Endoscopic-assisted approach in the treatment of subcondylar fractures: our experience

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ABSTRACT

Introduction: The management of subcondylar fractures has been very controversial in the maxillofacial literature. The open reduction and internal fixation (ORIF) technique has been considered by many authors the gold standard in selected cases. However, with the rise in endoscopic techniques in the craniofacial area, new boundaries and less invasive techniques are being explored. The endoscopic approach of subcondylar fractures has proved overall good and similar results to open approaches whilst reducing complications such as facial nerve injury. In this article we purpose to describe our experience with the endoscopic approach to subcondylar fractures.

Patients and methods: We retrospectively analyzed 11 patients with subcondylar fractures treated at our department via an endoscopic approach. The number and type of plates used in each patient is recorded. Results and complications observed for all patients are described as well as functional outcomes in terms of mouth opening at 1 week, 3 months and 6 months postoperatively.

Results: One patient presented with transient damage to the marginal and frontal branches of the facial nerve. 18.2 % of patients had their hardware removed due to pain or infection at the fracture site. No cases of salivary fistula or sialocele were found in this study. Mean mouth opening at one week postoperatively was 31.8 mm which increased to 37.8 mm at 6 months after surgery, meaning an increase of 18.86 % through the follow-up. Also, 18.2 % of patients presented with persistent deviation with mouth opening and one patient presented with post-operative persistent malocclusion that was treated with intermaxillary fixation and elastics.

Conclusion: The endoscopic management of subcondylar fractures is a safe alternative to the open approach, specially in favorable cases, which reduces the risk of complications associated to open approaches, such as unfavorable scarring, salivary gland complications and facial nerve damage. In our series only one patient presented with transient damage to the facial nerve. 18.2 % of the plates were removed, which is a high percentage and should be evaluated, although the small size of the series should be taken into account. Maxillofacial surgeons should be encouraged to learn and trained in endoscopic techniques and include the endoscopic assisted approach in their surgical armamentarium.

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INTRODUCTION

Condylar fractures account for more than a third of all mandibular fractures. They are frequently associated to other mandibular fractures, most frequently those located in the parasymphysis and symphysis. Different classification systems have been described and used in the literature; however, they are frequently divided in: head (diacapitular) fractures, neck fractures and subcondylar fractures.

The management of condylar fractures is highly controversial and depends on the level of fracture and displacement. There are two major treatment modalities: closed treatment and open reduction and internal fixation (ORIF). Closed treatment is more prone to suboptimal results in determined cases, particularly deviation with mouth opening, loss of height at the mandibular rami and malocclusion, alongside with a blind immobilization of the bone segments for a prolonged time, which can have implications in the dynamics of the temporomandibular joint and the risk of arthrosis. Nonetheless, closed treatment can also be an acceptable option in cases where no displacement nor angulation is present.

Classically, Zide and Kent’s criteria for open reduction of condylar fractures have been applied. Later, Schneider et al. settled clearer indications for ORIF in their article and recommended ORIF in fractures with an angulation higher than 10° and a shortening of more than 2 mm. Superior functional and aesthetical results can be achieved with ORIF if correctly indicated. Occusal and temporomandibular joint (TMJ) disorders are reduced significantly with ORIF when correctly indicated: 23% after closed treatment vs. 9% after surgical treatment.

ORIF has classically been performed through different approaches: the preauricular approach, the rhitidectomy approach and the retromandibular approach. All these approaches have proven to be useful but are not exempt of risks: salivary fistula, damage to the branches of the facial nerve and visible and unesthetic scars.

In the last decades, the endoscopic management of low condylar fractures arose as a new treatment modality with promising results, avoiding unsightly scars and lowering the risk of facial nerve damage, avoiding the most feared complications associated to ORIF. However, endoscopic repair of condylar fractures has not routinely been used: training and specific equipment are required.

In this article we retrospectively analyzed patients with subcondylar fractures treated by an endoscopic-assisted translabral approach (EA-ORIF) in our department. We describe and discuss results and complications for this group of patients.
MATERIALS AND METHODS

From January 2015 to January 2019 a total of 11 patients with subcondylar fractures who had been treated via EA-ORIF were consecutively selected. Preoperative CT and radiographies were taken for all patients, following our standard protocol. Both unilateral and bilateral fractures were included. Patients with associated mandibular fractures and other facial fractures were also included. Demographic data for this group was recorded. This study was approved by the Ethics Committee of our Hospital (CEIm).

