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Compare between intraorala and extraoral approaches of subcondylar mandibular fracture management

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***Abstract*---**Background: Mandibular fractures, including fractures of the subcondylar and condylar regions, are common facial fractures. Sub condylar fractures account for 20–62% of all mandibular fractures. But their management remains controversial. Although closed reduction is the most useful method, it can be difficult to achieve anatomical reduction with this technique compared with open reduction and internal fixation (ORIF). Aim of the work: To compare between intraoral and extraoral approaches in management of submandibular fracture. Patients and methods: This comparative study was conducted in the plastic surgery department, Faculty of medicine-Menoufia University on 20 patients complaining of sub condylar fracture of mandible. Patients were classified into two groups based on surgical approach: Group A: included ten patients undergoing surgical fixation via the intraoral approach. Group B: included ten patients undergoing surgical fixation via extraoral approach Group. Results: A statistically significant difference was found between groups regarding operating and time. Intraoral approach had a signifcanlty longer operating time compared to extraoral. A statistically significant difference was found between groups regarding interincisal distance. Intraoral approach had a significantly larger interincisal distance compared to extraoral approaches. A statistically significant difference was found between groups regrading field of exposure extraoral have wide field of exposure. Surgical site infection was reported in two 22.6%), one (14.3%), and one (8.3%) patients in groups A, B, No cases of postoperative bleeding were reported. Conclusion: extraoral approache was better in management of submandibular fracture.

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***Keywords*---**mandibular condyle, mandible, temporomandibular joint, Mandibluar fracture, subcondylar fracture.

Introduction

Mandibular fractures, including fractures of the subcondylar and condylar regions, are common facial fractures (1). Sub condylar fractures account for 20–62% of all mandibular fractures. But their management remains controversial (2). Although closed reduction is the most useful method, it can be difficult to achieve anatomical reduction with this technique compared with open reduction and internal fixation (ORIF) (3).

Among the numerous surgical methods that can be used in the treatment of subcondylar fracture (4), extraoral rather than intraoral approaches are generally preferred because they can be provided a sufficient surgical vision. However, compared with intraoral approaches, extraoral approaches commonly have a high rate of postoperative complications, such as salivary fistula formation, visible scarring, and facial nerve injury (5). The most surgeons agreed the consensus that the proper surgical indications for ORIF are the displaced bilateral or unilateral fractures of the mandibular condylar neck or subcondyle (6).

Therefore, in this study we will compare the clinical results achieved with different intraoral approach using an angulated screwdriver, transparotid and retromandibular approaches in patients with subcondylar fractures of the mandible (7). The aim of this study is to compare between intraoral, trans parotid and retromandibular approaches in management of submandibular fracture.

Patients and methods

This study included 20 patients complaining of subcondylar fracture of mandible in plastic surgery department, faculty of medicine, Menoufia University.
Inclusion criteria:

- Age older than 16 years.
- Presented with displaced subcondylar fracture with occlusion disturbance.

Exclusion criteria:

- Age younger than 16 years.
- Subcondylar fracture without occlusion disturbance.

Methods:
All patients were subjected to:

- Clinical assessment including complete history and physical examination.
- Routine laboratory investigations including complete blood picture (CBC), renal function test, liver test profile, bleeding profile, blood glucose level and virology.
- Radiological investigations including CT of the facial bone, X-ray panorama.

Assessment of dental occlusion:

Equipments needed:

Equipment required for an occlusal examination includes:
- Articulating paper in 2 different colours.
- Miller's forceps.
- Shim stock

Procedures:

- **Dry the teeth:** This allowed better colour transfer from the articulating paper. Additionally, applying Vaseline on articulating paper can help with colour transfer on to teeth.
- **Shim stock:** This is a thin strip of polyester film used to identify the presence or absence of occlusal or proximal contacts. Use the shim stock in between and across the two arches in order to establish teeth that are naturally occluding and naturally discluding. A positive contact resulted in a 'tug back' of the shim stock and a negative contact resulted in the strip removing itself from the occlusion on pulling. Record in the patient's notes where the shim stock holds are present.
- **Mark the dynamic contacts:** Using Miller's forceps to grasp the articulating paper, get the patient to slide their mandible laterally, forwards and backwards with the paper between their teeth. Start with dynamic contacts to prevent static contacts from being rubbed off.
- **Mark the static contacts:** Using a different coloured articulating paper (preferably a lighter colour to prevent coverage of the dynamic contacts), get the patient to bite down a few times with the paper between the maxillary and mandibular teeth on the left side before progressing on to the right.
- **Assess and make a note of the contacts:** Some clinicians like to take a mental note of the contacts to then be able to conform their restoration to that original occlusion. Alternatively, clinical photos, occlusal drawings/sketches or notes can be taken instead for a keepsake record.

Preoperative planning:

The dental occlusion was evaluated with clinical examination and a review of photograph was taken using self-cheek retractor. The direction and type of fracture fragments was evaluated pre- operatively with computed tomography.

Postoperatively:
- Clinical and radiological evaluations were performed during the postoperative follow-up period.
- Wound infection, nonunion, and plate and screw loosening or exposure.

