

COMPLICATIONS OF UNILATERAL CONDYLAR FRACTURE

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TITLE: COMPLICATIONS OF UNILATERAL CONDYLAR FRACTURE

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Abstract: The development of post-operative complications is influenced by the location of the fracture and degree of bone fragmentation. The fractures of the condyle represent 29-40% of the fractures of the facial skeleton, and about 20-35% of all mandibular fractures. Condylar fractures can be extracapsular (condylar neck or sub-condylar) or intracapsular, undisplaced, deviated, displaced or dislocated. Condylar fractures can be a cause of malocclusion, which is often followed by functional disorders such as mandibular hypomobility, pain, and masticatory dysfunction.

Keywords: Mandible, condyle, fracture, surgical treatment, dislocation.

INTRODUCTION:

In facial trauma mandibular fractures are extremely common in frequency, and around 19-52% of the fractures involve the condyle and the condylar process. Anatomical location is the key feature according to which the condylar fractures are classified (intracapsular and extracapsular) and degree of dislocation of the articular head also is taken into consideration. Since osteosynthesis materials were introduced for rigid internal fixation after anatomical reduction an ongoing current discussion regarding the treatment of condylar fractures of the mandible is on its progression. There are two types of therapeutic approaches to the fractures the first is functional and second is a surgical approach^[1].

In the recent past, it has become more common for the open treatment of condylar fractures and this is due to the introduction of plate and screw fixation devices that facilitate the stabilization of these occurred injuries. Moreover, there are many reports and a very less insight about open treatments have been recorded in the literatures^[2].

Intracapsular fractures occurring in condyle of mandible are classified as type A, fractures through the medial condylar pole; type B, fractures through the lateral condylar pole with loss of vertical height of the mandibular ramus; or also could be classified as type M, multiple fragments, comminuted fractures. The condylar neck is majorly involved in mandibular condyle fractures, with few reports of intracapsular fractures. Sagittal or vertical fractures of the mandibular condyle and chip fractures of the medial part of the condylar head are rare to be found by conventional radiograph techniques and are also commonly detected by a computed tomography (CT) scan^[3].

For moderate severity in displacement of condylar fractures, rigid or elastic maxillomandibular fixation is still commonly selected for a closed treatment. The reasons for this may be the difficult surgical access to the condylar area and the commonly difficult repositioning of the proximal fragment of the condyle. An open reduction and internal fixation of condylar fractures may be advised for bilateral injuries or considerably displaced condylar fractures, but closed treatment and intermaxillary fixation (IMF) may be advised in cases where condylar displacement is minimal, and the height of the ramus of the mandible is almost normal.^[4]

Functional therapy is adopted most frequently, since it allows fast mobilization and required functional stimulation of condylar growth and bone remodelling. It is indicated in almost all condylar fractures that occur in childhood, and in intracapsular and extracapsular fractures that do not include serious condylar dislocation in adults. In contrast, surgical treatment is advised priorly for adults with displacement or dislocation of the condylar head.^[5]

25–35% are condylar among mandibular fracture. Many studies have focused if treating such fractures by open or closed treatment method. A brief guideline for closed treatment is inadequate, but such guidelines could result in a good clinical practice. The treatments given were highly variable, ranging from doing nothing to applying maxilla mandibular fixation with stainless steel wires. The results of the different studies and the treatment modalities used were difficult to interpret; however no clear differences in the outcome measures were seen between the treatment modalities applied.^[6] Complications encountered after closed treatment included malocclusion, limited mouth opening, reduced range of motion, and persistent pain. Due to the heterogeneity between groups, high loss-to-follow-up, poor descriptions of the treatments given, and variability in outcome measurement methods, no clear associations between adverse outcomes and the treatments applied could be determined.^[7] This review suggests that due to the high level of methodological variability in the relevant studies published to date, there are currently no uniform standards for the closed treatment of condylar fractures that can be expected to yield good clinical results. The establishment of such standards could potentially improve treatment outcomes.

Sixty-one patients treated by open reduction and internal fixation for unilateral condylar process fractures were studied prospectively to Ellis, Throckmorton and Palmieri^[8] using Towne's and panoramic radiographs. The images were traced and digitized, and the position of the fractured condylar process was statistically compared with the position of the nonfractured condylar process in both the coronal and sagittal planes. After surgery, the difference in position between the fractured and nonfractured sides averaged less than 2° (not significantly different), indicating good reduction of the fractures. However, subsequently, between 10% and 20% of condylar processes had postsurgical changes in position of more than 10°. This study showed that it is possible to anatomically reduce the fractured condylar process, but changes in position of the condylar fragment may then result from a loss of fixation.^[9]

A study conducted on closed treatment that consisted of maxillomandibular fixation (MMF) with wires if there were severe occlusal disturbances. Mild occlusal disturbances were treated with elastic MMF. If there was no occlusal disturbance, a soft diet was advised. Sixty patient files were analyzed and 28 patients were seen for re-examination and an X orthopantomogram was taken. Functionality was graded with the Helkimo index at an average of 3.0 years follow-up. The clinical dysfunction index showed: severe symptoms in 11%, moderate symptoms in 39%, mild symptoms in 39% and 11% had no symptoms. Index for occlusal state showed: 21% severe occlusal disturbances, 61% moderate occlusal disturbances and 18% no occlusal disturbances. According to the anamnestic dysfunction index 89% of the patients were symptom-free. The clinical outcome group showed a significant left/right ramus length difference compared with a 20-person control group. The re-examined group did not significantly differ from the control group^[10].