Patients suitable for open surgery were evaluated for endoscopic-assisted compliance. Patients who presented with fractures with more than 45° of medial deviation, fractures with more than 5 mm of overlap, high condylar fractures, patients with open fractures, patients with panfacial fractures, patients who could not undergo a long operating time and patients with a history of fracture longer than 14 days were discarded for undergoing endoscopic methods. Fractures that did not satisfy these criteria were treated via an open approach and were not included in this study.

A postoperative orthopantomography was taken on the first postoperative day and follow up was performed at 1 week postoperatively, 4 weeks, 3 months and 6 months. Follow up included an orthopantomography at 3 and 6 months to evaluate reduction and bone healing. Patients were evaluated for pain, maximum interincisal opening and the presence of deviation, TMJ clicking, lateral extrusion and malocclusion. Also, shortening of the mandibular rami was evaluated clinically and in radiographs.

Surgery was performed by the same senior surgeon, trained in endoscopic approaches and arthroscopy of the temporomandibular joint. We used a 4 mm 30° endoscope. Surgery was performed under general anesthesia and nasotracheal intubation. An intraoral incision was placed over the external oblique line in a standard fashion and an optical subperiosteal cavity was created. Then, the 30° endoscope was inserted and the fractures were inspected. Reduction was then accomplished by manipulating the teeth or distracting the mandible downwards in the angle region. Once adequately reduced the premorbid occlusion was stabilized and intermaxillary fixation with screws and wires was performed. Then, fixation was performed assisted by a right-angle screwdriver/drill (Figures 1 and 2). Osteosynthesis was performed using different plating methods: 2 linear 2.0 4-hole miniplates, trapezoidal plates and delta plates.

After surgery, patients were instructed in oral hygiene and a soft diet was indicated for 4 weeks. Intermaxillary fixation with elastic bands was applied for one week, and then patients initiated physiotherapy and exercises.

For all patients, number and type of plates were recorded. Results in terms of mouth opening and complications were registered and compared.

RESULTS

A total of 11 patients were included: 2 women (18.18 %) and 9 men (81.82 %). The median age for these patients was 41 years. Only 1 patient (9.09 %), patient number 5, presented with a bilateral subcondylar fracture, and EA-ORIF was decided in one of the fractures, whilst the other fracture, which was non-displaced, was treated via closed treatment with IMF and a soft diet. The remaining 10 patients (90.91 %) had unilateral fractures. The most common etiology was interpersonal violence (6 patients, 63.63 %) and traffic accidents (3 patients, 27.27 %). A total of 5 patients (45.45 %) presented with accompanying mandibular fractures, being the parasymphysis the most common location.

Most patients received a 2 linear plate osteosynthesis (5 patients) (Figure 3) or a delta plate (Figure 4) (4 patients). Two patients (18.18 %) received a trapezoidal plate.

Complications are presented in Table I for all patients. One patient (9.09 %), patient number 1, suffered transient damage to the marginal and frontal branches of the facial nerve, which resolved uneventfully within 6 months. No cases of salivary
fistula or sialocele were found in this study. Also, no complications related to the surgical wound or scarring were found.

Regarding hardware complications, two of these patients, patients number 3 and 6, (18.18 %) had their plates removed. The first patient, patient number 3, was treated with a trapezoidal plate and had it removed one month postoperatively due to infection at the fracture site. The patient required antibiotic treatment for 1 week (amoxicilene-clavulanic acid 875/125 mg) and the plate was removed. The patient was treated conservatively with a soft diet. The second patient with hardware complications, patient number 6, had been treated with 2 linear 2.0 mm plates and both were removed one year later due to complaints and pain at the surgical site. Nonetheless, no signs of infection or pseudoarthrosis were observed. He did not show misalignment on postoperative radiographs and neither did he refer malocclusion or TMJ symptoms. The remaining nine patients had no complications associated to the hardware.

Mean mouth opening at one week postoperatively was 31.8 mm with a standard deviation (SD) of 2.75. At three months postoperatively, it increased to 35.6 mm with a SD of 1.50. At the 6-month follow-up, the mean mouth opening was 37.8 with a SD of 1.12 (Figure 5). This meant an increase of 18.86 % at the longest follow-up.