Evaluation:

Operation times of the intraoral, transparotid and retromandibular groups were determined from the respective anesthesia records. The cost of an operation analysis between intraoral, trans parotid retromandibular groups was performed with direct payment data. Clinical outcomes of both approaches were evaluated with the occlusion status, range of mouth opening (and deviation). Complication of these approaches were evaluated.

Statistical analysis

Data were checked, entered and analyzed using SPSS for data processing. The following statistical methods were used for analysis of results of the present study. Data were expressed as number and percentage for qualitative variables and mean + standard deviation (SD) for quantitative one. The comparison was done using the student "t" test, Mann Whitney test, Chi-square test, Z-test for percentage, odds ratio. *p* value of > 0.05 indicates non-significant results. *p* value of < 0.05 indicates significant results.

Results

Figure 1 summarizes the age distribution. The mean age was 37.1 ± 7.6, 33.3 ± 7.3, and 39 ± 7.7 years in groups A, B, and C, respectively. As demonstrated in figure 2, male patients accounted for 71.4%, 57.1%, and 66.7% of groups A, B, and C, respectively. On the other hand, female patients accounted for 28.6%, 42.9%, and 33.3% of groups A, B, and C, respectively.

As demonstrated in figure 3, right side was involved in four (57.1%), five (71.4%), and four (66.7%) patients in groups A, B, and C, respectively. Left side was involved in two (28.6%)in group A, one (14.3%) in group B, and two (33.3%) patients in group C. Bilateral involvement was reported in one (14.3%) patient in group A, and one (14.3%) patient in group B.

As shown in table 1, no statistically significant difference was found between groups regarding Lindahl classification (Chi-square test, P = 0.862). As shown in table 2, no statistically significant difference was found between groups regarding fracture type (Chi-square test, P = 0.776). As shown in table 3, no statistically significant difference was found between groups regarding the presence of associated fractures (Chi-square test, P = 0.956).

As shown in table 4, a statistically significant difference was found between groups regarding operating time (Kruskal-Wallis test, *P* = 0.002). Pairwise comparison demonstrated that intraoral approach had a signifcanlty longer operating time compared to transparotid and retromandibular approaches. However, no statistically significant difference was found between transparotid and retromandibular approaches regarding operating time (*P* = 0.922).

As shown in table 5, a statistically significant difference was found between groups regarding interincisal distance (Kruskal-Wallis test, *P* = 0.002). Pairwise comparison demonstrated that intraoral approach had a signifcanlty larger interincisal distance compared to transparotid and retromandibular approaches. However, no statistically significant difference was found between transparotid and retromandibular approaches regarding interincisal distance (*P* = 0.834). As demonstrated in table 6, no statistically significant difference was found between groups regarding postoperative complications (Chi-square test, P > 0.05).

Table 1. Lindahl Classification (N = 20)

	Group A (n= 7)		Group B (n=7)		Group C (n = 6)		*P* value*
	No.	%	No.	%	No.	%	
Classification							0.862
Deviated	2	28.6	3	42.9	2	33.3	
Displaced	4	57.1	2	28.6	3	50	
Dislocated	1	14.3	2	28.6	1	16.7	

* Chi-square test.

Table 2. Type of Fracture (N = 20)

	Group A (n= 7)		Group B (n=7)		Group C (n = 6)		*P* value*
	No.	%	No.	%	No.	%	
Type							0.776
Closed	5	71.4	6	85.7	5	83.3	
Open	2	28.6	1	14.3	1	16.7	

* Chi-square test.

Table 3. Associated Fractures (N = 20)

	Group A (n= 7)		Group B (n=7)		Group C (n = 6)		*P* value*
	No.	%	No.	%	No.	%	
Associated Fractures							0.956
None	3	42.9	3	42.9	3	50	
Symphysis	2	28.6	1	14.3	1	16.7	
Parasymphysis	2	28.6	3	42.9	2	33.3	

Table 4. Operating Time (N = 20)

	Group A (n= 7)	Group B (n=7)	Group C (n = 6)	*P* value*
Operating Time, min				0.002
Mean ± SD	76.7 ± 12.8	51.7 ± 5.1	52 ± 6.3	
Range	60 – 91	45 – 60	43 – 60	

* Kruskal-Wallis test.

Table 5. Interincisal Distance (N = 20)

	Group A (n= 7)	Group B (n=7)	Group C (n = 6)	*P* value*
Interincisal Distance, mm				0.002
Mean ± SD	42.6 ± 1.9	35.3 ± 4.2	34.7 ± 2.7	
Range	40 –45	30 – 40	31 – 39	

* Kruskal-Wallis test.

