MINIMALLY INVASIVE PROCEDURE FOR CONDYLAR FRACTURE: A REVIEW

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Abstract

Mandibular condylar fractures, among the most frequent maxillofacial injuries, can lead to significant functional and aesthetic complications if inadequately treated. Traditional open reduction and internal fixation (ORIF) ensures anatomical restoration but is associated with visible scarring, facial nerve injury, and extensive soft tissue dissection. Advances in surgical instrumentation, imaging, and endoscopic technology have driven the development of minimally invasive techniques, including retromandibular transparotid mini-incision, preauricular mini-incision, transoral endoscopic-assisted approach, mini-retroauricular approach, and modified Risdon mini-incision. These methods aim to achieve stable fixation with reduced morbidity, improved aesthetics, and faster recovery, while preserving function. Selection of approach depends on fracture location, displacement severity, surgeon expertise, and available equipment. Although early results are promising, widespread adoption is limited by technical demands. Further large-scale studies are required to standardize protocols and define applicability across diverse fracture patterns and patient populations.

Keywords: Mandibular Condyle Fracture, Minimally Invasive Surgery, Endoscopic-Assisted Approach, Facial Nerve Preservation, Maxillofacial Trauma

Introduction

Mandibular fractures rank as the third most common type of maxillofacial trauma, with the condylar neck being the structurally weakest segment of the mandible. Consequently, fractures of the mandibular condyle occur frequently, either in isolation or in association with other mandibular fractures. If left untreated or inadequately managed, condylar fractures can result in a spectrum of functional and esthetic complications, including malocclusion, restricted mouth opening, limitations in dietary intake, facial asymmetry, temporomandibular joint (TMJ) ankylosis, reduced posterior facial height, and in pediatric patients long-term disturbances in dentofacial growth and development.[1] From an anatomical perspective, mandibular condyle fractures are broadly classified into intracapsular and extracapsular types, the latter further subdivided into neck and subcondylar fractures. Management of these fractures has traditionally relied on open reduction and internal fixation (ORIF), a method that ensures stable fixation and anatomical restoration but is not without drawbacks. ORIF often necessitates relatively large extraoral incisions, which carry risks such as injury to the facial nerve, visible scarring, and significant soft tissue dissection.[2,3] In recent years, there has been a growing shift toward minimally invasive techniques for condylar fracture management, reflecting advancements in surgical instrumentation, imaging, and endoscopic technology. These approaches including intraoral and endoscope-assisted procedures—seek to achieve precise reduction and stable fixation while minimizing trauma to surrounding tissues.[4] By employing small, strategically placed intraoral incisions and specialized fixation devices (often under endoscopic visualization), surgeons can avoid prominent facial scars, reduce the risk of facial nerve injury, and facilitate faster recovery with improved postoperative function and aesthetics. This evolution in surgical strategy represents an important advancement in maxillofacial trauma care, offering patients effective fracture management with reduced morbidity.[5] This article gives an overview on Minimally invasive procedure for condylar fracture

Review of Literature

Minimally invasive techniques for managing condylar fractures have gained increasing attention due to their potential to reduce postoperative complications, particularly facial nerve injury and visible scarring, while maintaining functional and aesthetic outcomes. A variety of innovative approaches have been described in the literature, each emphasizing meticulous surgical planning and precision. Cortese et al. (2022) proposed a multistep strategy for dislocated condylar neck and subcondylar fractures, aimed at minimizing skin incisions and improving operative safety; in a series of ten patients, they reported satisfactory results in dental occlusion, bone alignment, and facial nerve preservation without significant complications.[6] Similarly, Kucukguven et al. (2022) introduced an ultrasound-guided technique for extracapsular condylar fractures, enabling real-time intraoperative visualization and accurate reduction using threaded K-wires; this approach yielded normal occlusion, adequate mouth opening, and no evidence of facial nerve injury, underscoring its viability as an alternative to conventional open methods.[7] In pediatric populations, Aksoyler et al. (2021) described an atraumatic intraoral technique for medially displaced subcondylar fractures, which achieved normal occlusion and painless temporomandibular joint function while minimizing surgical trauma, demonstrating the adaptability of minimally invasive methods to age-specific anatomical and healing considerations.[8] Despite these encouraging findings, some authors, such as Turner (2018), continue to advocate traditional open reduction and internal fixation for complex or severely displaced fractures, citing its reliability in achieving stable anatomical restoration.[9] Collectively, these studies highlight that while minimally invasive surgery offers distinct advantages in reducing morbidity and improving recovery, the choice of technique should be individualized, taking into account fracture type, displacement, patient age, and surgeon expertise.

Retromandibular Transparotid Mini-Incision

The retromandibular transparotid mini-incision approach involves a relatively small skin incision, typically measuring about 2–3 cm, positioned just posterior to the mandibular border within a natural skin crease, thereby offering a cosmetically favorable outcome with minimal visible scarring. This strategic placement provides direct and efficient access to the condylar neck and subcondylar regions, facilitating accurate fracture reduction and rigid internal fixation while minimizing the extent of soft tissue dissection compared to traditional open approaches.[10] By passing through the parotid gland in a carefully planned plane, the technique allows the surgeon to work in close proximity to the fracture site, which can shorten operative time and improve surgical precision. However, as with other transparotid methods, there remains a risk of temporary facial nerve weakness, typically involving the marginal mandibular or buccal branches, although such deficits are usually transient and resolve spontaneously.[11] Additional potential complications include salivary leakage or fistula formation, which are relatively uncommon when meticulous surgical technique is employed. Overall, this minimally invasive adaptation of the retromandibular approach combines the advantages of excellent surgical access, stable fixation, and favorable aesthetic results, making it a valuable option in the management of condylar and subcondylar fractures.[12]

