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Minimal Access Retromandibular Approach to Fractures of Vertical Segment of the Mandible: A Versatile Technique

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Abstract

Introduction Fractures of the condylar region of the mandible, although fairly common, also generate the most debate regarding management—both closed and open treatment options have been recommended and shown to yield good results. We present our experience with a minimal access retromandibular approach to fractures of the vertical mandible.

Materials and Methods This is a retrospective study of all patients who underwent open reduction and internal fixation for fractures of the vertical mandible (condyle, subcondylar region, ramus) using a retromandibular approach at a tertiary care hospital in a metropolitan city in India between January 2022 and July 2023. All fractures were approached using a standard technique through a retromandibular incision and a transparotid route. The proximal segment was mobilized, reduced, and fixed to the ramus with two 2-mm miniplates—one along the posterior border and the other along the sigmoid notch border. Postoperative guiding elastics were placed for 2 weeks without any rigid maxillomandibular fixation. Patients were followed at weekly intervals for 1 month followed by monthly visits for 6 months. At each visit, mouth opening, occlusion, and facial nerve function were assessed. Scar quality was assessed by both examiner and patient using the Patient and Observer Scar Assessment Scale (POSAS) scoring system.

Results A total of 25 subcondylar fractures in 20 patients were fixed using the retromandibular approach. Nineteen were male and 1 was female. The etiology of trauma was road accident (8), fall from train (2), fall from height (5) and assault (5). Fifteen patients had unilateral fractures while 5 had bilateral fractures. All patients had concomitant fractures of the mandibular arch which were also fixed. The interval between trauma and surgery ranged from 5 to 28 days. All patients had premature molar contact on the side of fracture with anterior open bite. Mouth opening ranged from 1.5 to 2.5 cm. All the fractures could be fixed using the retromandibular approach. None of the patients developed any facial nerve dysfunction or salivary leak. The occlusion was restored to pretrauma status in all patients and was stable at 6 months' follow-up. Mouth opening ranged from 3.5 to 4 cm.

Keywords
- retromandibular
- condylar
- condyle fracture
- open bite

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The POSAS observer score ranged from 09 to 19 with a mean score of 12.7. The POSAS patient score ranged from 17 to 28 with a mean score of 20.3 revealing that all patients were extremely happy with the scar.

Conclusion The minimal access retromandibular approach to the vertical mandible is a versatile technique enabling accurate reduction and fixation of fractures of the vertical segment of the mandible with good long-term functional and cosmetic results.

Introduction

The mandible, the only mobile bone in the skull with its unique articulation with the skull base, plays a vital role in mastication, speech, deglutition, and cosmesis. Therefore, mandibular fractures following trauma can cause significant morbidity. The two condyles and the subcondylar region of the mandible are innate areas of weakness and hence most commonly fractured.[1] The posterior border of the vertical segment of the mandible is in close proximity to the parotid gland, the extracranial facial nerve, and its proximal branches. Additionally, the upper half of the mandible is in close relation with internal maxillary artery and pterygoid plexus of veins in the infratemporal fossa.[2,3] Any approach to this region of the mandible is fraught with risk of trauma to these vital structures with resultant paresis/paralysis of facial muscles and/or torrential bleeding. While in the years gone by, closed treatment of such fractures was the norm,[4] with better understanding of the anatomy and complications associated with closed treatment as well as better tools for osteosynthesis, open reduction and internal fixation (ORIF) of these fractures is generally recommended.[5,6] The sheer volume of literature on the management of condylar/subcondylar fractures is a testament to the lack of general consensus regarding an ideal approach to this region. We report our experience with minimal access fixation of fractures in the vertical segment of the mandible through the retromandibular approach.

Materials and Methods

This is a retrospective study of all patients who underwent ORIF for fractures of the vertical mandible (condyle, subcondylar region, ramus) using a retromandibular approach at a tertiary care hospital in a metropolitan city in India between January 2022 and July 2023. The hospital records of all patients who presented with fractures of the vertical mandible were retrieved.

Inclusion criteria:

1. Age $>$ 18 and $<$ 60 years
2. Patients who underwent ORIF of fractures of the vertical mandible using the retromandibular approach described
3. Follow-up data of at least 6 months

Exclusion criteria:

1. Edentulous patients
2. Patients with concomitant maxillary fractures (Le Fort 1, 2 or palatal fractures) which could influence the occlusal results

Surgical Technique (►Figs. 1 and 2)

Under general anesthesia, arch bars are applied to both jaws. Maxillomandibular fixation (MMF) is established based on the wear facets on the dentition. The noncondylar fractures are exposed and fixed using miniplates. Once the dental arch is reestablished the condylar fracture is exposed and fixed as follows. Rigid MMF (done with SS wire loop) is removed and replaced with dental elastics—this helps in maintaining the occlusion while at the same time allowing downward traction on the distal fragment often needed for reduction of displaced condylar fractures.