Table 6. Complications (N = 20)

	Group A (n= 7)		Group B (n=7)		Group C (n = 6)		*P* value*
	No.	%	No.	%	No.	%	
SSI	2	28.6	1	14.3	1	16.7	0.776
Bleeding	0	0	0	0	0	0	-
Facial nerve palsy	0	0	2	28.6	0	0	0.127
Salivary-related	0	0	1	14.3	0	0	0.376
Implant-related	1	14.3	0	0	1	16.7	0.554
Trismus	0	0	1	14.3	1	16.7	0.554

SSI: surgical site infection

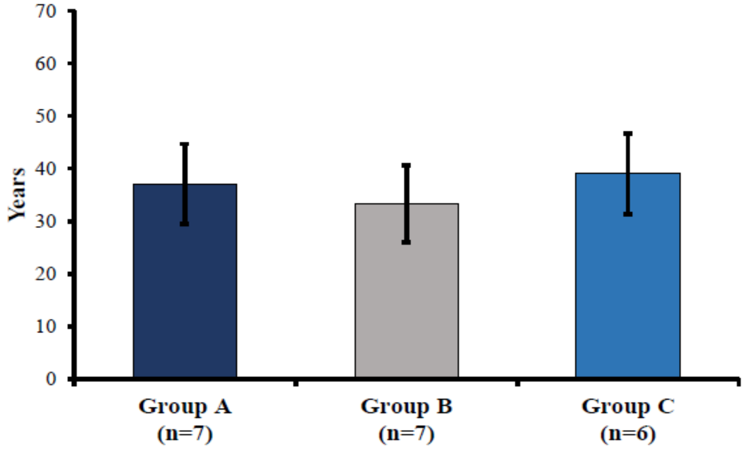


Figure 1. Age Distribution

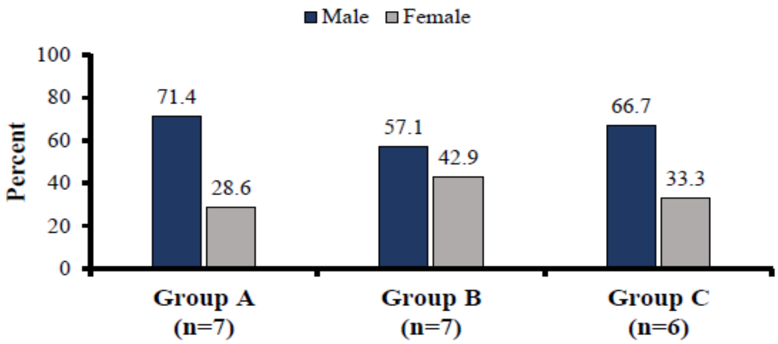


Figure 2. Gender Distribution

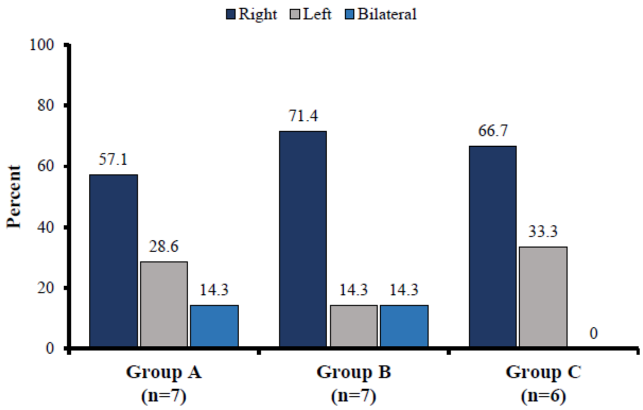


Figure 3. Laterality

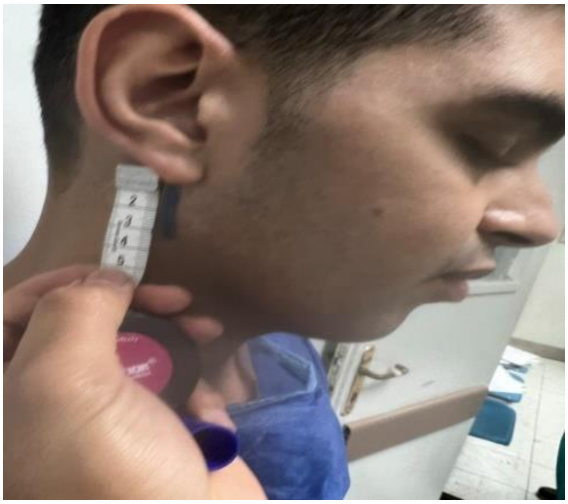
Case Presentation

Case (1)

Preoperative photos showing preoeratuve occulsion and retromandibular incision

(A)

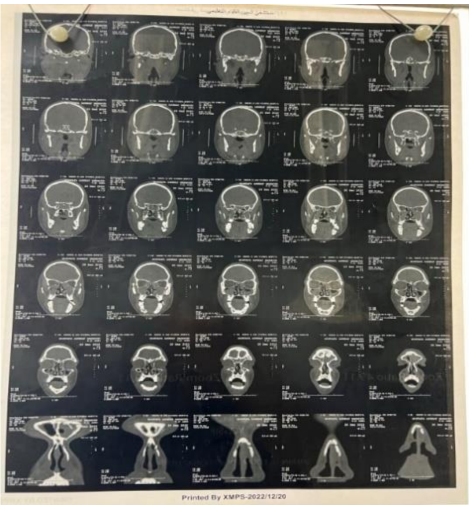
(B)

