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CLINICAL STUDY

Comparison of Approaches for the Rigid Fixation of Sub-Condylar Fractures

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Abstract
Aim The objective of this study was to compare the rate of complications encountered on using different incisions to access the fracture site for the open reduction and internal fixation of isolated subcondylar fractures. The parameters evaluated are: the occurrence of salivary fistula, infection, and injuries to the seventh facial nerve. An assessment of the surgical scar was also undertaken.
Materials and Methods 20 patients who met the previous criteria and were willing to participate in the study were placed (five each) into the pre-auricular, submandibular, retromandibular transparotid or retromandibular transmassetric group based on the incision scar they selected after a description of the operation and being explained about the possible complications.
Results and Conclusion Comparison of the complications could not ascertain the superiority of any approach over the other since the outcomes were not statistically significant. However, judging by operator and assistants' subjective assessment, the retromandibular approaches seem to provide a more direct visual field and an almost straight line access for the fixation of the fracture. The transmassetric approach seems to be a safer approach since the nerves encountered can be visualized and avoided.

Keywords Subcondylar fracture · Transmassetric · Transparotid · Submandibular · Preauricular

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Introduction

Subcondylar fractures most commonly result in medial dislocation of the head of the condyle with a subsequent loss of ramal height that causes open bite and facial asymmetry. Optimal osteosynthesis of such a fracture can be obtained only by rigid internal fixation after anatomic reduction. Studies by Ellis and Throckmorton published in 2000 conclude that patients who had ORIF had better restitution of condyle position and reinforcement of their fractured condylar processes. Patients who underwent closed reduction had displacement of the condylar process in the coronal plane, which persisted for up to 1 year, and had a significant shortening of the mandibular ramus on the fractured side [1–3] though bite forces did not show any significant difference [4].

In order to achieve anatomic reduction, it is essential to gain complete exposure of the surgical field for direct vision of the fractured ends and for mobilisation of the displaced segment. Distance between the incision line and the fracture level often necessitates tough and excessive retraction of tissues to gain adequate exposure leading to nerve injuries and tissue damage. Hence choice of surgical approach is of paramount importance in reducing post operative complications, especially while dealing with comparatively less accessible fracture sites like the subcondylar region. Since endoscopes are yet to gain popularity in the Indian scenario, conventional exposure techniques are the most common.

The commonly used access routes for the ORIF of a subcondylar fracture are: preauricular, submandibular, intraoral, and retromandibular incisions. The intraoral route is desirable since it avoids facial scarring but the exposure is limited and fixation requires trocar usage and dexterity. Therefore the extra oral route is the most commonly

selected one. However, each of these incision have varying degrees of complications reported due to the proximity to two vital structures namely the facial nerve and the parotid gland.

The purpose of this study was to compare the rate of complications encountered on using different incisions to access the fracture site for the open reduction and internal fixation of isolated subcondylar fractures. The parameters evaluated are: the occurrence of salivary fistula, infection, and injuries to the seventh cranial nerve. An assessment of the surgical scar was also undertaken together with the evaluation of the success of anatomic reduction.

Materials and Methods

All patients treated in the department of Oral and Maxillofacial Surgery at Sree Balaji Dental College and Hospital for unilateral fractures of the mandibular condylar process between Jan 2008–Dec 2010 were presented the chance to partake in this prospective study. Inclusion criteria for this investigational ethical review board-approved investigation were (1) unilateral sub-condylar fracture; (2) age 18–60 years; (3) without any medical complications; (4) dentulous with sufficient bilateral dentition to allow maxillomandibular fixation (MMF) and assessment of occlusal relationships; (5) no previous history of temporomandibular joint dysfunction or muscular or nervous problems; (6) without any significant pre-existing skeletal malocclusion; (7) no history of head injury, and (8) patient consent to participate. An attempt was made to examine the patients at 6 weeks and every 6 months after fracture treatment. Twenty cases of unilateral condylar fracture were chosen. Five patients each underwent each reduction and fixation through different approaches.

