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Submandibular Versus Transoral Endoscopic Approach for Fixation of Mandibular Condyle Fracture - A Systematic Review

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Abstract

Mandibular condylar fractures, are a prevalent form of facial trauma, these fractures can lead to complications such as pain, restricted mandibular movement, muscle spasms, malocclusion, TMJ pathologies, and facial asymmetry. The primary goals of management are to restore normal occlusion and mouth opening, minimize the risk of TMJ ankylosis, and improve the patient's quality of life. Treatment options include conservative (closed reduction) and surgical (open reduction) approaches. Historically, closed reduction was favored due to the challenges of surgical access to the condyle and the risks of facial nerve damage. However, open reduction is now preferred due to its superior functional and radiological outcomes. Open reduction and internal fixation (ORIF) of subcondylar fractures are indicated in cases such as condyle dislocation into the cranial fossa, inability to achieve occlusion with conservative therapy, and extracapsular displacement. Surgical approaches for ORIF include preauricular, submandibular, retromandibular, and intraoral methods. While intraoral approaches reduce the risk of facial scarring and nerve damage, they offer limited exposure. Conversely, extraoral approaches provide better visualization but are associated with risks like facial scarring and salivary fistula. Endoscopic-assisted open reduction and internal

fixation (EAORIF) has emerged as a technique that mitigates the risks of traditional surgery while maintaining its benefits. This review compares two endoscopic approaches submandibular and transoral approaches in terms of operating time, accessibility, aesthetics, post-operative mouth opening, TMJ function, and complications. The transoral approach is gaining attention for its superior visual field and reduced risk of facial scars and nerve damage, though it remains technically challenging and requires specialized instruments and expertise.

Keywords: Condylar fracture, Endoscopic approaches, Transoral approaches, ORIF of condylar fracture, EAORIF

Introduction

Mandible fractures continue to be one of the most common forms of facial trauma worldwide. The incidence of condyle fractures varies with different studies and regions. Overall it ranges from 16 to 42% [1-3]. The complications of condylar fracture include pain, restricted mandibular movement, muscle spasm and deviation of the mandible, malocclusion, pathological changes in the TMJ (temporomandibular joint), osteonecrosis, facial asymmetry and TMJ ankylosis. The goals of management are to restore normal occlusion along with adequate mouth opening, to minimize the risk of TMJ ankylosis and other possible pathologies, to decrease morbidity and increase quality of life of the patient. The two principal approaches recommended for the management are functional and surgical. Earlier, these fractures were commonly managed by closed reduction (CR). The preferance of conservative management over open reduction was due to the challenge of surgical access to the condyle and difficulty in positioning the proximal bone fragment and also the risk of damaging the facial nerves. However, in recent times, open reduction is preferred over closed reduction owing to its improved results such as quality of life, functional and radiological outcomes.

The open reduction and internal fixation of subcondylar fractures has well defined set of indications. The absolute indications for open treatment of subcondylar fractures include dislocation of the condyle into the middle cranial fossa, inability to open mouth or establish occlusion after conservative therapy, intra-articular foreign body, and lateral extra capsular displacement. Besides the absolute indications, some relative indications include medical necessity (alcoholism, seizure disorder, bulimia, and so forth), displacement of the condyle out of the fossa, bilateral mandibular fractures involving subcondylar fracture.

In addition, there are proposed absolute indications for conservative therapy which include the following: - Intracapsular fractures, fractures in small children, fractures without dislocation.

The surgical approaches for open reduction and internal fixation include preauricular, submandibular, retromandibular, and intraoral approaches. Although the intraoral approach can avoid facial scar and the possible facial nerve damage, it offers limited exposure and visual field. Extra oral approaches like pre auricular, sub mandibular and retromandibular approaches are used for the fixation of the condylar fracture. It usually provides a good visual field for surgery, good fracture alignment and functional restoration. However it has some disadvantages like it creates facial scar, and possible complications like salivary fistula and facial nerve damage.