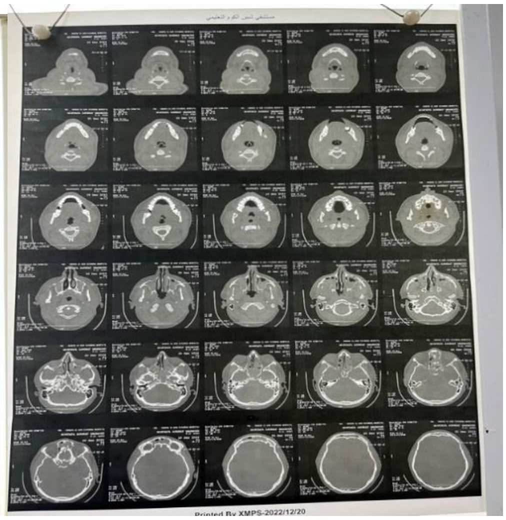


(C)

27 years oldmale patient presented with right subcondylar ,parasymphysial fracture and lef fracture body of mandible figures (A and B) showing oculsion with mouth opeening and clouser figure (C) showing incision site with retromandibular approach.

Preoperative CT imaging with 3D



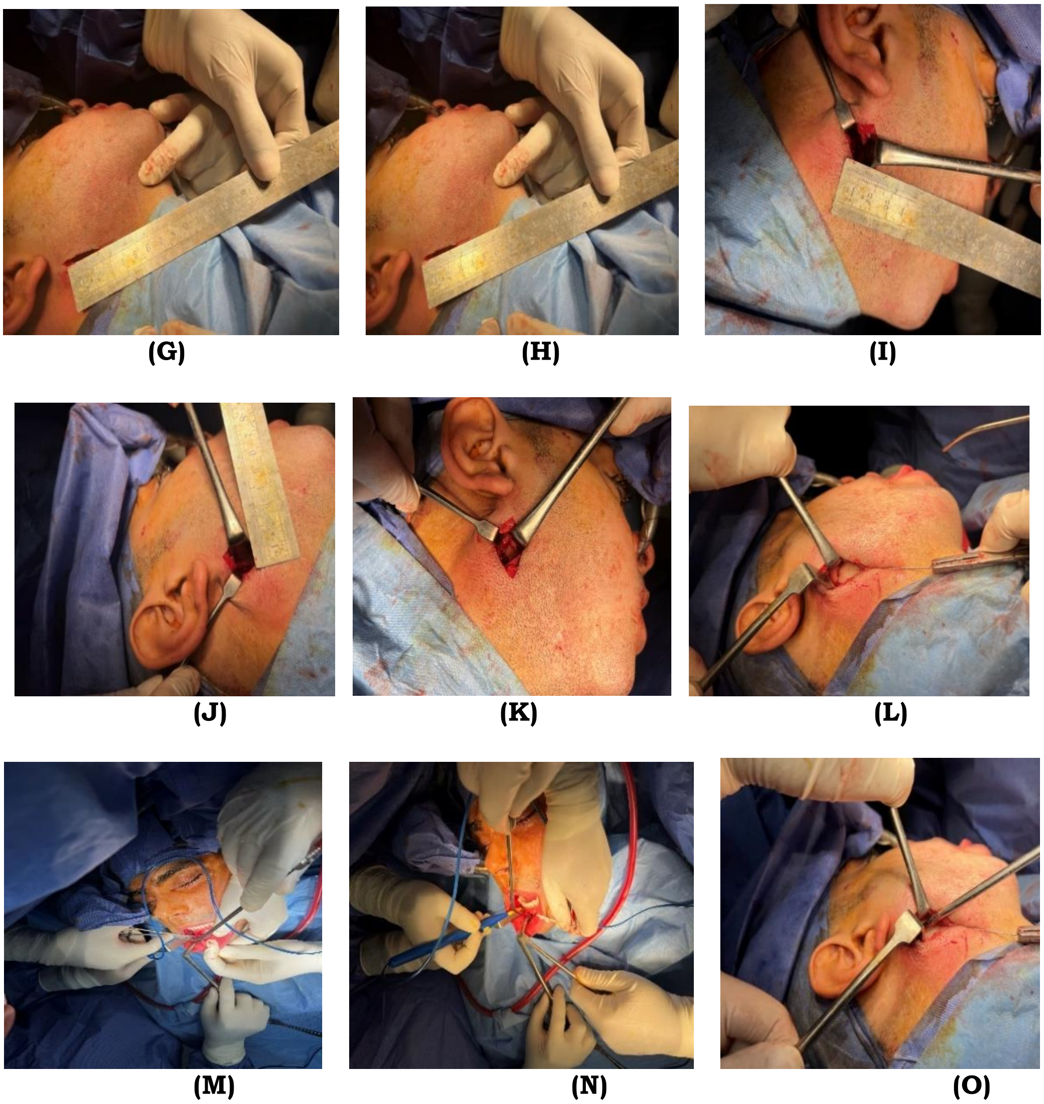


(D) **(E)**

(F)