Treatment Groups

Twenty patients who met the previous criteria and were willing to participate in the study were placed (five each) into the pre-auricular, submandibular, retromandibular transparotid or retromandibular transmassetric group based on the incision scar they selected after a description of the operation and being explained about the possible complications. Archbars were placed on the maxillary and mandibular dentition. All other fractures of the mandible were rigidly stabilized by use of internal bone plate or screw fixation. All the patients underwent the surgery under general anesthesia through nasal intubation.

Surgical approach for the: Retromandibular Anterior Parotid Transmassetric Approach (Fig. 1a–1 h)

A 3–5 cm skin incision was made 1 cm below the radix of the auricular lobule to 5–15 mm above the angle along the posterior edge of the mandibular ramus. The subcutaneous tissue of the skin flap was raised forward to expose the anterior or top edge of the parotid myofascial layer. The subcutaneous tissues superficial to the superficial muscular aponeurotic system were dissected anterior and superior, aiming to the fracture. Then, the parotid myofascia was selectively stripped according to the different sites of the condylar fracture to pull the parotid tissue backward and expose the masseter and periosteum attached on the surface of the condylar process. The anterior edge of the parotid myofascia was mainly exposed; the parotid myofascia was pulled backward, and this protected the buccal branch of the facial nerve and the parotid duct. Next, with blunt dissection, the masseter muscular fibers were gently divided in a fashion that parallels the facial nerve fibers. Facial nerve branches were encountered in approximately 50% of the patients and were carefully protected with a retractor when present. Through the dissection of the masseter muscle, the mandibular periosteum was reached, incised, and elevated until the fracture stumps appeared. Between the buccal branch and parotid duct, the masseter and periosteum of the mandible were dissected to expose the fracture site.

Modified Preauricular Approach

A question mark-shaped incision was made beginning about a pinna's length away from the ear, antero superiorly just within the hair line and curving backwards and downwards well posterior of the main branches of the temporal vessels till it meets the upper attachment of the ear. The temporal incision was carried through the skin and superficial fascia to the level of the temporal fascia. The full depth of this fascia was reflected with the skin flap. Blunt dissection in this plane was carried downwards to a point about 2 cm above the malar arch where the temporal fascia splits. Starting at the root of the malar arch, an incision running at 45° upwards and forwards was made through the superficial layer of the temporal fascia. Once inside this pocket, the periosteum of the malar arch was safely incised and turned forward as one flap with the outer layer of temporal fascia, superficial fascia containing the nerves and skin. The pocket was developed anteriorly as far as the posterior border of the frontal process of the malar bone and posteriorly joined to the preauricular dissection which follows closely the cartilaginous external auditory

