



Clinical Assessment of Retromandibular Antero-Parotid Approach for Reduction of Mandibular Subcondylar Fractures: Report of 60 Cases and Review of the Literature

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ABSTRACT

This study assessed the efficacy of the retromandibular antero-parotid approach for open reduction and internal fixation (ORIF) of subcondylar fractures. Sixty patients with the mean age of 31.03 years underwent surgical reduction with a 20-25mm incision in the retromandibular area with an antero-parotid transmasseteric approach. All patients were followed between 6 to 12 months. At the end of the first week, six patients exhibited postoperative malocclusion. At the next visits, all patients had optimal occlusion. Maximal interincisal opening (MIO) of 56 patients (93.3%) was >37mm, and only four patients (6.7%) had MIO<37mm. In three patients (5%), weakness of the buccal branch of the facial nerve was noticed postoperatively. No salivary gland complications were seen. The surgical scar was hardly noticeable. Retromandibular access with transmasseteric antero-parotid approach is the technique of choice for treatment of high- and low-level subcondylar fractures with adequate visibility and direct access to the condylar area.

Keywords: Mandibular Condyle; Wounds and Injuries; Parotid Region; Surgical Procedures; Fracture Fixation; Case Reports

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INTRODUCTION

In the maxillofacial region, condyles are most susceptible to fracture. Condylar fractures account for 25-50% of facial fractures. If not diagnosed or properly managed, they can result in severe functional defects, improper occlusion, mouth opening limitation, jaw deviation, and limitations in lateral mandibular excursions [1,2]. It has been well documented that intracapsular fractures can cause ankyloses if not undergo intensive rehabilitation [3]. These fractures can be unilateral or bilateral or may be accompanied by fractures of other parts of the mandible or other facial bones [4,5]. Management of subcondylar fractures has long been a highly

debated and challenging topic in maxillofacial surgery. Closed treatment, i.e. maxillomandibular fixation, used to be the mainstay of treatment even for fractures with large displacements [6,7]. At present, a consensus has been reached on open reduction and internal fixation (ORIF) as the treatment of choice for most subcondylar fractures, particularly bilateral fractures or unilateral fractures with large displacements [5,6]. Several methods have been proposed for ORIF of subcondylar fractures and plate osteosynthesis, which are generally divided into intraoral and extraoral techniques [8,9]. The intraoral techniques are endoscope-assisted. The extraoral techniques include

submandibular, retromandibular trans-parotid/antero-parotid, preauricular, and facelift approaches. Some surgeons prefer intraoral techniques due to the lower risk of scar formation and nerve damage [10,11]. However, intraoral techniques require an endoscope, special equipment, and high experience and expertise of the surgeon. Most surgeons prefer extraoral techniques due to better visibility. However, extraoral techniques carry the risk of surgical complications, such as facial nerve damage, salivary gland fistula, and clinically significant scars, which question the use of these techniques and raise some concerns [9]. It is reported in the literature that facial nerve damage in extraoral techniques occurs in 3 to 48% of cases; however, there are fewer reports of facial nerve damage with endoscopic intraoral approaches [8,12,13]. Among the approaches to condylar fractures, the retromandibular antero-parotid approach can be used for the management of high- and low-level subcondylar fractures. It provides visibility and direct access to the condylar area and allows for accurate fixation of the fracture. Due to the optimal site and size of the incision, insignificant scars may occur with a low rate of complications. This study sought to assess the efficacy and safety of the retromandibular antero-parotid approach for ORIF of subcondylar fractures in 60 patients.

MATERIALS AND METHODS

Patients:

This prospective study was conducted on 60 patients including 52 males (86.7%) and eight females (13.3%), with an age range of 17-47 years (mean age, 31.03 years; median: 31.5 years) presenting to Sina Hospital with subcondylar fractures, from January 2013 to March 2017, who underwent ORIF via the retromandibular antero-parotid approach. Of 60 patients, 22 (36.6%) had bilateral and 38 (63.4%) had unilateral subcondylar fractures. The fracture was on the right side in 28 (46.7%) and on the left side in 10 patients (16.7%). Forty-two patients had fractures in other parts of the mandible in addition to subcondylar fractures. Of all the patients, 25 (41.7%) suffered from motor vehicle accidents.