A surgical headlight is an essential tool to ensure unhindered illumination of the operative field. The head is turned to the opposite side. The posterior border and angle of the mandible are marked. A 2.5-cm incision is marked beginning at the tip of the ear lobe just behind the posterior border. The incision line is infiltrated with diluted adrenaline solution. Incision is deepened through skin and subcutaneous tissue and through the thin layer of superficial musculoaponeurotic system (platysma) to expose the parotid capsule. The parotid capsule is incised sharply in the line of the incision and also slightly beyond cranially and caudally by retracting the skin/platysma flap. The posterior border of the mandible is

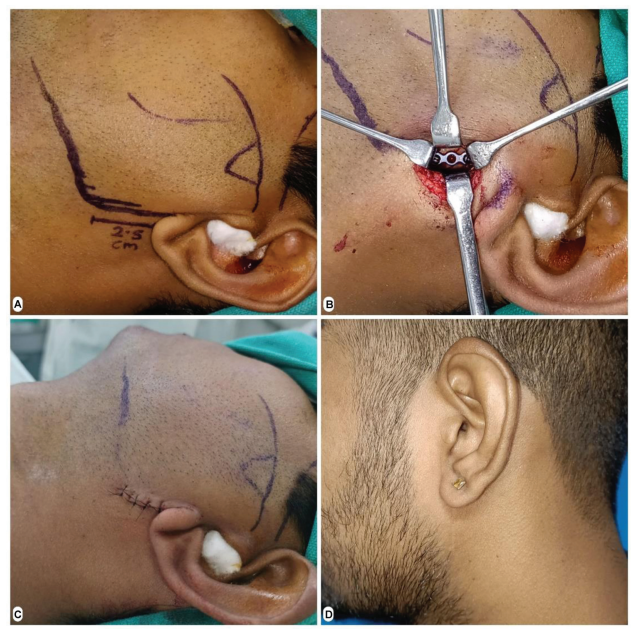

Fig. 1 Intraoperative and postoperative pictures of fixation of left subcondylar fracture using minimal access retromandibular approach. (**A**) Surface marking of mandible and the incision. (**B**) Miniplate fixed along posterior border. (**C**) Sutured incision at the end of surgery. (**D**) Well-healed imperceptible scar 8 months postoperatively.

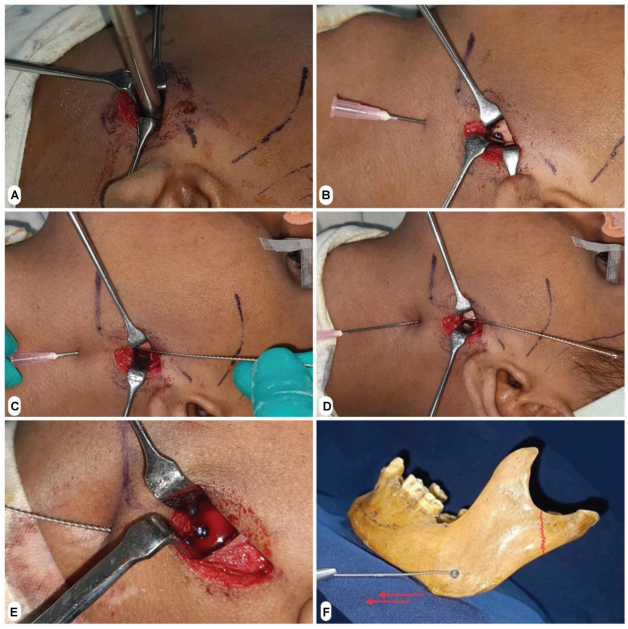

Fig. 2 SS wire loop technique for providing traction on the distal fragment. (**A**) Inserting a 2 mm × 8 mm screw near the angle keeping the screw-head slightly above the bone. (**B**) Inserting a 16-G hypodermic needle into the dissected subperiosteal pocket from the submandibular region. (**C**) Passing a loop of 24-G SS wire through the incision into the bevel of the needle. (**D**) Railroading the wire loop with the needle through the submandibular puncture. (**E**) Passing the loop around the screw head. (**F**) Representation of the traction provided at the angle with the wire loop.

palpated to visualize the direction of transparotid dissection needed. This part of the dissection is done under magnification. Using a hemostat or blunt-tipped scissors, dissection proceeds toward the posterior border by opening the instrument tips in the direction of the nerve fibers. No attempt is made to look for the facial nerve branches; however, any branches that are seen are dissected for the length of the incision and retracted. Once the pterygomasseteric sling is seen, it is incised sharply to expose the posterior border. A periosteal elevator is used to expose the ramus up to the angle inferiorly and the fracture line superiorly. The proximal fragment may be within the retracted skin muscle flap and must be freed using an elevator. If the posterior border can be aligned by manipulation, a miniplate is inserted along the border with two bicortical screws on either side.

If inferior traction on the distal fragment is needed for reduction, a 2-mm screw is inserted near the angle. A loop of 24-G SS wire is brought into the dissected area by railroading on a 16-G needle and passed around the screw. The other end of the wire loop is held with a strong hemostat and used for downward traction (►**Fig. 2**). In patients with condylar neck fractures presenting late (more than 3 weeks), it may not be possible to relocate a small medially displaced, dislocated proximal fragment into its correct position due to the attendant fibrosis. In these cases, using this wire loop technique to pull the distal fragment inferiorly, the proximal fragment can be delivered out after freeing its soft tissue attachments and fixed using extracorporeal fixation of miniplate.