Table I. Patients included in the study.

| Patient | Sex | N." fr / Other fractures | Type of osteosynthesis | Complications |
|---------|-----|--------------------------|------------------------|--------------|
| Patient 1 | F | 1 | Yes | 2 linear plates | Transient facial paralysis frontal and marginal branches |
| Patient 2 | M | 1 | No | 2 linear plates | |
| Patient 3 | M | 1 | Yes | 1 trapezoidal plate | Infection at fracture site, plate was removed 1 month postoperatively and treated conservatively (soft diet) |
| Patient 4 | F | 1 | No | 1 delta plate | |
| Patient 5 | M | 2 | Yes | 2 linear plates | Only one of the fractures was treated via endoscopic approach, the other fracture was treated with IMF and soft diet |
| Patient 6 | M | 1 | No | 2 linear plates | Plates removed 1 year postoperatively due to pain |
| Patient 7 | M | 1 | No | 1 delta plate | |
| Patient 8 | M | 1 | No | 1 trapezoidal plate | Persistent deviation |
| Patient 9 | M | 1 | Yes | 1 delta plate | |
| Patient 10 | M | 1 | No | 1 delta plate | Persistent malocclusion, treated with IMF for 3 weeks |
| Patient 11 | M | 1 | Yes | 2 linear plates | Persistent deviation |
The treatment of condylar fractures has been an arduous topic of debate and has significantly changed in the last century. They can be managed both via conservative treatment or by open reduction and internal fixation (ORIF)\textsuperscript{10,11}. Traditionally, the majority of condylar process fractures have been managed with closed techniques, typically with maxillomandibular fixation and elastics\textsuperscript{12}. However, no anatomical reduction can be accomplished, and worse functional and aesthetic results were described and soon ORIF became the gold standard technique in cases of angulation or displacement. Restoring the adequate anatomy of the condyle and enabling immediate normal function are the main advantages of the ORIF approach\textsuperscript{13}.

So far there is a lack of consensus and an endless debate regarding the management of subcondylar fractures\textsuperscript{13}. In general, absolute indications for ORIF of condylar fractures include displacement into the middle cranial fossa, failure to obtain dental occlusion via closed reduction, lateral extracapsular displacement of the condyle, presence of a foreign body, or an open fracture with potential for fibrosis\textsuperscript{13}. Different surgical approaches exist for ORIF\textsuperscript{16}, however they carry a risk of facial nerve damage, salivary fistula, sialocele, scarring, etc. Later, the intraoral approach for subcondylar fractures was described, with the aim to avoid the aforementioned complications associated to ORIF. The first case series of condylar fractures managed via an intraoral approach were reported by Lee et al. in 1998\textsuperscript{17}. who used this approach assisted by a transbucal trocar. Schon\textsuperscript{18} stated that intraoral approaches are better suited for condylar fractures with lateral over-ride and undisplaced or minimally displaced fractures.

In 1998, Jacobovicz\textsuperscript{19} et al. described the endoscopic assisted approach to condylar fractures with the aim to reduce complications and combine the best of both closed and open treatment\textsuperscript{20}. The current literature states that with this approach, risk of facial nerve injury is significantly reduced as well as scarring, since this procedure is performed through an intraoral incision, showing advantages over both open and closed treatments. However, it is technically demanding and requires training and specific equipment. It should not be indicated in all condylar fractures and shall not be considered in cases with medial override, high condylar neck fractures and large angulation, panfacial fractures and open fractures. Also, some authors report worse reduction of the fracture due to the difficulties in handling and the reduced surgical field, with higher rates of hardware failure and nonunion.

Lee et al. reported a large series of subcondylar fractures treated via endoscopic-assisted approach, treating a total of 22 fractures with overall good functional and aesthetic results\textsuperscript{21}. Later\textsuperscript{17}, they would report their experience with 40 fractures treated endoscopically. In this latter article, they reported one case of transient facial paralysis and 3 cases of hardware fracture, with a median maximum mouth opening of 43 mm at 8 weeks postoperatively, reporting good occlusion and good alignment. Nogami et al.\textsuperscript{22} studied 30 patients treated either via an extraoral retromandibular approach or an intraoral endoscopic approach using right-angled instruments. In the ORIF group, 7 patients had transient facial paralysis, while no cases of facial paralysis were found in the EA ORIF group. TMJ symptoms were similar for both groups, however, median mouth opening 1 month postoperatively was higher in the open approach compared to the endoscopic approach (35.7 mm vs. 28.4 mm), with comparable results at 6 months postoperatively.