Interpersonal violence was the cause of injuries in 21 patients (35%) and fallings in 14 patients (23.3%). Table 1 shows the demographic information. The exclusion criteria included the presence of any kind of fracture in the maxilla.

Table 1. Demographic information of the patients

Variables	No.	%
Age (years)	17-30	28 46.7
	31-40	22 36.6
	> 40	10 16.7
Gender	Male	52 86.7
	Female	8 13.3
Condylar fracture side	Right	28 46.7
	Left	10 16.7
	Bilateral	22 36.6
	Midline	6 10
Associated mandibular fractures	Parasymphysis	18 30
	Body	8 13.3
	Angle & Ramus	10 16.7
Trauma mechanism	MVA	25 41.7
	IPV	21 35
	Falling	14 23.3

IPV: interpersonal violence; MVA: motor vehicle accident

Surgical procedure:

After preparation, draping and general anesthesia, the anatomical locations of the zygomatic arch, the posterior border of the mandible, the condyle, the coronoid process, the sigmoid notch, and the fracture line were marked on the skin. The incision line was also marked with a 20-25mm length in the retro-mandibular region parallel to the posterior border of the mandible at a 1cm distance from it and approximately 5mm lower than the earlobe (Fig. 1).



Fig. 1. Marking of the anatomical landmarks and the incision line

Next, 1:100,000 epinephrine was injected into the retromandibular and parotidomasseteric fascia and around the fracture line. In this area, the facial nerve is located 2cm deep under the skin after exiting the stylomastoid foramen. It then runs obliquely and enters into the parotid gland where it passes next to the retromandibular vein and external carotid artery. A cutaneous incision was made, and after incising the skin and subcutaneous tissues, dissection was performed to the level of the superficial muscular aponeurotic system (SMAS; Fig. 2).



Fig. 2. Incision of the skin and subcutaneous tissues and dissection to the level of the superficial musculo-aponeurotic system

Care was taken not to cut the skin too thin when elevating the flap to maintain the blood supply of the flap. After reaching the parotid capsule, dissection was performed in an anterosuperior direction to expose the fibers of the masseter muscle. After reaching the masseter muscle fibers, dissection was continued bluntly parallel to the facial nerve branches towards the mandibular ramus. In most cases, there was no need to find the facial nerve branches, but when noticed, they were protected using a retractor. Medial and posterior to the body of the mandible, the facial nerve trunk is divided into upper and lower divisions; the upper division gives rise to the temporal and zygomatic branches while the lower division branches into the buccal, marginal mandibular, and cervical nerves. Dissection was continued anteriorly to the parotid gland through the space between the

upper and lower facial nerve divisions or between the buccal and marginal mandibular branches in the form of blunt dissection over the mandibular ramus. Dissection was safely continued through the masseter muscle fibers, located deeper than the facial nerve. After reaching the bone, the periosteum was elevated and the fracture site was exposed (Fig. 3). To enhance the exposure of the fractured condylar segment and its buccal repositioning, the distal segment may be pulled down intraorally by applying pressure at the site of molar teeth with repositioning the broken segment using a periosteal elevator.



Fig. 3. Exposure of fracture site

Next, two four-hole plates were placed over the fractured condyle and fixed in place with four screws. After fixing the broken piece in place, four screws were tightened in the distal segment and the fracture was fixed (Fig. 4).



Fig. 4. Fixation of fracture line with two 4-hole miniplates

However, due to the conduction of anatomical reduction, intermaxillary fixation was not required in any phase of surgery unless for reduction and plating of other fractures. The area was copiously irrigated and the incision was sutured. A drain was not required in any patient. All patients were hospitalized for zero to five days after trauma and underwent surgery within three days following their hospital admission. In patients with bilateral fractures, only one side was subjected to ORIF and the other side was subjected to closed reduction.