Preauricular Mini-Incision

The preauricular mini-incision approach is particularly well-suited for the management of high condylar head fractures, offering direct access to the temporomandibular joint (TMJ) region. It involves creating a small incision placed just anterior to the ear, carefully aligned within a natural skin crease to optimize cosmetic outcomes by minimizing visible scarring. This strategic entry point provides excellent visualization of high-level fractures, allowing for precise manipulation and fixation while reducing the extent of tissue dissection compared to

more extensive open approaches.[13] Because of its proximity to the TMJ, this technique facilitates accurate anatomic restoration of the condylar head and joint function. However, its utility is limited when addressing fractures located lower in the condylar neck or subcondylar region, as the working corridor does not provide adequate access to these sites. Despite this limitation, the preauricular mini-incision remains a preferred minimally invasive option in appropriately selected cases, balancing surgical exposure, functional restoration, and aesthetic considerations.[14]

Transoral Endoscopic-Assisted Approach

The transoral endoscopic-assisted approach (EATA) represents a modern, minimally invasive technique for managing condylar fractures, combining an intraoral incision with the use of a rigid endoscope and specialized angled instruments to achieve direct visualization of the fracture site. This approach allows for precise reduction and secure fixation of the condylar segment, typically performed with the aid of a transbuccal trocar system to introduce fixation hardware. By accessing the fracture through the oral cavity, the technique completely eliminates external scarring and avoids dissection in the vicinity of the facial nerve, thereby significantly reducing the risk of iatrogenic nerve injury.[15] The minimally invasive nature of the procedure also contributes to reduced soft tissue trauma, shorter hospital stays, quicker postoperative recovery, and faster return to normal jaw function. However, the method is not without challenges; it has a notably steeper learning curve and may initially require longer operative times as the surgical team adapts to the endoscopic equipment and altered ergonomics. Additionally, its application is limited in cases involving severely comminuted fractures, where visualization and stabilization become more complex. Despite these constraints, EATA offers a valuable scar-free and nerve-sparing alternative for appropriately selected condylar fracture cases, especially in patients prioritizing functional restoration alongside optimal aesthetic outcomes.[16]

Mini-Retroauricular Approach

The mini-retroauricular approach is a minimally invasive surgical technique designed primarily for the management of high mandibular condylar fractures, offering a balance between optimal exposure and cosmetic considerations. This method involves a small incision, typically measuring 1.5–2 cm, placed discreetly within the retroauricular crease, effectively concealing the resulting scar.[9] The incision provides excellent access and direct visualization of the condylar head and high subcondylar regions, enabling precise fracture reduction and stable fixation with miniplates and screws. One of the key advantages of this approach is its ability to allow screw placement at mechanically favorable angles, thereby enhancing fixation stability. Careful, anatomically guided dissection during the procedure minimizes the risk of injury to the facial nerve branches and protects the parotid gland, significantly reducing complications such as transient facial weakness, sialocele, or salivary fistula—permanent nerve damage is rare. Clinically, the mini-retroauricular approach has been associated with consistently favorable functional and aesthetic outcomes, making it an appealing alternative to more conventional techniques such as the preauricular or retromandibular approaches. It combines the benefits of ease of access, low complication rates, and excellent scar concealment, and while technically less demanding than endoscopic-assisted methods, it still requires precise anatomical knowledge and refined surgical skill for optimal results.[17]

Modified Risdon Mini-Incision

The Modified Risdon Mini-Incision is a refined surgical technique for open reduction and internal fixation (ORIF) of mandibular angle and subcondylar fractures, developed to optimize access while minimizing complications such as facial nerve injury and noticeable scarring. Unlike the classic Risdon approach, this modification involves placing the incision higher and closer to the mandibular angle—typically about 1 cm below the mandibular border—often

along a natural skin crease in the upper neck, which enhances scar concealment.[18] Layered dissection is carried out with meticulous preservation of the facial nerve branches, particularly the marginal mandibular and buccal branches, thereby significantly reducing the risk of temporary or permanent nerve damage. A key advantage of this technique is that it eliminates the need to identify and dissect facial vessels, which not only simplifies the procedure but also reduces operative time. The approach provides direct, efficient access to the mandibular angle and subcondylar region, allowing for accurate fracture reduction and secure fixation with excellent visibility. From an aesthetic standpoint, the shorter incision length and strategic placement result in superior cosmetic outcomes compared to the traditional Risdon method.[19] Clinically, it has been reported as a straightforward, safe, and effective approach with low rates of facial nerve palsy, rapid recovery, and functional restoration. Comparative studies suggest that, in many cases, the Modified Risdon Mini-Incision offers advantages over the retromandibular approach in terms of ease of execution, speed, and aesthetic results, without compromising surgical safety or effectiveness, making it a practical and reliable choice for subcondylar fracture management.[20]

Conclusion

Minimally invasive approaches to condylar fracture management offer several distinct advantages, including reduced scar visibility, a lower risk of facial nerve injury particularly with transoral or small extraoral incisions—shorter recovery times, and decreased postoperative edema. The choice of surgical technique must be guided by factors such as fracture location (high condylar head, neck, or subcondylar), degree of displacement, surgeon expertise, and the availability of specialized equipment, especially in the case of endoscopic methods. While these techniques show considerable promise for appropriately selected condylar and subcondylar fractures, their widespread adoption is tempered by the technical demands they impose. Further large-scale clinical studies are essential to standardize protocols

and clarify their applicability across the full spectrum of fracture patterns and patient populations.

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