The endoscopic assisted open reduction and internal fixation (EAORIF) approach minimizes the pitfalls of external surgical approach such as facial nerve injury, salivary fistula and external scarring while providing the

benefits of anatomic reduction. There could be two routes for endoscopic approaches for fixation of the condyle or subcondyalar fractures. Either we can approach the area through submandibular approaches or transoral approaches. In recent years, endoscope-assisted transoral approach has attracted much attention as it provides good visual field without the risk of facial scars or nerve damage. Endoscopic reduction and fixation of condylar fracture is technically challenging; the procedure requires specialized instruments and the surgeon's experience. During the operation, endoscope, retractors, forceps, elevators, and a suction cannula are all positioned through the narrow oral incision. Endoscopic approach has an advantage of having more space with good visualization, and facilitated the use of an angulated screw driver. The purpose of this review is to compare the two endoscopic approaches in terms of operating time, accessibility, aesthetics, immediate post-operative mouth opening movements, TMJ function and complication related to this.

Aim & Objectives

Aim

- To compare the transoral endoscopic approach with the submandibular endoscopic approach for fixation of the mandibular condylar fracture.

Objectives

- To systematically compare the effectiveness submandibular versus transoral endoscopic approach for the management of mandibular condylar fractures fixation according to the PRISMA guidelines and PICOS model.
- To draw out a conclusion regarding the effectiveness of each treatment according to the type of condyle fracture.
- To evaluate and discuss the various complications of each treatment modality.

To evaluate the outcome in terms of operating time, accessibility, maximal interincisal opening, scar, TMJ pain, nerve injuries and complications.

Methodology

An elaborate data base search using engines (Google Scholar, Pubmed, Ebsco Host, Medline, Cochrane Library and Embase) was done to collect articles pertaining to Submandibular versus Transoral Endoscopic Approach for Fixation of Mandibular Condyle Fracture**.** The study selection was restricted to articles published in English and from the year 1950 until July 2022. The boolean terms used for the search were mandibular condylar fracture, condylar fracture, submandibular approach for condyle, trans oral approach for condylar fracture, subcondylar fracture, subcondylar endoscopic fracture fixation with submandibular approach, subcondylar fracture fixation with trans oral approach. (condyle fracture"[Mesh] OR "condyle"[All Fields] AND "fracture [All Fields] OR "subcondylar"[All Fields] AND "fracture [All Fields] OR "subcondylar fracture [All Fields]) AND ("fixation"Mesh] OR "fixation [All Fields] OR ORIF (All Fields] OR "open"[All Fields] AND "reduction"[All Fields) AND internal [All Fields] AND fixation [All Fields] OR "open reduction internal fixation"All Fields]) AND ("subcondylar"(All Fields] OR "risdon"[All Fields] OR "submanibular"[All Fields] AND "approach (All Fields] transoral OR (All Fields OR endoscopic All Fields] AND "transoral All Fields) OR "transoral endoscopic (All Fields) OR "endoscopic approach")

The type of studies included were systematic reviews, randomized control trials and original research.

The review was done in accordance with Preferred Reporting items for systemic Reviews and Meta-Analysis (PRISMA) statement guidelines after detailed

PICO analysis. 4408 records were obtained through database searches. After removing duplicates, 141 records were excluded. Out of the remaining 4267 records, titles were screened and 4213 articles were excluded after evaluating the title and abstract. Subsequently, 54 full-text articles were assessed for eligibility, out of which 52 did not meet the inclusion criteria and were excluded. Finally, 2 studies were selected for quantitative and qualitative assessment of the submandibular versus transoral endoscopic approach for fixation of mandibular fracture. After that a thorough review and analysis of the articles were made to know which better option for the fixation of condylar fracture is.

PICO Analysis

Which is a better endoscopic approach for fixation of condylar fracture-option for Condyle Fracture.

Submandibular or Transoral Endoscopic Approach?