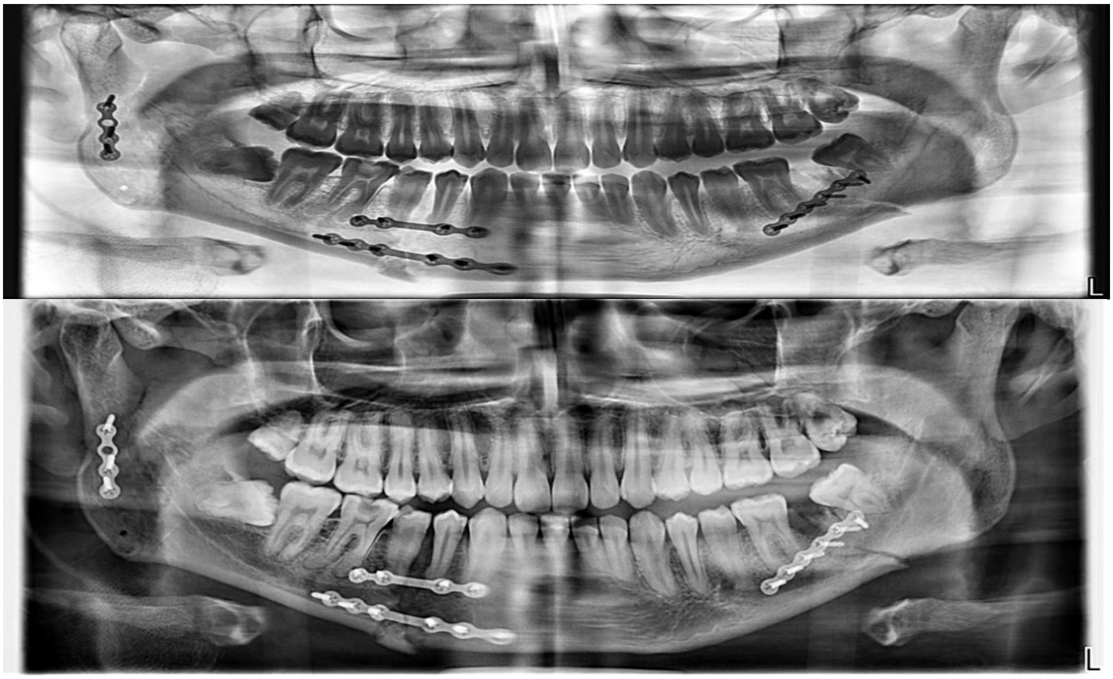
Preoperative CT imaging showing fracture sites

Intraoperative photos showing incision and fracture



(G, H, I) Intraopertive incsioin retromandibular approache and size of incsion figure.
(J, K, L) Fracture subcondylar fracture figure.
(M, N) Parasmphysial fracture and mental nerve figure.
(O) Wire used to reduce the fracture.

Postoperative photos showing occlusion with panorama x ray imaging showing plates



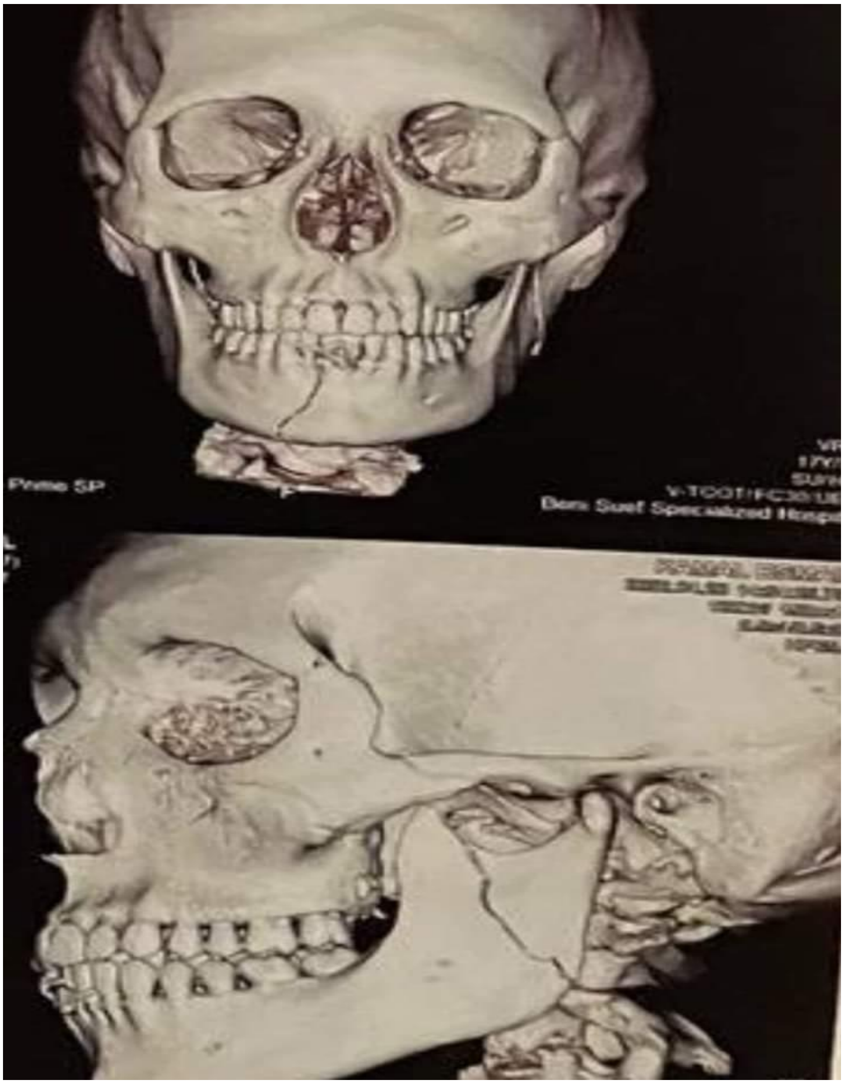
(p) Postopertive panorama x ray which showing post operative reduction of fracture with fixation with plate and screw