Outcomes:

The patients were followed-up one and two weeks, one month, and six to 12 months after treatment in terms of mandibular movements, maximal interincisal opening (MIO), lateral mandibular excursions, occlusion (subjective assessment by the patient), tenderness (assessed by mild manual pressure on bilateral temporomandibular joint (TMJ) area as positive or negative), facial nerve injury, salivary gland complications (presence or absence), infection and scarring [measured as positive (hypertrophy, keloid formation, and hyperpigmentation) and negative] at the incision site. Linear measurements were made using a caliper in millimeters (mm). Panoramic and mandibular posteroanterior (PA) radiographs were ordered immediately after treatment and at the final follow-up session after six months to assess the quality of fixation of the fracture site and proper reduction (less than 2 mm bony gap between fractured segments and less than 10 degrees of deviation of the condylar part from the ramus axis). All the digital images were taken by Planmeca ProMax® unit (Planmeca, Helsinki, Finland).

Ethics:

This study followed the Declaration of Helsinki on medical protocol and ethics and was approved by the ethics committee of Tehran University of Medical Sciences (code:32131). During hospitalization, patients signed written informed consents to undergo ORIF surgery and were briefed about all possible surgical complications and other available modalities for the management of subcondylar fractures.

RESULTS

In all patients, the fracture had been properly reduced and the plates were in the correct position (Fig. 5 and 6). In two patients, because of the narrow nature of the condylar neck, we were unable to use two plates for fixation of the fractured segment and only one four-hole plate was employed. Radiolucent lesions were not seen around any plate.



Fig. 5. Postoperative posteroanterior mandibular view

The occlusion, MIO, and lateral mandibular excursions were recorded to assess the TMJ function. Occlusion was determined by marking the occlusal contacts of teeth using articulating papers and subjectively by the patients. In 10 patients, adequate occlusal contacts were not present due to having poor dentition and absence of posterior teeth. At the end of the first week after surgery, all patients, except for six, had postoperative occlusion similar to the preoperative state.



Fig. 6. Postoperative panoramic view

Light elastic treatment was performed for the aforementioned six patients for one week. At the next visits, all patients had optimal occlusion. One week post-operatively, the MIO was 39.44 ± 2.78 mm (range: 34-51). At the last follow-up session, MIO of 56 patients (93.3%) was >37 mm (45.53 ± 5.5 mm, range: 35-58) and only four patients (6.7%) had $\text{MIO} < 37$ mm.



Fig. 7. Surgical scar of the retromandibular incision after 6 months

One week after the surgery, the mean value of lateral mandibular excursions was 7.66 ± 2.27 mm towards the operated joint and 5.2 ± 1.55 mm towards the sound joint.

At the final follow-up session, this value was 7.8 ± 2.46 mm towards the operated joint and 7.63 ± 1.88 mm towards the sound joint. In addition, the mean value of protrusive movements was 6.11 ± 1.75 mm and 9.34 ± 1.61 mm at the first week postoperatively and the last session, respectively.

The facial nerve was preserved in all patients; they had normal facial functions. In three patients (5%), weakness of the buccal branch of the facial nerve was noticed postoperatively, which completely resolved at the six-month follow-up.

No case of salivary gland complications, such as sialocele, salivary gland fistula, Frey's syndrome, or postsurgical infection, was seen at any of the follow-up sessions. The surgical scar was hardly noticeable with no wide or hypertrophic scars. All patients were fully satisfied with the surgical scar (Fig. 7). Table 2 summarizes the follow-up results.