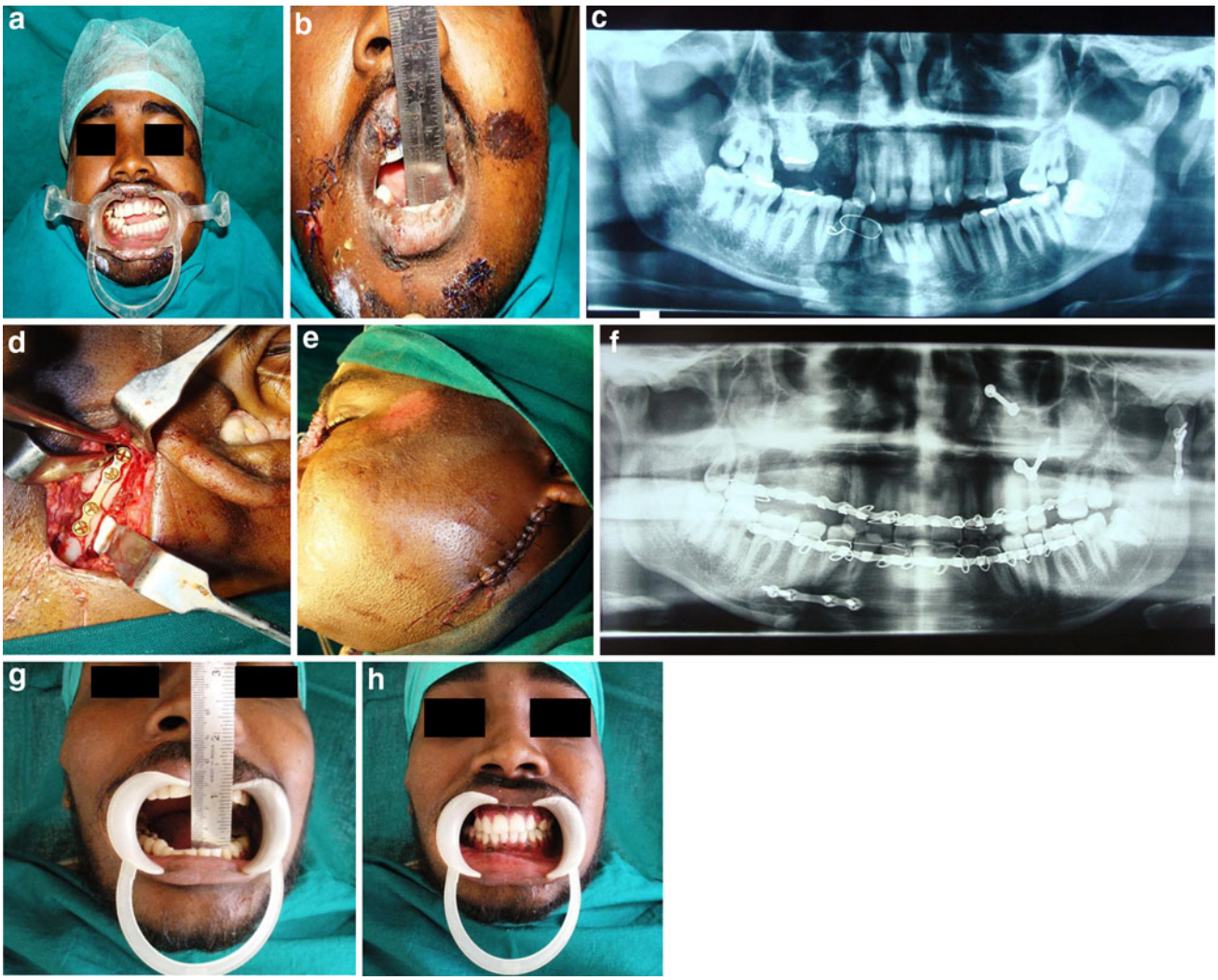

Fig. 1 Transmassetric approach. **a** Pre operative photo, **b** Pre operative mouth opening, **c** Pre operative OPG, **d** Exposure gained, **e** Wound closure, **f** Post operative OPG, **g** Post operative mouth opening, **h** Post operative occlusion

canal beneath the glenoid lobe of the parotid gland and the superficial temporal vessels. The auricular artery and the middle temporal artery when encountered were divided and ligated. Proceeding downwards from the lower border of the arch and articular fossa, the tissues lateral to the joint capsule were dissected and retracted and fracture site exposed.

The fracture segments were then mobilized, and the fracture was reduced. To facilitate reduction, a second operator assisted in retracting the angle inferiorly using digital pressure over the second mandibular molar tooth.

Fixation of the fractured condylar segment with mandibular segment was done using miniplate osteosynthesis in all the cases. After the placement of the plate on the planned site, the screws were placed with the screw holder and tightened thereby completing the rigid fixation. Once the plate was fixed stably, the wound was thoroughly irrigated and closed in layers. Postoperative antibiotics, analgesics and anti-inflammatory medications were prescribed. The patients were instructed not to apply any sort of pressure on the site of the surgery. Patients were instructed to have soft diet for the first 7 days and sutures were removed on the 7th post operative day. The patients were recalled for review up at 1 week intervals for a month and monthly intervals for next 1 year. Outcome measures involved each patient being examined according to standard protocol together with standardized radiographic assessment (Orthopantomogram) at the 6th week and thereafter every 6 months. No patient was placed into postsurgical inter-maxillary fixation. Instead, only training elastics were used to assist the patient to occlude into the pre-surgical occlusal relationship using single Class II elastic on the side of condylar process fracture.