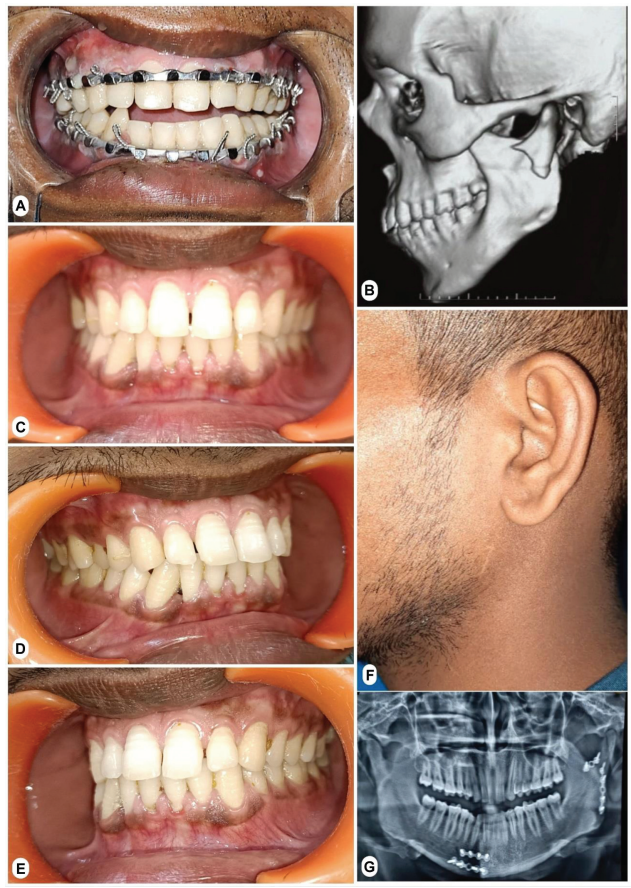

Fig. 3 Pre- and postoperative pictures and radiographs of a 24-year-old male patient operated for open reduction and internal fixation (ORIF) of left subcondylar and right parasymphyseal fracture. (**A**) Preoperative occlusal photograph showing premature molar contact on the left side with anterior open bite. (**B**) Computed tomography (CT) scan showing left subcondylar fracture with lateral override. (**C**–**E**) Postoperative occlusal pictures showing restoration of normal occlusion. (F) Postoperative picture showing faint scar in the retromandibular region. (**G**) Postoperative orthopantomogram (OPG) showing good fixation of condylar fragment with 2 miniplates.

Once the posterior border plate is fixed, the available area on the proximal fragment is reassessed for the possibility of fixing a second miniplate; in cases with fracture at the neck it may not be possible. If there is sufficient space, another miniplate is fixed along the anterior border of the fracture. The elastics are removed and mouth opening and occlusion are rechecked and confirmed.

The parotid capsule is closed with absorbable sutures and the incision is closed in layers; no drains are used. Postoperatively, compression is maintained with an elastic pressure garment. Guiding elastics are placed without any rigid MMF. The elastics are reduced after 1 week and removed completely after 2 weeks. The patients are advised functional jaw mobility exercises including mouth opening, side-to-side movements, and protrusive movements within pain threshold after 1 week. The arch bars are maintained for 3 to 4 weeks in case guiding elastics are needed.

Postoperative follow-up is at weekly intervals for 1 month, then monthly for 6 months, and then at 1 year postoperatively. At each visit, the following findings are noted and

recorded—any adverse symptoms, maximal mouth opening, occlusion, facial nerve function, and scar assessment. Digital orthopantomogram (OPG) is obtained at 6 months postoperatively. Mouth opening was measured as interincisal distance (in cm) at maximal mouth opening.

Scar assessment was done using the Patient and Observer Scar Assessment Scale (POSAS) after obtaining appropriate permission. It is a reliable and reproducible instrument available for the evaluation of scars.[7] The linear scar version of the POSAS 3.0 was used for evaluation. Each item of the POSAS 3.0 is rated on a 5-point score. The observer scale has 9 items (minimum 9 and maximum score of 45) and patient scale has 17 items (minimum 17 and maximum score of 85) and in both scales higher the score, poorer is the scar quality.

For all patients who were included, the following data was retrieved—demographics, date of trauma, date of surgery, details of trauma, associated systemic trauma, symptoms at presentation, mouth opening, and occlusion at presentation, preoperative computed tomography (CT) scan findings including pattern of subcondylar fracture, postoperative CT scan, and OPG, postoperative mouth opening, occlusion, facial nerve function and scar assessment at last visit, postoperative complications, and any revision surgeries.

The data was compiled into a master chart and analyzed.

Results

In the study period, a total of 24 patients underwent ORIF of mandibular fractures using the approach described. Two of these were panfacial fractures, 1 was edentulous, and 1 did not have adequate follow-up data, so these were excluded.

A total of 20 patients with 25 subcondylar fractures were included in the study—19 male and 1 female. Fifteen patients had unilateral fractures of the subcondylar region (right: left = 06:09) and 05 had bilateral fractures. The modes of trauma included road accidents (08/40%), fall from train (02/10%), fall from height (05/25%), and assault (05/25%). The interval between trauma and surgery ranged from 5 to 28 days. Four patients underwent surgery late, that is, more than 3 weeks from the date of trauma.

►**Table 1** shows the fracture pattern according to Lindahl[8] classification and the associated fractures. There were 18 subcondylar and 7 neck fractures. Twenty-three of the 25 fractures had overriding of the proximal fragment—9 medial and 14 lateral. Six of the fractures were associated with dislocation of the condylar head from the fossa. All patients had associated mandibular fractures in other locations including parasymphyseal 16 (right 09, left 07), body (03), and angle (01). Two patients had comminuted fractures of the vertical mandible involving two or more separate fracture lines.

All patients included in the study exhibited premature molar contact on the side of the fracture with resultant open bite anteriorly; the open bite was pronounced in the bilateral cases.

