fracture segment, b) Retromandibular approach showing the fracture line and the displaced proximal segment of the sub-condylar fracture, c) Maintaining the proper occlusion following fracture reduction and fixation, d) Internal rigid fixation using 2.3 four-hole plate.

III. RESULTS

a. Clinical assessment

At 1 week and 3 months follow up period, healing went uneventful for all ten patients with satisfactory clinical results, restoration of repeatable occlusion and maximal mouth opening (Table 1). None of the patients experienced postoperative limitation of mouth opening, deviation, posterior open bite, infection or facial nerve palsy as a complication.

b. Radiographic assessment

The radiographic ramal height was only assessed immediately (1 week) postoperative. The statistical analysis showed that the Mean value of ramal posterior border height was significantly higher in the normal side in comparison to the fractured side ($t=3.92$, $p=0.009$). Intergroup comparisons, mean and standard deviation values for ramal height are presented in (Table 2).

Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows.

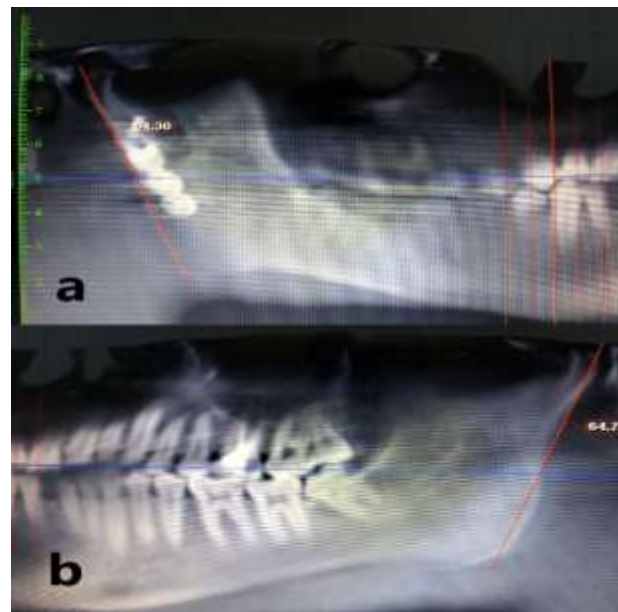


Figure (2): Measuring the Ramal posterior border height: a) at the fractured site, b) at the contralateral site.

Table (1): Demographic information of the patients & postoperative occlusion assessment.

Patient no	Sex	Age	Fracture site	Fracture Etiology	Post-operative occlusion
1	M	43	Rt	MVA	Restored
2	M	46	Rt	MVA	Restored
3	F	39	Rt	Human violence	Restored
4	M	32	Lt	MVA	Restored
5	M	51	Lt	Fall from height	Restored
6	M	47	Rt	Violence	Restored
7	M	41	Rt	MVA	Restored

(M= male, F= female, MVA= Motor vehicle accident)

Table (2): Intergroup comparison of ramal posterior border height (mm) immediate postoperative

(mm) (Mean± SD)		Mean difference [95% CI]	t-value	p-value
Fractured side	Normal side			
53.35±6.59	53.79±6.55	-0.44 [-0.75: -0.14]	3.29	0.009*

(CI=Confidence interval, *significant (p<0.05))

IV. DISCUSSION

Fixation of Condylar fracture with marked displacement or significant compromise of ramal height can't be attained with closed reduction but rather ORIF. Yang RC et al., 2022 The optimal technique for ORIF is still a controversial issue.

Proper ORIF technique of sub-condylar fracture is mandatory to avoid long term postoperative complications such as facial asymmetry, TMJ dysfunction, pain and open bite. Shakya s et al., 2020 Restoration of ramal height, facial symmetry through accurate anatomical reduction is more attainable with ORIF. Tanja B et al., 2015 ORIF is the gold standard for management of displaced Condylar fractures.

Whatever the technique utilized for ORIF, care must be taken to avoid displacement of the proximal condylar segment (due to muscle pull) or excessive stripping of the condyle (to attain proper reduction) to avoid risk future condylar resorption. So BK et al., 2021 Condylar resorption can be yielded also by remodeling of the condyle to regain its normal physiological position if it wasn't properly reduced. Hence, appropriate technique for open reduction is crucial. Ellis E & Dean J et al., 1993 & Hai-Hua Zhou et al, 2019

The present study evaluates a different technique of ORIF that includes utilization of the proximal fractured segment fixated to four-hole compression plate as a guiding arm for reduction of the fracture to the ramal stump.

The authors suggests that this new technique results in reduced operative time and minimal stripping of Condyle by utilization of single compression plate

instead of 2 four- hole miniplates. Moreover, it's well known that technique of fixation, position, number, type of plates used for fixation can affect stress induced in the Condylar segment. Murakami K et al., 2017.

de Jesus GP et al, 2014 compared different plate number, design and hole number and concluded that single efficient plate is optimal for Condylar reduction. The success of this technique was assessed by ramal height assessment of the fractured side in comparison to the contralateral side on CBCT.

In low sub-condylar fractures, the mandibular height is determined by the fractured condylar segment He D et al., 2009, hence many previous studies compared the postoperative ramus height of the fractured side to the contralateral normal side on two- dimensional radiography like orthopantomogram (OPG) Kommers S et al., 2014, Muhammed Shiju et al., 2015, Hanan M et al., 2017, Mahmoud F et al., 2018 & Batool A & Areej A, 2019 However, it has proved to be non-reliable.

Few studies evaluated it on computed tomography but they compared Preoperative ramus height to the postoperative one and other outcomes like occlusion or ramus angle were assessed. Devireddy SK et al., 2014 None of them compared the fractured side ramal height to the contralateral non-fractured side on CBCT.

Only one study compared the fractured to the normal side height but in the intracapsular/ high condylar fractures. Yang RC et al., 2022, Other study compared the fractured to the normal side regarding

the ramal height but on OPG. Kommers S et al., 2014 & S.P. Chang et al., 2018

Sugiura T et al., 2001 showed that restoration of ramal height was more efficient with lag screws more than miniplates or wires.

In the present study, the mean immediate Postoperative ramus height was 53.35 ± 6.59 mm for the fixated fractured side compared to 53.79 ± 6.55 mm for the non-fractured side with statistically significant difference. This might be attributed to minor inaccuracy of placement of Condyle in the fossa or decreased sample size. However, this result come on line with kommers S et al., 2014 who reported shortened ramal height on fracture side (66% of patients) compared to the normal one while the remainder (34% of patients) showed increased ramal height on the fractured side.

However, kommers S et al., 2014 measured ramus height on orthopantogram not CBCT and reported that ramus is considered shortened when difference between the height of fractured versus normal side is 4.2 mm.

Regarding Postoperative occlusion, it was restored in all patients with uneventful healing. To get full benefit from the ramal height assessment tool as an indicator for proper technique utilized for ORIF, the degree of fracture displacement should be assessed and correlated with it.

V. CONCLUSION

Within the limitations of current study, we may conclude that the fractured proximal condylar segment could be used as a guidance for Open reduction and rigid internal fixation of low subcondylar fractures with subsequent restoration of the height of the ramus as compared to that of the contralateral non-fractured side. The authors recommend further studies with larger sample size.

Conflict of interest:

Authors declare no conflicts of interest

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Ethics:

The study protocol was approved by the ethical committee of Faculty of Dentistry- Cairo university on 31 January, 2023, approval number 22-1-23

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