Submandibular Group (Risdon)

A curvilinear incision approximately 4–5 cm is marked onto the skin with a marking pen at the region of the angle of the mandible approximately one finger-breadth inferior and posterior to the angle of the mandible. Dissection was carried out through subcutaneous fat and superficial fascia to reach the platysma muscle. The platysma was then incised to reach superficial layer of deep cervical fascia. The marginal mandibular branch of facial nerve, just deep to this layer was identified and preserved. Dissection was then carried through deep cervical fascia to the inferior border of mandible. The masseter muscle was sharply divided at the inferior border to expose bone. Muscle, periosteum and soft tissues were retracted superiorly to expose the fracture site.

Retromandibular Transparotid Approach (Hinds) (Fig. 2a–j)

The skin incision was placed, about 3–4 cm long, parallel to the posterior border of the mandible, commencing 0.5 cm below the earlobe. The dissection was carried out in the sub-dermal fat plane. The parotid capsule, which appears as a white glistening layer, was identified. The parotid gland was entered by incising the capsule. The gland was blunt dissected in an anteromedial direction towards the posterior border of the mandible. This was done by inserting a curved haemostat and spreading it open parallel to the expected direction of the branches of the facial nerve. The posterior border of the mandible was identified and the pterygomasseteric sling was incised. The masseter was stripped along with the periosteum from the angle of the mandible along the posterior border, as high as possible, exposing the fracture site with the help of suitable retractors. During closure, the layer that contains the parotid capsule was routinely closed very tightly by using a running horizontal 3–0 polyglactin suture. Sealing this layer is essential to prevent salivary fistulae from occurring. Drains were not placed when using this approach because of the possibility that they could increase the incidence of salivary fistulae.

Complications Assessed

Intraoperative

The following intraoperative details were tabulated: excessive hemorrhage, encounter with the facial nerve and overt damage to branches of the facial nerve.

Postoperative Wound Problems

The following postoperative details were tabulated: wound infection, defined as purulent drainage from the incision, Frey's syndrome, defined as perspiration of the skin of the preauricular area while eating, and salivary fistula, defined as a persistent clear drainage from the incision site.

Seventh Nerve Palsy

The patient's perception of the height and lateral position of the lips and perioral soft tissues from one side to the other were assessed to help decide whether a soft tissue asymmetry was present. They scored the facial soft tissue symmetry as (1) symmetric, (2) slightly asymmetric, or (3) obviously asymmetric. When an asymmetry was noted, the patients listed which side appeared "weak," and what facial structures were affected (i.e, lower lip, upper lip, periorbital areas).

Assessment of Surgical Scars

The character of any observed scar was scored as (1) no perceptible scar, (2) visible but thin and linear scar, (3) wide scar, and (4) hypertrophic scar or keloid. The color of the scar was scored as (1) not perceptible, (2) normal skin color, (3) white thin line (4) darker than surrounding skin, and (5) lighter than surrounding skin.

Results

The mean time from incision to skin closure, including fixation for all the procedures was 110 min (SD 15; range 75–210) in 20 surgeries. There was no significant difference in the time taken for any of the approaches. However, the submandibular incision took the shortest time for approaching the fracture, however, on calculation of the fixation and the suturing time, it was not statistically significant. Pre auricular incision, being slightly longer took a longer time for suturing, though it was not statistically significant. On an average the sub-mandibular incision approach took 100 min (SD 20, range 75–180), pre-auricular incision took 115 min (SD 10, range 85–210) transparotid incision took 110 min (SD 10, range 90–115 min) and transmassetric approach took 115 min (SD 10, range 110–120 min).