DISCUSSION

Condylar trauma is a highly debated and challenging topic in the management of maxillofacial traumas because although a good primary clinical outcome is achieved, it is often associated with serious late complications, such as pain, mandibular movement limitation, muscle spasm, malocclusion, pathological changes of the TMJ,

Table 2. Postoperative complications in 60 patients

Complications		Time interval after operation		
		1 week	1 month	6-12 months
TMJ function	MIO < 37mm	10 (16.7%)	4 (6.7%)	4 (6.7%)
	Occlusal instability	6 (10%)	None	None
Salivary gland	Salivary fistula	None	None	None
	Sialocele	None	None	None
	Frey's syndrome	None	None	None
	Infection	None	None	None
	Complete paralysis	None	None	None
Facial nerve	Weakness	3 (5%)	3 (5%)	None
	Plate fracture/displacement	None	None	None
Radiographic evaluation	Screw loosening	None	None	None
	Lesion around screws	None	None	None

TMJ: temporomandibular joint; MIO: maximum interincisal opening

osteonecrosis, asymmetry, and ankyloses in many cases, which may even occur despite treatment [14-16]. The closed treatment used to be the conventional standard treatment for the management of subcondylar fractures because, for long, it was believed that this method had fewer complications with optimal esthetic and functional results compared to the open treatment [17]. However, at present, an increasing number of papers report superior results for open treatment (ORIF) of subcondylar fractures in terms of occlusion, bone morphology, and TMJ function [18-20]. Eckelt et al [21] and Schneider et al [22], in their studies on a large number of patients, reported a condylar angle of 10 to 45° and shortening of the ramus height by more than 2mm as the criteria for surgery. In the current study, patients who met one of these criteria were subjected to ORIF.

Surgical approach:

Surgical approaches to access the condylar area include preauricular, submandibular, and retromandibular incisions, each with advantages and disadvantages. Complications of surgical treatment of condylar fractures include perioperative complications such as bleeding and postoperative complications such as infection, facial nerve paralysis, impaired function of the auriculotemporal nerve, Frey's syndrome, and scar formation. An extraoral approach enables direct access to the fracture site; however, it is associated with a higher risk of scar formation and nerve damage [17].

A submandibular incision is the incision of choice for the management of fractures at the angle and body of the mandible but it provides inadequate access to the middle and superior condylar and ramus fractures and may complicate fixation [23]. Biglioli and Colletti [24] introduced a surgical approach by making an incision posterior to the angle of the mandible, extending for 20mm. This incision allows for adequate access to the condylar area but does not sufficiently expose the ramus [24]. Preauricular and post-auricular incisions are suitable for accessing intracapsular and high-level subcondylar fractures [25]. Retromandibular and

submandibular approaches and rhytidectomy are used for the management of low-level subcondylar fractures [26]. In the current study, we evaluated the retromandibular antero-parotid transmasseteric approach because, despite the high number of studies on ORIF of condylar fractures, studies on this approach are lacking. The retromandibular approach was first introduced by Hinds in 1967 and was then modified by Koberg in 1978 [12]. Wilson et al [27] introduced the transmasseteric antero-parotid approach, which provided adequate access to the condyle and ramus with decreased risk of facial nerve injury.

Surgical complications:

TMJ function:

In the current study, all condylar fractures were managed by anatomical reduction without perioperative intermaxillary fixation. Intermaxillary fixation was only performed in case of the presence of other fractures. After the operation, intermaxillary fixation or elastic treatment was only performed for one or two weeks to obtain accurate intercuspation or for other fractures that had not undergone rigid fixation. At the end of the first week, 10 patients had decreased MIO, which was probably due to tenderness and surgical manipulation of the area. At the final follow-up session, four patients still had MIO<37mm. These patients had bilateral condylar fractures, and fractures on the other side had been managed by closed reduction, which was probably responsible for decreased range of movement of the mandible. In the assessment of mandibular lateral excursions at the end of the first week, the movement towards the affected joint was significantly greater than the movement towards the other side, which indicated decreased translation at the operated site. This difference gradually decreased until the next follow-up sessions, and both sides eventually became equal. The results of the current study were in agreement with those using a transparotid approach, with no significant differences [28-30]. It is believed that unstable occlusion in the first week after surgery in some patients is due to edema and inflammation of the joints, which can be simply

managed by anti-inflammatory drugs and guiding elastics within a short time after the operation.