P-Population: Patients reporting with condylar / subcondylar fractures and Requiring open reduction and internal fixation of condylar fracture

I-Intervention: Internal fixation through transoral endoscopic approach

C-Comparison: Internal fixation through submandibular Endoscopic Approach

O-Outcome: Operating time, Difficulty, Aesthetics (scar), Nerve injury, mouth opening and TMJ movements, adequacy of reduction and fixation, complications.

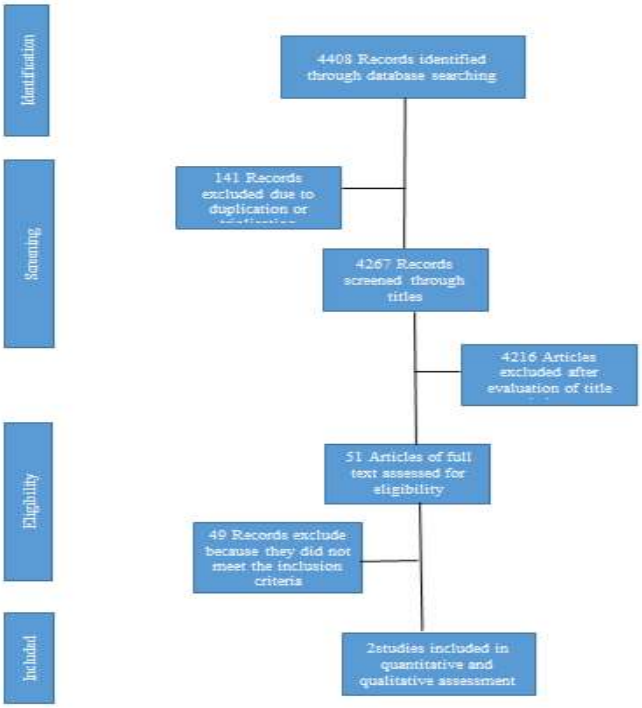

Figure 1:

Results

This systematic review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The database searches resulted in 4408 records. 141 Records were excluded due to duplication or triplication. 4267 Records were screened through titles. 4213 Articles were excluded after evaluation of title and abstract. 54 Articles of full text assessed for eligibility. 52 Records were exclude because they did not meet the inclusion criteria. 2studies included in quantitative and qualitative assessment of submandibular versus transoral endoscopic approach for fixation of mandibular fracture.

Results of individual studies

Na-Hyun Hwang et al [14]

The submandibular endoscopic group had 12 males and 3 females, with an average age of 41.2 years. The transoral endoscopic group consisted of 10 males and 5 females, with an average age of 36.7 years.

The mean follow-up duration was 10.2 months for the Submandibular endoscopic group and 12.7 months for the transoral endoscopic group. The operative views of both approaches were compared, and it was found that the submandibular endoscope provided a better visualization of the posterior margin of the ramus and condyle, with a visual axis parallel to the axis of the condyle ramus unit. The transoral endoscope, on the other hand, provided a clear view of the anterior margin of the condyle and sigmoid notch.

All fractures in the transoral endoscopic group were fixed with a trocar, while only 2 patients in the submandibular endoscope group required trocar fixation ($P<0.05$). The other 13 fractures in the submandibular endoscope group were successfully fixed with an angulated screwdriver. Three patients in the transoral endoscopic group and 2 patients in the submandibular endoscope group had fractures on the lower neck.

. submandibular endoscope allowed for the use of an angulated screwdriver to fix sub condylar fractures, it was not effective for fixing lower neck fractures as the angulated screwdriver required more than 10mm of free space above the fracture, which was difficult to create on the proximal segment of the neck. As a result, all condylar neck fractures were fixed using the trocar system. In the TE group, 9 patients received 2 plate fixations, and 6 patients received 1 plate fixation. In the SEI group, 12 patients received 2 plate fixations, and 3 patients received 1 plate fixation. The difference between the two groups was not statistically significant ($P>0.05$). The mean operation time was 128 minutes in the TE group and 120 minutes in the SEI group, which included open reduction and internal fixation of combined fractures, but did not include intermaxillary fixation time.