All the patients underwent ORIF of the fractures in the vertical segment using the technique described. Two of the 4 patients presenting late ($\geq$ 3 weeks) needed extracorporeal fixation technique for the neck fractures. None of the patients developed facial nerve weakness, salivary leak/fistula, or scar dehiscence at any stage during the postoperative course. At 6 months' follow-up, the mouth opening in all patients was more than 3.5 cm and the occlusion had been restored to the pretrauma status (►**Figs. 3**–**8**). The postoperative CT scan and OPG showed good restoration of anatomy (►**Figs. 3** and **5**-**8**), and in unilateral cases (►**Figs. 3** and **6**-**8**) the restored anatomy can even be compared with the normal side.

Table 1 The pattern of condylar fractures (Lindahl[8] classification) in the study along with the associated mandibular fractures

Fracture level	Cases	Side of fracture	Patients
Condylar Neck	07	Right	06
Subcondylar region	18	Left	09
Total	25	Bilateral	05
		Total patients	20
Fracture displacement			
Angulation with medial override	09	**Concomitant fractures**	**Patients**
Angulation with lateral override	14	Right parasymphyseal	9
Angulation without override	02	Left parasymphyseal	7
Total	25	Body	3
		Angle	1
Condylar head displacement		Total	20
No displacement	12		
Mild/moderate displacement	07		
Dislocation	06	Additional fracture lines in ramus on same side	2
Total	25		

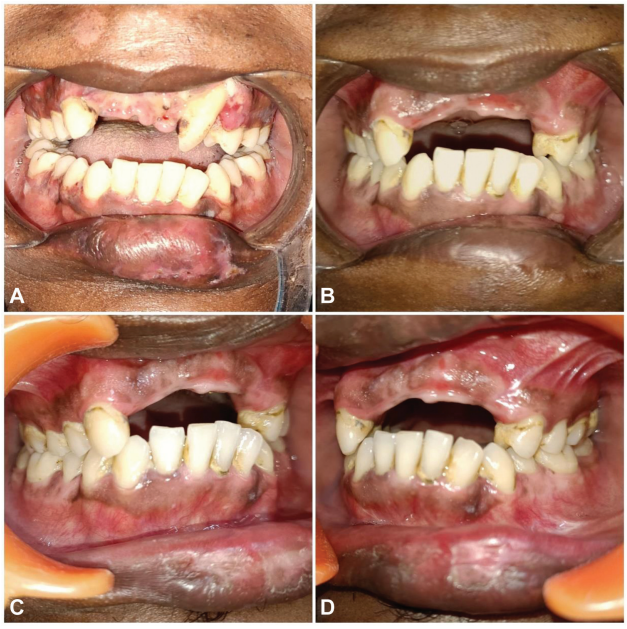

Fig. 4 Pre- and postoperative occlusal pictures of a 34-year-old male patient operated for open reduction and internal fixation (ORIF) of bilateral condylar neck and symphyseal fracture. (**A**) Preoperative occlusal photograph showing premature molar contact on both sides with open bite. (**B**–**D**) Postoperative occlusal pictures showing restoration of normal molar occlusion.

The POSAS observer score (minimum 9; maximum 45) ranged from 09 to 19 with a mean score of 12.7.

The POSAS patient score (minimum 17; maximum 85) ranged from 17 to 28 with a mean score of 20.3, revealing that all patients were extremely happy or happy with the scar.

Seven patients exhibited mild deviation of the mandible to the side of the fractured condyle at extremes of mouth opening but did not complain about the same.

Discussion

The mandible is the only mobile bone in the craniofacial skeleton. In order to fulfill its role in mastication, deglutition, and phonation, it has evolved a unique three-dimensional anatomy—a strong arch form bearing dentition to occlude with the corresponding maxillary teeth, a pair of ellipsoid condyles with narrow necks articulating with the glenoids of the skull base at specialized ginglymal joints enabling a wide range of movements, and a pair of fairly wide thin rami bridging these two functional units. This assembly allows the human mandible to sustain the greatest forces generated anywhere in the human body, that is, masticatory, while also allowing subtle movements for animation and speech.

The subcondylar region is one of the most common sites for fractures of the mandible causing disabling malocclusion, mouth opening problems, and deviation of the lower jaw.[9] The condylar neck is in close proximity to several vital structures which may be injured while attempting to reduce and fix fractures[10] in this region. The trunk of the facial nerve, as it exits the stylomastoid foramen, enters the parotid gland and arborizes into its terminal divisions within the superficial lobe;