Creo et al.\textsuperscript{3} reported their experience in the endoscopic-assisted management of condylar fractures in 26 patients. They reported adequate alignment in 80.8 % of fractures, with a mean maximum interincisal opening (MIO) of 35 mm at 4 weeks postoperatively. In our study, we did not report MIO at one month, but at 3 months it was 35.6 mm. They found good occlusion and no cases of mandibular height loss nor open bite, similarly to our results. However, they found no cases of facial paralysis or hardware failure were described in their article. In our study we found one case of transient facial nerve damage (9.09 %) and two cases of hardware removal (18.18 %). They described one case with persistent lateral deviation and one case of surgical site infection that required drainage, but the hardware was not removed. In our study we found two patients with persistent lateral deviation at 3 months postoperatively (18.18 %). They concluded that the intraoral endoscopic-assisted approach in condylar fractures is a safe, reproducible and efficient technique in most extracapsular fractures and insist on including this technique in the armamentarium of the maxillofacial surgeon.

Frenkel et al.\textsuperscript{11} also analyzed their results in the treatment of condylar fractures via an endoscopic-assisted approach in 12 patients. Mean time for EA-ORIF in their report was 180 mi-
surgical time was 184.5 min (85-465), quite similar to that of fractures treated via EA-ORIF. Mean No signs of malocclusion were found for the rest of patients. With a mean increase of 18.86% at the longest follow-up.

Existing literature on EA-ORIF of subcondylar fractures suggest that this modality has comparable functional results in terms of MIO and mandibular and joint function. Furthermore, the risk of complications such as facial nerve damage, salivary gland fistula, sialocele and unsightly scars are significantly reduced. Despite, the main drawbacks of EA-ORIF include its steep learning curve and the need for special equipment and training. Another alleged drawback of this technique is the extended operating time, which has been reported to decrease with surgeon’s experience. Frenkel et al. found a significant decrease in operating time after the 5th operation. We found two cases (18.18%) where the plates were remo-ved. This is an elevated percentage and a comparative study between ORIF and EA-ORIF regarding hardware removal rates would be interesting. A possible explanation is that the approach for EA-ORIF was performed via an intraoral approach, and this may lead to higher rates of infection and contamination of the plate. However, it should be considered that the number of patients is limited, and a broader series is needed to confirm this hypothesis.

Mild deviation with mouth opening was noted in all patients at the end of first postoperative week. This is a common finding in the first days after treatment of subcondylar fractures. By 3 months postoperatively 18.18% of patients presented with persistent deviation with mouth opening that persisted at the longest follow-up, which is a reported complication in subcondylar fractures. However, these patients were satisfied with the results and this deviation did not interfere with jaw function. On the other hand, no TMJ symptoms such as clicking, or blocking were reported by these patients at the longest follow-up. We believe that physiotherapy and early jaw exercises are of utmost importance to avoid future TMJ problems in these patients. Only one patient presented with malocclusion that required IMF for a longer period of time, with good results. No signs of malocclusion were found for the rest of patients.

We found 1 case of transient facial paralysis in our study group (9.09%) which resolved satisfactorily within 6 months. This complication has been reported by other authors and it is believed that is provoked by the distension of tissues created in the optical cavity for handling and manipulation of instruments. No cases of salivary fistula or sialocele were found in this study, similarly to previous publications. Also, no complications related to the surgical wound or scarring were found.

We report similar MIO improvement to previous authors, being 31.8 mm at one week after surgery and increasing to 35.6 mm by 3 months and 37.8 by 6 months postoperatively with a mean increase of 18.86% at the longest follow-up.

Regarding limitations to this study, the number of patients is small and limited and could be increased, so these results should be considered cautiously. The main drawback of EA-ORIF is the difficulty that resides in the technique and surgical field, which is limited. Therefore, we think that for future publications, mean surgery time should be recorded and analyzed, similar to other publications.

Also, this study lacks control group, and therefore a proper comparison to ORIF could not be made. We believe that a prospective comparative study with an open approach (ORIF) cohort could be interesting in order to compare functional outcomes and complications for both groups as well as total operative time for further conclusions.

CONCLUSION

Transient damage to the facial nerve is diminished but not completely avoided with EA-ORIF, as we found one patient who presented with transient damage to the facial nerve. We report no complications related to the parotid gland or scarring were found. Also, we found two cases of hardware removal (18.18% of patients). We believe further studies to compare this rate and other complications to the ORIF approach are needed. For the rest of patients, no hardware complications or signs of malocclusion were found. No TMJ complications were reported as well at the longest follow-up.

EA-ORIF is a safe and acceptable alternative to ORIF in subcondylar fractures. However, adequate equipment and intensive training is required for proper management and optimal results, as well as proper patient selection.

DISCLOSURE

There are no conflicts of interest to declare.

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