In each group, two patients experienced mild medial override, which was effectively treated using the respective endoscopic approach. In the TE group, one patient experienced temporary facial nerve buccal branch palsy, which spontaneously resolved two months after surgery. Both groups showed satisfactory occlusion, but some patients in the TE and SEI groups experienced temporomandibular joint clicking. Additionally, two patients in the TE group and one patient in the SEI group experienced oral wound dehiscence. No patients exhibited chin deviation during mouth opening, and there were no complaints of cheek trocar scars or submandibular scars.

R. Schoⁿn etal [15]

Endoscopy-assisted reduction of condylar process fractures was performed in 17 patients using either the submandibular or transoral approach. Nine patients with condylar neck fractures, severely dislocated fractures with medial override, and comminuted fractures were treated with the submandibular approach, while eight patients with moderately dislocated fractures or lateral override were treated with the transoral approach. The extraoral approach was used for the nine patients with six condylar neck fractures, two subcondylar fractures, and two comminuted fractures of the subcondylar region. One patient had a non-dislocated subcondylar fracture and one had a severely dislocated bilateral condylar neck fracture. The transoral approach was used for three condylar neck fractures and five subcondylar fractures. The 2.0 mm zygoma 4- or 5-hole AO-ASIF miniplate (Nos 443.44, 443.45, Synthes) was used for fixation of the plate at the condylar fragment and the control of reduction was facilitated by the endoscope. Transbuccal stab incisions were made in all patients where the submandibular approach was used and in four patients of the transoral group. In four patients of the

transoral group, angulated drills and screwdrivers were used for the reduction and fixation of the fractures to avoid incisions for the transbuccal insertion of screws. Adequate anatomic reduction was achieved in all patients, and the operating time was 2 hours and 50 minutes on average. In all but one patient, immediate postoperative movement was allowed. A soft diet was maintained for 7 days after surgery. After 6 months, the mouth opening in all patients was more than 40 mm without significant deviation, and there were no signs of TMJ dysfunction or pain in the TMJ area. Temporary weakness of the mandibular branch of the facial nerve was observed in two patients treated with the submandibular approach postoperatively, but after 6 months there were no signs of facial nerve damage. The submandibular scars were 4-5 cm in length, with two being invisible and seven being aesthetically acceptable.

Combined results

Operating time

A total of 47 patients underwent treatment for mandibular condylar fractures, with 24 of them receiving the submandibular approach and the remaining 23 receiving the transoral approach. The average duration of the submandibular endoscopic approach was 120 minutes, while the average duration for the transoral endoscopic approach was 128 minutes.

Accessibility

While the transoral endoscope was effective in visualizing the anterior border of the condylar neck, it had limited visibility of the posterior border. This was likely because the subcondyle and ramus are convex at their center. Since the posterior border of the mandible is crucial for confirming proper fracture alignment, this posed a challenge. The posterior border could be well visualized by the submandibular endoscopic approaches.

Aesthetics

The submandibular scar had a length of 4-5 cm and was considered to be aesthetically acceptable or invisible in 7 and 2 patients, respectively. On the other hand, there were no visible scars on the face in the transoral endoscopic approach.

Immediate post-operative mouth opening

All patients, except one from the second group, were allowed immediate postoperative movement. The non-dislocated subcondylar fracture on the left side was managed conservatively by maxillomandibular fixation for 12 days and the comminuted fracture of the ascending ramus on the right side was treated by open reduction.

Maxillomandibular fixation

In two patients, guiding elastics were used for 5 days when the occlusion was not secure postoperatively. Patients were advised to maintain a soft diet for 7 days after the surgery. Mild medial override was observed in two patients in each group, and both patients were successfully treated with the endoscopic approach.