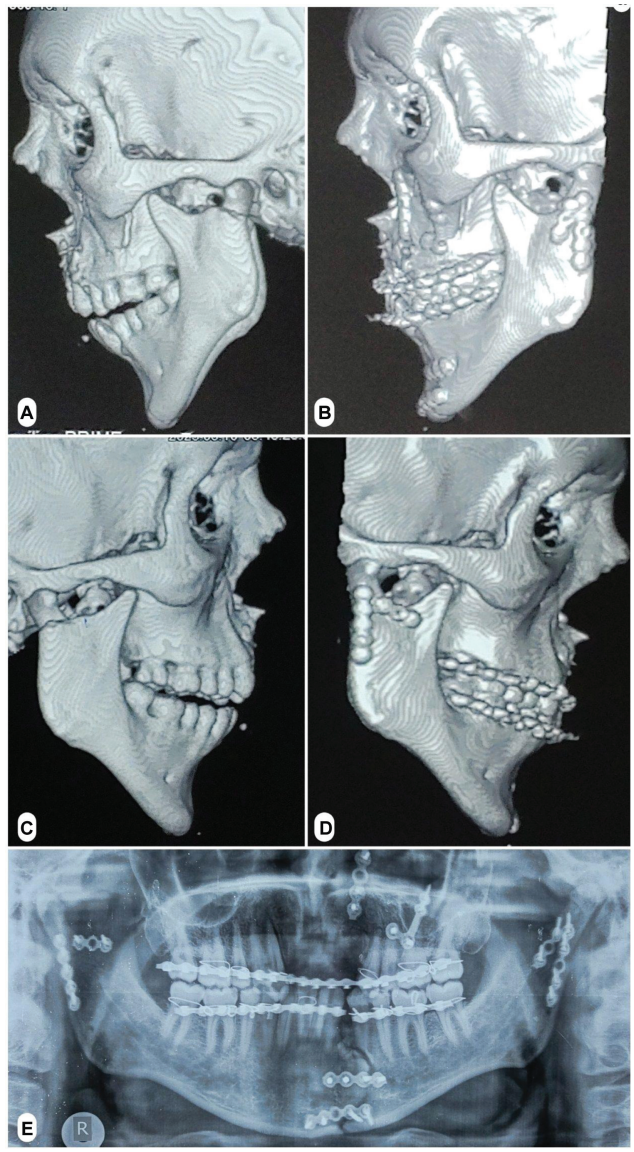

Fig. 5 Pre- and postoperative radiographs of the patient in Fig. 4. (**A**, **C**) Preoperative computed tomography (CT) scan showing left condylar neck fracture and right subcondylar fracture with medial override in both. (**B**, **D**) Postoperative CT scan showing the condylar fractures fixed with 2 miniplates. (**E**) Postoperative orthopantomogram (OPG) showing the reduced condylar fractures and the symphyseal fracture fixed with 2 miniplates. Note that this patient also had localized fractures of the left zygomaticomaxillary buttress and nasomaxillary buttress but not a complete Le Fort fracture of the maxillary arch.

here, the posterior border of the mandible is encased between the two lobes of the parotid gland. The internal maxillary artery courses medial to the condylar neck. Thus, any attempt to manipulate, reduce, and fix subcondylar fractures risks damage to the facial nerve, parotid gland, or the internal maxillary artery. The primary concern with any approach to these fractures is avoidance of facial nerve injury, salivary fistula/leak, and torrential bleeding.

Several approaches to these difficult fractures have been described. The preauricular approach has an excellent cosmetic outcome but only affords access to the condylar head and neck.[10,11] The intraoral approach avoids cutaneous scars

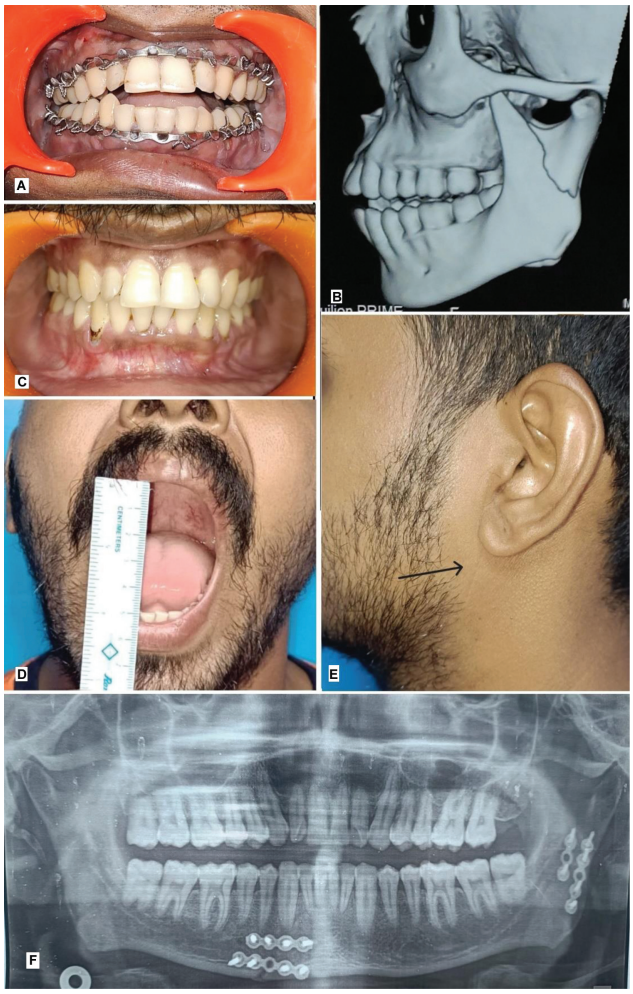

Fig. 6 Pre- and postoperative pictures and radiographs of a 26-year-old male patient operated for open reduction and internal fixation (ORIF) of left subcondylar and right parasymphyseal fracture. (**A**) Preoperative occlusal photograph showing anterior open bite. (**B**) Computed tomography (CT) scan showing left subcondylar fracture. (**C**) Postoperative picture showing restoration of normal occlusion. (**D**) Postoperative picture showing normal mouth opening. (**E**) Almost imperceptible scar in the retromandibular region. (**F**) Postoperative orthopantomogram (OPG) showing good restoration of mandibular height compared to right side.