At least one of the facial nerve branches were seen in 14 of 20 cases (four submandibular, five transparotid, four transmassetric, two preauricular). The most frequently encountered was the marginal mandibular branch (10 cases; four submandibular, four transparotid, two transmassetric),

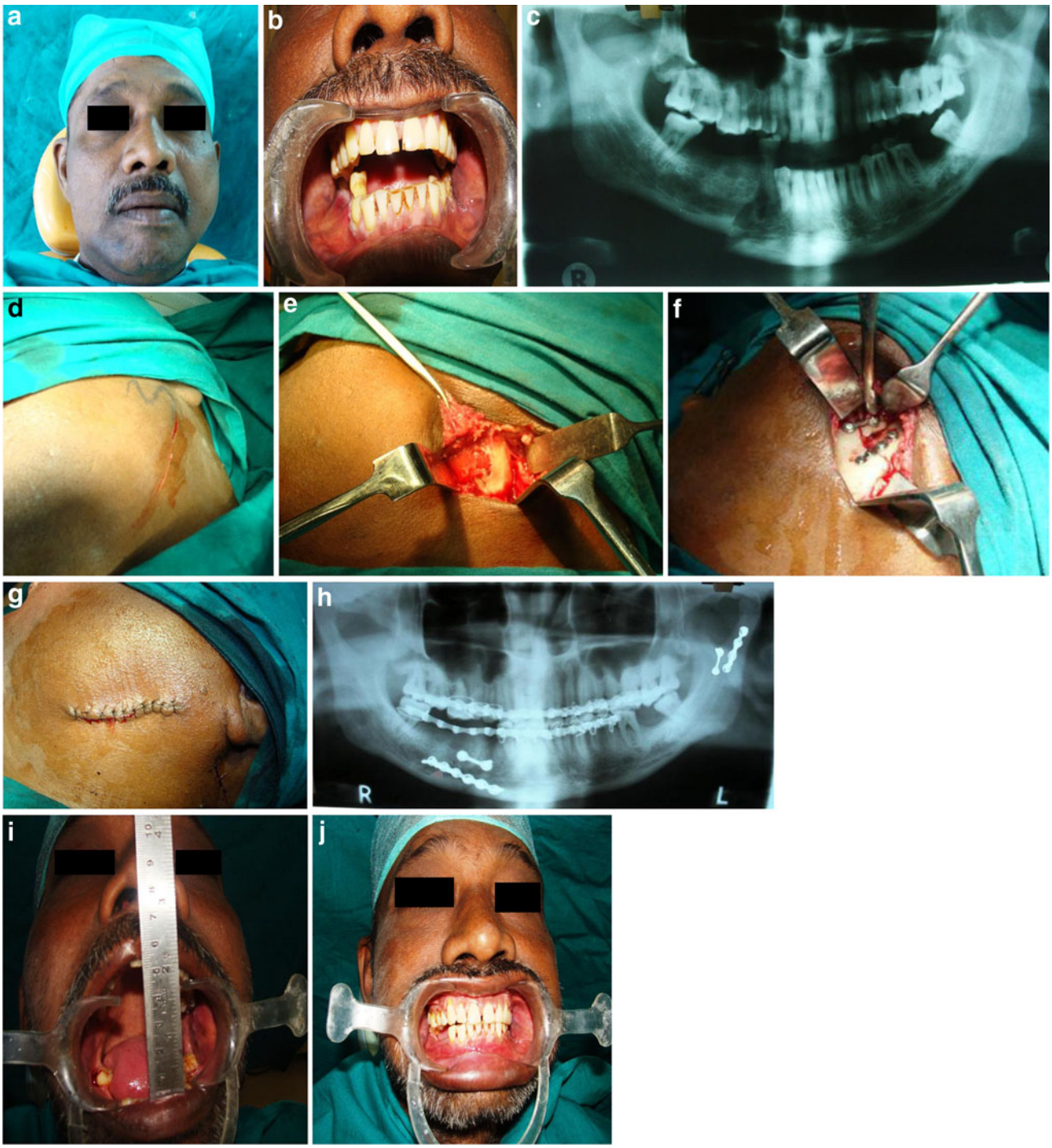

Fig. 2 Transparotid approach. **a** Pre operative photo, **b** Pre operative occlusion, **c** Pre operative OPG, **d** Incision, **e** Exposure, **f** Exposure and rigid fixation, **g** Wound closure, **h** Post operative OPG, **i** Post operative mouth opening, **j** Post operative occlusion

followed by the buccal branches (6 cases; four transparotid, two transmassetric). When both were encountered, the dissection to the mandible was performed between the manually retracted buccal and marginal mandibular branches. None of the nerves encountered were severed, however, they were often stretched to a great extent during surgery.

Intraoperative bleeding was moderate and none of the patients required a transfusion post operatively. In two cases, the retromandibular vein was tied and sectioned and it was retracted posteriorly in the four others. Internal maxillary artery was not encountered in any of the cases. Two of the transparotid and one of the transmassetric cases

developed parotid fistulae. They responded well to occlusive pressure dressings and antisialogogues. The fistulae regressed in 3 weeks. There were no cases of wound infection, Frey's syndrome, pus discharge, abscess or cellulitis.

Anatomic reduction was achieved in all cases. All patients achieved good occlusion with no open bite within 2 weeks. Ramal symmetry was maintained. None of the patients complained of any swelling, tenderness or discomfort 4 weeks after the surgery.

7 cases of facial soft tissue asymmetry during animation were noticed. three of the pre auricular group had difficulty in closing the eye, which resolved within the 6 weeks to absolute normalcy. The upper lip was involved in 3 cases (one submandibular, two transparotid). Lower lip asymmetry was reported by one patient who underwent submandibular incision.