Mouth opening and TMJ function

All patients in both groups had mouth opening of over 40 mm without any noticeable deviation of the chin. During mouth opening, none of the patients showed any signs of chin deviation. However, there were 3 patients in the transoral endoscopic group and 2 patients in the submandibular endoscopic group who displayed temporomandibular joint clicking.

Complications

Two patients treated with the submandibular approach showed temporary weakness of the mandibular branch of the facial nerve postoperatively, but there were no signs of facial nerve damage after 6 months. In the transoral endoscopic group, two patients experienced oral wound dehiscence, while one patient in the

submandibular endoscopic group experienced the same issue.

Discussion

Fractures of the mandibular condyle are common and account for 9% to 45% of all mandibular fractures [16, 17]. They occur as unilateral as well as bilateral fractures and can occur together with fractures of the mandibular corpus or dentoalveolar injuries. Although closed reduction has been the most widely used method earlier, even for the treatment of dislocated condylar fractures, anatomic reduction is difficult to achieve with the same. To overcome the limitation of closed reduction open reduction and internal fixation (ORIF) has been advocated. With open reduction and internal fixation, function of the temporomandibular joint can be rapidly achieved, and superior results concerning function have been reported. Many approaches have been described for the open treatment of condylar fractures including preauricular, retromandibular, and submandibular approaches. However, there is a risk of complications associated with these surgical approaches, salivary fistulas, visible scars, and temporary or permanent facial nerve damage. Moreover the open reduction and fixation of condylar fractures is a technically demanding surgical procedure, and miniplate fractures have been reported in up to 35% of the cases [14,15,16,17]. Nevertheless, good functional results have been achieved after open reduction and fixation, thus stressing upon the need for fixation of the fractures. To overcome the risk of complications the endoscopic approaches has been described. The use of endoscope can offer several advantages, including minimally invasive approaches, enhanced visualization, reduced scarring, faster recovery times, reduced complications. The endoscopic-assisted open reduction and internal fixation (EAORIF) approach has emerged as a promising option for addressing condylar or subcondylar fractures, offering advantages over traditional external surgical approaches. There are two possible routes for endoscopic approaches: submandibular approach and transoral approach.

One of the key benefits of EAORIF is the reduced risk of complications such as facial nerve injury, salivary fistula, and external scarring, while ensuring precise anatomical reduction.

The endoscopic approach is somewhat technically challenging, increased operating time and required special instruments.

Visualisation and access plays a key role ensuring that the reduction is adequate. Both the intra-oral and the submandibular approach provide a good access to the subcondylar area. Although the transoral endoscope was successful in visualizing the anterior border of the condylar neck, while with the submandibular endoscopic approach the posterior border is well visualized. This is due to the convexity of the subcondyle and the ramus on its center. The good alignment of fracture can best be confirmed by inspecting the posterior border of the mandible. Anterior border of the condylar neck is continuous with the sigmoid notch, and the fracture alignments are sometimes obscure. The posterior border could be well visualized by the submandibular endoscope, and some reports described the advantage of a second port on the sub-mandible for inferior traction in addition to the endoscope port.[22]

Both the approaches allow immediate post-operative function and the maxillo- mandibular fixation is less often required. In our review, all the patients, except one in the submandibular group were allowed post-operative movement. Also, guiding elastics were placed in two patients.

Mouth opening and TMJ function in the post-operative phase are good indicators of a successful treatment

outcome. All the patients in our review reported adequate mouth opening (>40mm), with no evidence of chin deviation. A total of 5 patients (3 trans-oral and 2 submandibular), though, did present with clicking in the TMJ. Anehosur et al [18] and Eroglu et al [19] however, reported chin deviation in a few patients, but the same was resolved by 6 months.

Presence of post-operative facial scar can adversely affect the patient's confidence. The trans-oral approach offers the advantage over submandibular approach since there is no facial scar. With the submandibular endoscopic approach, there could be 4 to 5 cm of scar, which was considered aesthetically acceptable or invisible in 7 & 2 patients as per our review. This was similar to studies by Schon et al, Mueller et al, Aboelatta et al, Hwang et al [20].