(Q) **(R)** **(S)**

Postoperative occulosion and mouth opening

Case (2)

Preoperative imaging CT with 3D



(A) 23 years old male patient presented with left subcondylar and right parasymphysial fracture. Pre operative CT imaging showing left subcondylar and right parasymphysial fracture.

Intraoperative photos showing incision and fracture

(B)

(C)

(D)

(E)

(F)

(B,C) Intraopertive incsioin retromandibular approache and size of incsion.
(D, E) Fracture subcondylar fracture reduction and fixation with plate and screw.
(F) Parasmphysial fracture and plate and screw.

Postoperative photos showing occlusion

(G) (H) (I)

Postoperative occulosion and mouth opening

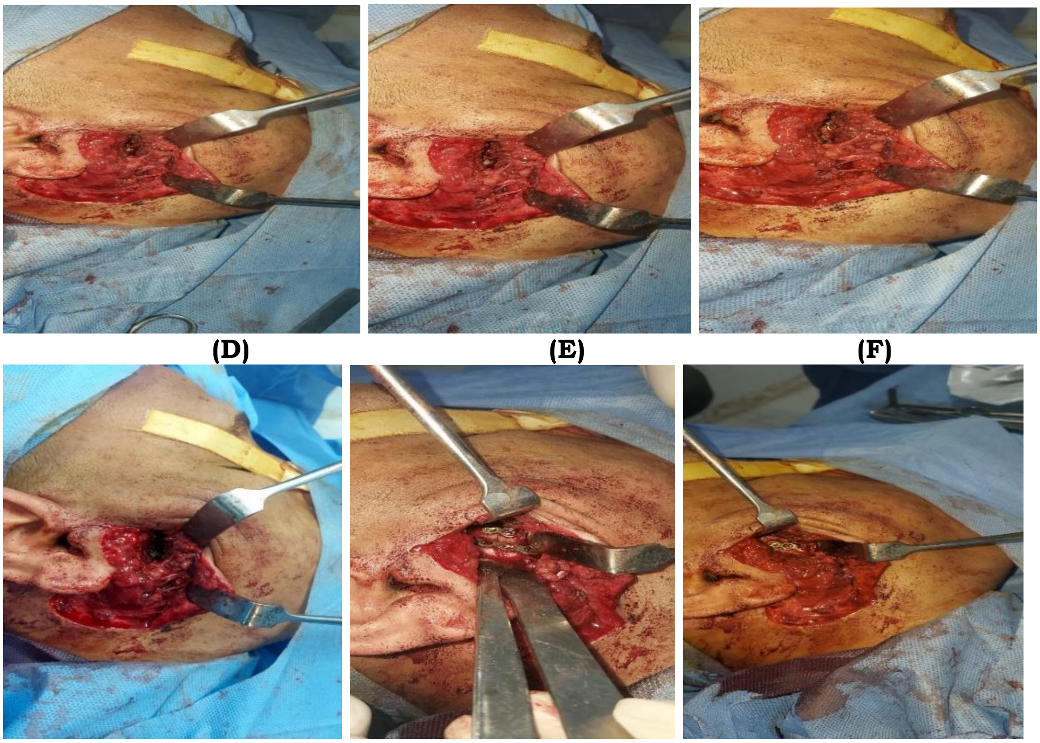
Case (3)

Preoperative photos showing CT with 3D

(A) (B) (C)

45 years old male patient presented with right subcondylar. Preoperative CT imaging showing right subcondylar.

Intraoperative photos showing transparotid incision and fracture



(D) (E) (F)

(G) (H) (I)

(D,E,F) Intraopertive incsioin transparotid approache and size of incsion and parotid gland and facial nerve branches.
(G) Fracture subcondylar fracture.
(H, I) Reduction of subcondylar fracture and fixation with plate and screw.

Discussion

Condylar fracture is one of the most common mandibular fractures consisting of 25%-35% of all mandibular fractures. Despite many research and clinical trials, there is still a debate about whether to treat these fractures conservatively or by open reduction and internal fixation (ORIF) (8).

Various approaches, such as pre-auricular, intra-oral, retromandibular, and sub-mandibular, have been described in the literature for the management of condylar and sub-condylar fractures. The retromandibular transparotid approach, as described by Hinds and Girroti, is the most direct approach as it provides the shortest distance between the incision and the fracture site (9).

The objective of our study was to compare between intraoral, trans parotid and retromandibular approaches in management of submandibular fracture. This comparative study was conducted in the plastic surgery department, Faculty of medicine-Menoufia University on 20 patients complaining of sub condylar fracture of mandible.