All five of the patients who underwent pre auricular incision were satisfied with their scar (not perceptible scar) however, three were distressed when periorbital weakness was encountered. The scar was imperceptible and was hidden in the hair line. One of the submandibular incision scars thickened and formed a white, thickened scar. (wide scar lighter than surrounding skin). The three cases which developed parotid fistulae also developed wide scars, darker than the surrounding skin. None of the scars developed into a keloid. All the rest of the scars were adjudged as imperceptible.

On assessment of each of the approaches by the operator and assistant as per the ease of approach and the ease of locating the fractured condyle and fixation of the same, it was found that the pre auricular approach and the submandibular approach due to their distance from the site of fracture required excess retraction and did not provide straight line access for fixation, which needed to be surmounted by excessive retraction of the tissues. The transmassetric and transparotid approaches provided straight line access and required lesser retraction. Post operative care for the preauricular approach required drains. Transparotid approach needed occlusive bandages to prevent parotid fistulae.

Discussion

Comparison of the complications could not ascertain the superiority of any approach over the other since the outcomes were not statistically significant. However, judging by operator and assistants' subjective assessment, the retromandibular approaches seem to provide a more direct visual field and an almost straight line access for the fixation of the fracture. The transmassetric approach seems to be a safer approach since the nerves encountered can be visualized and avoided.

Ellis et al. [3] in their analysis of the surgical complications with open reductions comment that although there are several approaches to the open treatment of condylar fractures, their experience has been that the most reliable for applying plate and screw fixation is the retromandibular (or its facelift variant).

Surgical approaches to the condylar process must provide chances for avoiding injury to the branching facial nerve. Most commonly, the dissection to the mandiblular condyle requires dissection between the buccal branches and the marginal mandibular branch.