Some of the possible complications include wound dehiscence, facial nerve damage non-union. In our review, 2 patients in the trans-oral group and one in the submandibular group reported with wound dehiscence. Also, two patients in the submandibular group showed temporary weakness of the marginal mandibular branch of the facial nerve, but it resolved within 6 months. Schemelzeisen et al [21] reported swelling and non-union in one patient but no such complication was reported in our review. Anehosur et al, tool reported transient facial nerve weakness in a few cases, but the incidence was higher in ORIF through retromandibular approach than EAORIF [18].

The EAORIF is, however, a technically challenging procedure, requiring special equipment, well- trained assitants and a steep learning curve. The time taken for the procedure too dictates the efficiency of the procedure. According to Na-Hyun Hwang et al the mean operation time was 128 and 120 minutes in the transoral endoscopic approach group and the Submandibular endoscopic group respectively. The operation time included open reduction and internal fixation of combined fractures, but not intermaxillary fixation time. According to Schmelzwisen et al EAORIF was 86.5 minutes [21].

Submandibular endoscope has another advantage in endoscope placement. The transoral endoscope requires the surgeon or the assistant to hold the scope constantly. Although it can be attached to a specialized retractor, the endoscope and the attached video camera can be quite heavy to be held for a long period of time. However, submandibular endoscope can be rested horizontally on the patient's chest and the assistant or the scrub nurse can adjust its position when needed. Transoral endoscopic subcondylar reduction generally requires specialized instruments such as endoscope with brow lift sheath retractor (Karl Storz, Culver, CA) and Subcondylar Fracture Fixation Set (Synthes, Paoli, PA). However, the SEI approach allows any 30-degree angle endoscope and angulated screw drivers to be used during reduction and fixation. The approach facilitated the use of angulated screw driver for fixation. The surgical outcomes and operation time of the methods were not different from those of TE approach.

There were some limitations of the review. The specific treatment according to the site of fracture was not addressed. Also, there was limited data regarding pediatric condylar fracture, and lack of homogenous classification schemes. Zide and Kent have classically described criteria for ORIF of condylar fractures. However, newer criteria advocates for closed reduction in displacement less than 10 degree and ramus height shortening less than 2 mm. ORIF is currently indicated with displacement>45 degree and ramus height shortening>15 mm. The intermediate group (displacement 10–45 degree and ramus shortening of 2–

15 mm) can be managed either with open or closed treatment. Nevertheless, ORIF has been used with greater frequency over the past decade. Endoscopic approaches for subcondyle fractures have developed with the advantage of minimized facial nerve damage and no visible scars.

We compared the surgical duration of the 2 groups, and concluded that there were no significant differences in operation time of the 2 surgical methods. The surgical time included time required for treatment of combined fractures. Therefore, isolated subcondylar fractures took less time than in patients of combined complex fractures. We suggest that the SEI approach is a relatively simple procedure with good visualization. The surgical outcomes and operation time of the methods were not different from those of TE approach. It should be emphasized that not all procedures may be appropriate for endoscopic approaches, and the decision to use an endoscope should be based on the specific condition and necessity of the patient.

Summary and Conclusion

We have compared two different approaches (submandibular endoscopic and transoral endoscopic approaches) to fix the condylar fracture and compared different parameters like operating time , accessibility, aesthetic, immediate post-operative mouth opening, maxilla mandibular fixation , TMJ function and complication related to these procedures. We found that there are not much difference in the operating time, there are certain complications related to both the procedures but gradually with time they resolved. If we are more concerned for esthetics then trans oral approaches will be a better option for the patient .for accessibility sub mandibular approaches will be a better option with this approach we can visualize up to the posterior border of condyle as well as we can use a angulated screw driver during plating.

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Annexure