Facial nerve:

Facial nerve damage is a common complication and a major concern for surgeons when using extraoral approaches. In the current study, facial nerve damage was seen in three cases, which was temporary (5%) and resolved until the next follow-ups. Temporary nerve damage is mainly due to accessing the mandibular ramus by passing through the facial nerve branches with pressure and tension, resulting in transient neurapraxia, which is resolved over time [12]. Surgeons have reported 0-8% transient nerve damage following the transmasseteric antero-parotid approach [3,23,31]. Nerve damage has been reported in 12 to 48% of the cases with the retromandibular transparotid approach [4,32-36]. In the preauricular approach, the risk of nerve damage is lower since the incision site is far from the nerves; however, visibility and access are poor due to the relatively far distance from the fracture site; this approach can be hardly used for fractures below the sigmoid notch [37]. However, Bhutia et al [12] reported the prevalence of nerve damage to be 3 to 48% with this approach. Nerve damage with the submandibular approach has been reported in 5 to 48% of the patients [38]. Permanent facial nerve damage has never been reported in the literature.

Salivary gland complications:

Due to the proximity of the surgical site to the parotid gland in the management of subcondylar fractures, there is a risk of salivary gland complications, such as salivary fistula, sialocele, and Frey's syndrome. In the antero-parotid approach, access is from the anterior aspect of the parotid gland; therefore, the parenchyma of the parotid gland is not invaded, and thus, the risk of such complications is lower. The current study results confirmed this assumption. None of the patients in the current study had any salivary gland complications at any of the follow-up sessions. Other studies using the antero-parotid approach also confirmed this finding and did not report salivary gland fistula in any patient [3,23,24].

However, Biglioli and Colletti [24] reported two cases of postoperative infection in patients in whom the parotid capsule had been surgically manipulated. They explained that parotid gland capsule manipulation was probably the reason for this complication [24]. In studies that utilized the transparotid approach, the prevalence of salivary gland fistula has been reported to be 2.3 to 11.4%, which was managed conservatively and resolved after a couple of weeks [4,29,30,34]. Other salivary gland complications, such as sialocele and Frey's syndrome, were not seen, except for one case of sialocele following the retromandibular transparotid approach [34].

Infection:

In the current study, similar to that of Ellis et al [4], condylar fractures were managed after the reduction of other fractures using the same instruments. Thus, all instruments were contaminated with saliva and intraoral microbial flora. Despite this, no infection occurred, which was probably due to the rich blood supply of the maxillofacial region and prophylactic administration of antibiotics. In the literature, infection has been rarely reported with open surgical approaches to the TMJ area.

Scar formation:

Clinically significant scars are a major cause of patient dissatisfaction despite fracture reduction and proper function of the TMJ. The cutaneous incision in the antero-parotid approach is limited to a short 2cm incision in the shadow zone (between the posterior border of the mandible and anterior border of the sternocleidomastoid muscle), which is hardly visible. In the study by Manisali et al [34], using the same cutaneous approach like ours, two patients complained of hypertrophic and hyper-pigmented scars while in the current study, clinically significant scars were not seen. Other studies did not report significant scarring either [23,24,30]. However, Salgarelli et al [31] mentioned that access to condylar fractures through a 2cm retromandibular incision was extremely difficult and provided inadequate visibility and access and prolonged the surgery, which was in contrast to our findings.

CONCLUSION

In the current study, a retromandibular incision with a transmaseteric antero-parotid approach was used for the management of condylar fractures. This method can be used for the management of high- and low-level subcondylar fractures as well as ramus and coronoid fractures. It provides adequate visibility and direct access to the condylar area and allows for accurate fixation of the fracture. Due to the optimal site and size of incision, insignificant scar, and low rate of complications (such as facial nerve damage and salivary gland complications), this method is recommended for ORIF of condylar fractures.

CONFLICT OF INTEREST STATEMENT

None declared.

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