In a study by Lutz et al. [6] based on 20 parotidomasseteric dissections from ten embalmed cadaveric heads, it was concluded that the inferior buccal branch had an average height of 16.8 mm and the highest standard deviation (7.2). Extremes were, respectively, 32 and 7 mm. The marginal mandibular branch had an average height of 3.2 mm with standard deviation equal to 3.0. Extremes were, respectively, 9 and −3 mm. They conclude that the high sub-mandibular trans-masseteric approach provides great exposure of facial nerve branches lying on the masseter muscle, if even encountered. Through masseteric incision performed between 10 and 20 mm above the base of the mandible, the marginal mandibular branch is safe from wound with an added safety margin of 4 mm. The surgeon using high submandibular trans massetric approach is most likely to encounter the inferior buccal branch. It can then be avoided under visual control. This makes it a swift and safe approach to the mandibular condyle.

The position of a preauricular incision is too high for subcondylar fractures, especially for those below the sigmoid notch; therefore, submandibular incision is sometimes required, and it not only increases the operation time, but also affects the appearance. Further, the accurate placement of the internal fixation plate is difficult, and the probability of facial nerve injury also increases correspondingly. Hammer et al. [7] demonstrated that the incidence rate of facial nerve injury after preauricular incision was 3.2–42.9%. Submandibular incision is the preferred choice for fractures of the mandibular body and mandibular angle, but for fractures of the ramus or middle and high condylar fractures, this incision presents restricted space for exposure and operation, which qualitatively affects rigid internal fixation. Widmark et al. [8] reported that the incidence of the facial nerve injury after submandibular incision was 5.3–48.1%. Although intraoral incision is advantageous because it does not cause facial scars and because the incidence rate of facial nerve injury is low, its range and indications necessitate the frequent use of additional equipment. Compared with the above mentioned types of incisions, retromandibular incision is favored by surgeons because it has the following advantages: it is

closer to the condylar process; it causes no obvious scars; and it provides better exposure of fractured end and the posterior edge of the ramus. However, the method requires traversal of the parotid gland tissue, which increases the incidence of facial nerve injury and salivary fistula. Ellis et al. [5] reported that the incidence of facial nerve injury in the case of this method was 6–10.5%. Tang et al. [9] report that the modified retromandibular incision approach was adopted for open reduction and rigid internal fixation not only for condylar fracture but also for fracture of the ramus, and good results were obtained.

In reply to the comment by Wiwanitkit [11], Trost et al. [10, 12] comments that the marginal branch of the facial nerve is more likely to be injured using the retromandibular (transparotid) technique because the dissection automatically crosses this nerve. In the experience of Chossegros et al. [13] transient palsies were observed in 2 (10%) of 19 patients, and no definitive palsy developed. In contrast, using the high cervical transmasseteric anteroparotid approach, the marginal branch is avoided, because superficial dissection over the superficial musculo-aponeurotic system must be performed 45 mm above the lower border of the mandible. The buccal branches of the facial nerve were identified in Trost's series in 50% of cases; nevertheless, their potential injury would have no clinical consequences because of the numerous anastomoses and multiple innervations of the peribuccal muscles in this area. Trost has reported that he has used this approach in about 100 cases (condylar fractures, temporomandibular joint unicompartmental and bicompartmental prosthesis, and orthognathic surgery) with no facial nerve morbidity, not even transient. Similar results have been reported by Meyer et al. [14] using approximately the same technique. The greatest advantage of this approach is the extraordinary safety to the facial nerve branches (even in extreme conditions) and, in particular, the avoidance of the marginal nerve branch. The high cervical transmasseteric anteroparotid approach is the most appropriate technique, not only for condylar fractures, but also in the field of condylar neck surgery in general.

Approaches are chosen as per operator ease and practice. The learning curve is often steep when the approaches are complex and more armamentarium is required. In a developing country like India, most hospitals lack complex armamentarium and the surgeons are compelled to use basic instruments to approach difficult accesses. ORIF of condylar fractures is often avoided by many surgeons for fear of complications and therefore it is necessary to select an approach that the surgeon is well trained in. We have found that the transmassetric approach is an approach that is easier to master and nerve damages can be avoided best.

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