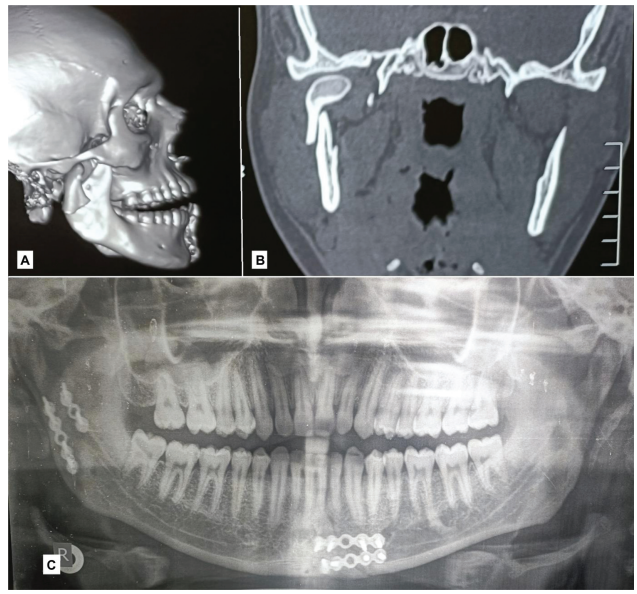

Fig. 7 Pre- and postoperative radiographs of a 22-year-old male patient operated for open reduction and internal fixation (ORIF) of right subcondylar and left parasymphyseal fracture. (**A**, **B**) Preoperative computed tomography (CT) scan showing right subcondylar fracture with dislocation of condylar head. (**C**) Postoperative orthopantomogram (OPG) demonstrating reduction and 2-plate fixation of the condylar fragment.

completely but suffers from limited access and visualization and need for specialized instrumentation.[10,12–14] The submandibular approach[10,15] provides only an oblique access with difficulty in fixing fractures higher up on the ramus. The transmasseteric approach[10,16] needs a longer incision so that the skin flap can be retracted anteriorly past the parotid gland for direct perpendicular access to the fracture site.

The retromandibular approach to the mandible was described by Hinds and Girotti[17] in 1967 primarily as an access for a vertical subcondylar osteotomy. This was done as an elective procedure in an otherwise intact mandible with controlled osteotomy cuts below the sigmoid notch. Over the years, several authors[10,18,19] have described the use of this incision for exposure and fixation of subcondylar fractures notably Ellis and Dean.[10] However, most authors also reported complications such as transient/permanent facial nerve weakness and salivary fistula/sialocele. Also, although Hinds and Girotti's original description limited the length of the incision to 2.5 cm, most subsequent publications demonstrate incisions of at least 3 cm or longer often reaching or going beyond the mandibular angle.

In a study involving 38 patients with unilateral condyle fractures fixed using the retromandibular transparotid approach, Sikora et al[18] concluded that this approach allows for direct visualization of the fracture providing proper reduction and osteosynthesis. They reported 3 cases of partial paresis of the facial nerve, plate fracture in 2 patients (single-plate technique), and loosening and displacement of screws in 4 patients.

Yang and Patil[19] prospectively analyzed 42 patients with 48 condylar neck or subcondylar fractures operated by the retromandibular approach and fixed with a single 2–mm miniplate fixation system. They reported three cases of suboptimal occlusal status, two cases of hematoma that were drained and resolved, eight patients with facial nerve weakness which resolved in a few weeks, and three cases of salivary fistulae that resolved after treatment.

In a retrospective review of 93 unilateral condylar fractures fixed using this approach, Ellis et al[20] reported 3 cases of salivary fistula and 16 cases of transient facial nerve paresis. They concluded that surgical complications of open treatment of condylar process fractures that lead to permanent dysfunction or deformity are uncommon. Similarly, Bouchard and Perreault[21] retrospectively analyzed 108 patients with 118 subcondylar fractures operated by this approach and reported 4 salivary fistula, 2 sialoceles, and 1 Frey syndrome.

In our study, none of the patients developed transient or permanent facial nerve weakness or salivary leak/fistula.