Patients were classified into three groups based on surgical approach: Group A: included seven patients undergoing surgical fixation via the intraoral approach. Group B: included seven patients undergoing surgical fixation via the transparotid approach. Group C: included six patients undergoing surgical fixation via the retromandibular approach.

In our current study, the mean age was 37.1 ± 7.6, 33.3 ± 7.3, and 39 ± 7.7 years in groups A, B, and C, respectively. No statistically significant difference was found between groups regarding age distribution (Kruskal-Walli's test, $P = 0.158$). Male patients accounted for 71.4%, 57.1%, and 66.7% of groups A, B, and C, respectively. On the other hand, female patients accounted for 28.6%, 42.9%, and 33.3% of groups A, B, and C, respectively. No statistically significant difference was found between groups regarding gender distribution (Chi-square test, $P = 0.850$).

Our study can be supported by Koirala and Subedi (10) who retrospectively studied 9 patients with 35 sub-condylar mandibular fractures who underwent open reduction and internal fixation through the retromandibular transparotid approach. Their study reported that there were 23 males (79.3%) and 6 females (20.7%). The ages ranged from 16 to 57 years, with a mean age of 29.8 (SD 11.1).

Regarding laterality, right side was involved in four (57.1%), five (71.4%), and four (66.7%) patients in groups A, B, and C, respectively. Left side was involved in two (28.6%) in group A, one (14.3%) in group B, and two (33.3%) patients in group C. Bilateral involvement was reported in one (14.3%) patient in group A, and one (14.3%) patient in group B. No statistically significant difference was found between groups regarding side distribution (Chi-square test, $P = 0.828$).

In agreement with our findings, Kanno et al. (11) who aimed to assess the retromandibular transparotid approach for reduction and rigid internal fixation using two locking miniplates in mandibular condylar neck fractures reported that thirteen patients had unilateral condylar neck fractures and six had bilateral condylar fractures, with condylar neck fractures on one side and sub condylar neck fractures on the other in three patients and condylar head fractures on the other in the remaining three patients.

Concerning mechanism of injury, RTA was reported in five (74.1%), four (57.1%), and three (50%) patients in groups A, B, and C, respectively. FFH was reported in two (28.6%) patients in group A, two (28.6%) in group B, and two (33.3%) in group C. Assault was reported in one (14.3%) patient in group B, and one (14.3%) patient in group C. No statistically significant difference was found between groups regarding mechanism of injury (Chi-square test, $P = 0.846$).

In harmony with our findings, Koirala and Subedi (10) reported that the most common etiology was a road traffic accident (18, 62.1%), followed by physical assault (6, 20.7%) and then a fall injury (5, 17.2%).

According to Lindahl Classification, deviated fracture was observed in two (28.6%), three (42.9%), and two (28.6%) patients in groups A, B, and C, respectively. Displaced fractures were reported in four (57.1%) patients in group

A, two (28.6%) in group B, and three (50%) in group C. Dislocation was reported in one (14.3%) patient in group A, two (28.6%) patients in group B, and one (16.7%) patient in group C. No statistically significant difference was found between groups regarding Lindahl classification (Chi-square test, $P = 0.862$).

Our results showed that closed fracture accounted for 71.4%, 57.1%, and 66.7% of groups A, B, and C, respectively. On the other hand, open fracture was reported in 28.6%, 42.9%, and 33.3% of groups A, B, and C, respectively. No statistically significant difference was found between groups regarding fracture type (Chi-square test, $P = 0.776$).

Concerning associated Fractures, isolated sub condylar mandibular fractures were reported in three (42.9%), three (42.9%), and three (50%) patients in groups A, B, and C, respectively. Associated symphyseal fractures were reported in two (28.6%) patients in group A, one (14.3%) patient in group B, and one (16.7%) patient in group C. Associated Para symphyseal fractures were reported in two (28.6%) patients in group A, three (42.9%) patients in group B, and two (33.3%) patients in group C. No statistically significant difference was found between groups regarding the presence of associated fractures (Chi-square test, $P = 0.956$).

In concordance with our findings Koirala and Subedi (10) reported that seventeen (48.6%) fractures were isolated sub-condylar fractures. Symphysis and parasymphy-sis fractures were the most associated fractures (22.9%). Eighteen fractures (51.4%) were located at the condylar base and 15 (42.9%) were displaced.

Regarding surgical outcomes, the mean operating time was 76.7 ± 12.8, 51.7 ± 5.1, and 52 ± 6.3 minutes in groups A, B, and C, respectively. a statistically significant difference was found between groups regarding operating time (Kruskal-Walli's test, $P = 0.002$). Pairwise comparison demonstrated that intraoral approach had a significantly longer operating time compared to transparotid and retromandibular approaches. However, no statistically significant difference was found between transparotid and retromandibular approaches regarding operating time ($P = 0.922$). The mean interincisal distance was 42.6 ± 1.9, 35.3 ± 4.2, and 34.7 ± 2.7 mm in groups A, B, and C, respectively. A statistically significant difference was found between groups regarding interincisal distance (Kruskal-Walli's test, $P = 0.002$). Pairwise comparison demonstrated that intraoral approach had a significantly larger interincisal distance compared to transparotid and retromandibular approaches. However, no statistically significant difference was found between transparotid and retromandibular approaches regarding interincisal distance ($P = 0.834$).