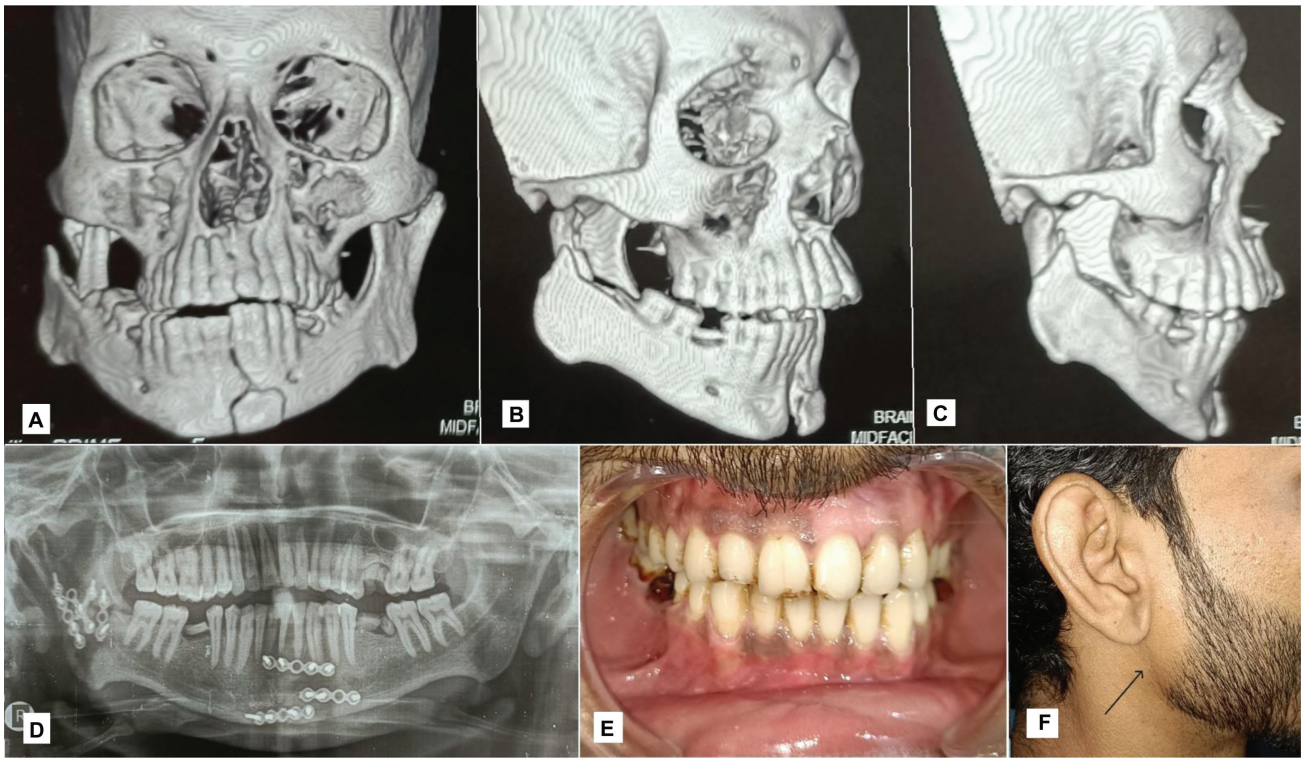

Fig. 8 Pre- and postoperative pictures and radiographs of a 23-year-old male patient operated for open reduction and internal fixation (ORIF) of comminuted fracture of right ramus/condyle and left parasymphyseal region. (**A–C**) Preoperative computed tomography (CT) scan showing comminution of right ramus with vertical fracture line passing through sigmoid notch and additional horizontal fracture through the ramus and subluxation of condylar head. (**D**) Postoperative orthopantomogram (OPG) showing fixation of ramus/condyle and parasymphyseal fractures with 3 miniplates each. (**E**) Postoperative picture showing restoration of normal occlusion. (**F**) Postoperative picture showing faint scar in the retromandibular region.

This could be due to our protocol of using magnification during the initial transparotid dissection to identify any facial nerve branches and protect them. Our SS wire loop technique allows us to provide traction to the distal fragment without any additional skin retraction, thus avoiding traction injury to the facial nerve twigs. Also, we take care to approximate the parotid capsule with absorbable sutures and provide compression at the surgical site which may prevent or seal any subclinical salivary leaks.

Biomechanical studies[22–24] have conclusively proven the benefits of two miniplate fixation of the condylar region for sustaining mechanical loads. This approach provides sufficient access to enable two-plate fixation in the vertical mandible. We have not encountered any instances of plate failure/fracture.

We believe any extension of the scar beyond the mandibular angle makes the scar conspicuous. Hence, we limit our retromandibular incision to 2.5 cm. None of the series reports any cases of comminuted fractures managed by the same approach. The retromandibular approach provides excellent access to the vertical mandible from the neck right up to the angle and also the sigmoid notch enabling two-plate fixation of these fractures. Also, the access is direct/perpendicular and not oblique. We could achieve adequate reduction and fixation with multiple plates in comminuted ramus and condyle fractures without extending the incision. Using the technique described by Ellis and Dean,[10] this approach can also be used for fixation of high condylar fractures.

If a subcondylar fracture is not reduced early, the displaced proximal fragment can get "gummed" in an abnormal position due to organizing hematoma and fibrous tissue. In addition, contracted soft tissue holds the distal fragment in a higher position and makes reduction extremely difficult especially in medially displaced fractures. Using our technique of railroading a loop of SS wire around a screw at the mandibular angle, we can effectively provide inferior traction on the distal fragment without any additional incisions. This creates additional space for dissecting the proximal fragment and reducing it into position.

In patients with *high* fractures presenting late (more than 3 weeks), it may not be possible to relocate a small medially displaced, dislocated proximal fragment into its correct position due to the attendant fibrosis. In these cases, an extraoral vertical ramus osteotomy (EVRO) has been described to access the medially displaced proximal fragment followed by extracorporeal fixation.[25,26] Using the wire loop traction technique to pull the distal fragment inferiorly, the proximal fragment can be delivered out after freeing its soft tissue attachments and fixed extracorporeally without the need for a vertical ramus osteotomy. Thus, the dislocated condylar fragment is fixed to the vascular proximal bone unlike with EVRO where it is fixed to an osteotomized avascular segment; this may enhance fracture healing and final survival of the condylar piece.[27,28] In our series, we were able to achieve

adequate reduction and fixation even in cases presenting late (more than 3 weeks after trauma) without extending the incision.

We assessed the postoperative scars by a validated scar assessment scoring system (POSAS) which revealed good outcomes in all cases.

Conclusion

The minimal access retromandibular approach to the vertical mandible is an excellent technique for reduction and fixation of fractures in this difficult region of the mandible with good long-term functional and cosmetic results.

Funding
None.

Conflict of Interest
None declared.

References

1 Halazonetis JA. The 'weak' regions of the mandible. Br J Oral Surg 1968;6(01):37–48
2 Odaka K, Matsunaga S. Course of the maxillary vein and its positional relationship with the mandibular ramus require attention during mandibuloplasty. J Craniofac Surg 2020;31(03): 861–864
3 Orbay H, Kerem M, Ünlü RE, Cömert A, Tüccar E, Şensöz Ö Maxillary artery: anatomical landmarks and relationship with the mandibular subcondyle. Plast Reconstr Surg 2007;120(07):1865–1870
4 Ellis E. Indications for open reduction and closed reduction treatment. J Oral Maxillofac Surg 2004;62:12–13
5 Ellis E III, Simon P, Throckmorton GS. Occlusal results after open or closed treatment of fractures of the mandibular condylar process. J Oral Maxillofac Surg 2000;58(03):260–268
6 Eckelt U, Schneider M, Erasmus F, et al. Open versus closed treatment of fractures of the mandibular condylar process-a prospective randomized multi-centre study. J Craniomaxillofac Surg 2006;34(05):306–314
7 van de Kar AL, Corion LUM, Smeulders MJC, Draaijers LJ, van der Horst CM, van Zuijlen PP. Reliable and feasible evaluation of linear scars by the Patient and Observer Scar Assessment Scale. Plast Reconstr Surg 2005;116(02):514–522
8 Lindahl L. Condylar fractures of the mandible. I. Classification and relation to age, occlusion, and concomitant injuries of teeth and teeth-supporting structures, and fractures of the mandibular body. Int J Oral Surg 1977;6(01):12–21
9 Barde D, Mudhol A, Madan R. Prevalence and pattern of mandibular fracture in Central India. Natl J Maxillofac Surg 2014;5(02): 153–156
10 Ellis E III, Dean J. Rigid fixation of mandibular condyle fractures. Oral Surg Oral Med Oral Pathol 1993;76(01):6–15
11 Yabe T, Tsuda T, Hirose S, Ozawa T. Preauricular transparotid approach to mandibular condylar fractures without dissecting facial nerves. J Craniofac Surg 2013;24(04):1365–1367
12 Alagarsamy R, Lal B, Arangaraju R, et al. Nonendoscopic intraoral approach for condylar fracture management-a systematic review. Oral Surg Oral Med Oral Pathol Oral Radiol 2023;135(05): 596–613
13 Wilde F. Intraoral endoscopic approach for treatment of condylar fractures of the mandible. In: Bonanthaya K, Panneerselvam E, Manuel S, Kumar VV, Rai A, eds. Oral and Maxillofacial Surgery for the Clinician. Singapore: Springer; 2021
14 Schön R, Gutwald R, Schramm A, Gellrich NC, Schmelzeisen R. Endoscopy-assisted open treatment of condylar fractures of the mandible: extraoral vs intraoral approach. Int J Oral Maxillofac Surg 2002;31(03):237–243
15 Nam SM, Lee JH, Kim JH. The application of the Risdon approach for mandibular condyle fractures. BMC Surg 2013;13:25
16 Narayanan V, Ramadorai A, Ravi P, Nirvikalpa N. Transmasseteric anterior parotid approach for condylar fractures: experience of 129 cases. Br J Oral Maxillofac Surg 2012;50(05):420–424
17 Hinds EC, Girotti WJ. Vertical subcondylar osteotomy: a reappraisal. Oral Surg Oral Med Oral Pathol 1967;24(02):164–170
18 Sikora M, Olszowski T, Sielski M, Stąpor A, Janiszewska-Olszowska J, Chlubek D. The use of the transparotid approach for surgical treatment of condylar fractures - own experience. J Craniomaxillofac Surg 2015;43(10):1961–1965
19 Yang L, Patil PM. The retromandibular transparotid approach to mandibular subcondylar fractures. Int J Oral Maxillofac Implants 2012;41(04):494–499
20 Ellis E III, McFadden D, Simon P, Throckmorton G. Surgical complications with open treatment of mandibular condylar process fractures. J Oral Maxillofac Surg 2000;58(09):950–958
21 Bouchard C, Perreault MH. Postoperative complications associated with the retromandibular approach: a retrospective analysis of 118 subcondylar fractures. J Oral Maxillofac Surg 2014;72(02): 370–375
22 Choi BH, Kim KN, Kim HJ, Kim MK. Evaluation of condylar neck fracture plating techniques. J Craniomaxillofac Surg 1999;27(02): 109–112
23 Tominaga K, Habu M, Khanal A, Mimori Y, Yoshioka I, Fukuda J. Biomechanical evaluation of different types of rigid internal fixation techniques for subcondylar fractures. J Oral Maxillofac Surg 2006;64(10):1510–1516
24 Asprino L, Consani S, de Moraes M. A comparative biomechanical evaluation of mandibular condyle fracture plating techniques. J Oral Maxillofac Surg 2006;64(03):452–456
25 Boyne PJ. Free grafting of traumatically displaced or resected mandibular condyles. J Oral Maxillofac Surg 1989;47(03):228–232
26 Hammond D, Arafat A, Bainton R. Revisiting the Boyne procedure. Med J Armed Forces India 2012;68(01):39–41
27 Park SY, Im JH, Yoon SH, Lee DK. A follow-up study on extracorporeal fixation of condylar fractures using vertical ramus osteotomy. J Korean Assoc Oral Maxillofac Surg 2014;40(02):76–82
28 Gupta MV, Sahoo NK. Extracorporeal fixation of displaced mandibular condylar fracture: viable option. Med J Armed Forces India 2009;65(03):229–231