In line with our findings, Ghezta et al. (12) reported that Thirty-nine patients with 47 fractures were evaluated. There were 34 sub condylar fractures (located below the sigmoid notch) (87%), and 5 fractures were in the head region in bilateral cases. Of the fractures, 31 (79%) were unilateral and 8 (21%) were bilateral. In a multivariate study, condylar coronal displacement, coronal sagittal displacement, difference in the ramal height, maximal interincisal distance, protrusive movements, and deviation of the mandible on opening showed statistically significant differences in pretreatment and post-treatment patients ($P = .001$). The interincisal distance was 46.8 mm (SD, 5.2 mm) postoperatively versus 24.1 mm (SD, 6.7 mm) before treatment. The average range of protrusion was significantly lower (P = .001) in patients before treatment, at 1.9 mm (SD, 1.2 mm), when compared with 6.1 mm (SD, 2.0 mm) postoperatively. During mouth opening, deviation of the mandible is often a sign of compensatory movement of the contralateral joint due to shortening of the ascending ramal height on the affected joint. The mean deviation of the mandible from the midline was 4.2 mm (SD, 1.0 mm) in patients before treatment, with a significant difference (P = .001) in patients after treatment, with a mean of 1.9 mm (SD, 0.995 mm). Temporary injuries to the facial nerve branches were observed in 3 cases (8%) 1 week after treatment, which later resolved within 3 weeks to 3 months.

Also, Dalla Torre et al. (13) who aimed to study surgical treatment of mandibular condyle fractures using the retromandibular anterior transparotid approach and a triangular-positioned double miniplate osteosynthesis technique, revealed that the mean maximal interincisal distance ranged from 38 mm after 1 week to 45 mm after 6 months. Deviations/deflections were seen in 22.5% of the cases 1 week postoperatively and decreased to 2% at 6 months postoperatively. A temporary facial palsy was diagnosed in 3.9% during the first follow-up, whereas no impairment was recorded after 3 or 6 months. At the same time, no patient had occlusion disturbances or complications regarding the parotid gland or the osteosynthesis 6 months postoperatively.

Finally, surgical site infection was reported in two (28.6%), one (14.3%), and one (16.7%) patient in groups A, B, and C, respectively. No cases of postoperative bleeding were reported. Facial weakness was reported in two (28.6%) patients in group B. One (14.3%) patient in group B suffered from a salivary fistula. Implant loosening was reported in one (14.3%) patient in group A, and one (16.7%) patient in group C. Trismus was reported in one (14.3%) patient in group B, and one (16.7%) patient in group C. No occlusal stability was reported in either group. No statistically significant difference was found between groups regarding postoperative complications (Chi-square test, $P > 0.05$).

Our study agrees with Bouchard et al. (14) who retrospectively analyzed 108 patients with sub-condylar fractures who underwent ORIF through the retromandibular approach. They reported transient FNP in 22% of cases, permanent paralysis in one case, and infection in 11.9% of cases. They also observed four salivary fistulae, two sialoceles, one case of Frey's syndrome, and two seromas.

Also, Shi et al. (15) retrospectively analyzed 102 neck and sub-condylar fractures and found various degrees of facial nerve injury in 18% of patients. They reported that condylar neck fracture, fracture-dislocation, and operator inexperience were the three factors associated with facial nerve injury. Collectively, these studies show that the risk of post-operative FNP ranges from 8% to 30%, and most of the injuries were transient except in one patient with permanent FNP.

Furthermore, Bruneau et al. (16) in their retrospective study of 48 sub-condylar fractures in 43 patients operated through the retromandibular sub-parotid approach reported 18.6% transient FNP and found condylar neck fracture and comminuted fracture as risk factors of FNP. Increased and prolonged traction force applied to reduce and fix the fracture may be the cause of the higher incidence of FNP.

Moreover, Kanno et al. (17) demonstrated that seven fractures (12.7%) were associated with FNP that resolved completely within 6 months. Further statistical analysis revealed dislocated and dislocated condylar neck fractures were significant risk factors for postoperative FNP ($p<0.05$). Other postoperative complications were minimal.

Although the sub-mandibular approach has been used for sub-condylar fractures, the increased distance from the incision site to the fracture makes reduction and fixation very difficult. When the proximal segment is displaced antero-medially, then ORIF through the sub-mandibular approach becomes even more difficult requiring excessive retraction force to reduce the fractured segment and to place the cranial-most screw, increasing the risk of facial nerve palsy. The trans-oral approach offers better cosmetic results and theoretically no risk of facial nerve injury. However, for antero-medially displaced sub-condylar fractures, the trans-oral approach should be combined with either endoscope or trans-buccal screw placement that might result in facial nerve palsy (18, 19).

Conclusion

Intraoral approach was associated with longer operating time and larger interstitial distance. While extraoral was associated with shorter operating time and smaller interstitial. regrading field of exposure extraoral has wide field of exposure which is good for comminuted fracture. Intraoral approach need special instruments that may not be available in many maxillofacial units. suggesting that transparotid and retromandibular were better approaches in management of submandibular fracture.

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