With the objective of analyzing the main variables that determine the choice of the method of treatment and the outcome in condylar fractures, Villarreal et al.^[11] conducted a retrospective analysis of 104 mandibular condyle fractures to analyze and determine the relationship between the principal clinical variables and the postoperative results. All patients underwent a clinic-radiologic investigation focusing on fracture remodeling, development, dental occlusion, and symmetry of the mandible. They analyzed the influence of the preoperative clinical variables (level of fracture, treatment, postoperative physical therapy, displacement and dislocation, comminution, loss of ramus height, patient age, gender, etiology, occlusion, status of dentition, and presence of facial and mandibular fractures) on the post-operative results and outcome. The principal factors that determined the treatment decision were the level of the fracture and the degree of displacement. The level of the fracture influenced the degree of preoperative coronal and sagittal displacement (neck fractures had greater medial and anterior displacement than head and subcondylar fractures) and the treatment applied.^[12] The functional improvement obtained by open methods was greater than that obtained by closed treatment^[13]. Open treatment increased the incidence of postoperative condylar deformities and mandibular asymmetry^[14]. The variables that influenced the method of treatment and predicted the prognosis were the level of fracture, degree and direction of displacement of the fractured segments, age, medical status of the patient, concomitant injuries, and status of dentition^[15].

To compare the occlusal relationships after open or closed treatment for fractures of the mandibular condylar process, a total of 137 patients with unilateral fractures of the mandibular condylar process (neck or subcondylar), 77 treated closed and 65 treated open, were included in the study of Ellis, Simon and Throckmorton. Standardized occlusal photographs obtained at several postsurgical time intervals were examined and scored by a surgeon and an orthodontist. The patients treated by closed techniques had a significantly greater percentage of malocclusion compared with patients treated by open reduction, despite the initial displacement of the fractures being greater in patients treated by open reduction.^[16]

COMPLICATIONS:

Muscle spasm, pain, malocclusion, restricted mandibular movement, facial asymmetry and deviation of the mandible, osteonecrosis and pathological changes in the TMJ and ankylosis, are the common complication in condylar fractures, irrespective of whether treatment was performed or not. They also include fracture of the mandibular fossa of temporal bone fracture, tympanic plate, with or without displacement of the condylar segment into the middle cranial fossa, damage occurring to the cranial nerves, growth disturbance, vascular injury, bleeding, arteriovenous fistula, and can potentially change the balance in the muscles of mastication.^[17]

TREATMENT:

In a recent prospective study, 32 cases no treatment was deemed necessary. In addition there were 9 cases with concomitant fractures treated with osteosynthesis where no surgical intervention was considered necessary for the condylar fracture. That brings the total number of untreated condylar fractures to 41. Physical therapy was the only form of treatment in additional 9 fractures bringing the total of condylar fractures where no surgical treatment was applied to 50.^[18]

Intermaxillary fixation as the sole mode of treatment was applied in 167 cases. To the above number one should add 149 cases where intermaxillary fixation was part of the treatment for associated fracture(s) in other parts of the mandible (or the maxilla) that were treated with osteosynthesis. That brings the total of cases treated with intermaxillary fixation to 316.^[19]

Miniplate osteosynthesis of a condylar fracture was applied in 22 cases. From these 19 cases were associated with other fractures. In only 1 case unilateral condylar osteosynthesis was applied (this was associated with other fractures as well). All fractures treated with open reduction were sub-condylar fractures. In all but two there was malocclusion. In the one case with no occlusal deviation there was dislocation and in the other there was lateral displacement of the condyle, which also had occurred in another two fractures treated with open reduction; the latter, however, also demonstrated malocclusion. Altogether 16 of the fractures that were treated with miniplates demonstrated displacement: in 9 cases it was medial, in three it was lateral, anteroposterior override was recorded in 3 and there was no contact in 1 case. Six cases with no displacement were also treated with open reduction; they were all associated with malocclusion; two cases without malocclusion were treated with miniplates; in one of these the condyle was dislocated and in the other there was lateral displacement and no contact between the fragments. Intermaxillary fixation was applied in 19 of the 22 cases treated with osteosynthesis.^[20]

Physical therapy was part of every treatment. Mouth opening, and deviation was checked on a weekly basis. More complicated cases were followed more often. Those in intermaxillary fixation were also checked weekly. At that time the intermaxillary fixation was removed and the patient was advised to open and close the mouth for about an hour or an hour and a half before maxillomandibular fixation was applied again.

CURRENT TECHNIQUES FOR MANAGEMENT OF COMPLICATIONS:

In the past, closed reduction with concomitant active physical therapy that is conducted after intermaxillary fixation during recovery period had been mainly used.^[21] However, as it has disadvantages such as metastasis of the fractured bone by muscle strength, abnormal occlusion due to inappropriate fixation, and inappropriate function of the temporomandibular joint (TMJ) due to disuse muscular atrophy caused by long-term intermaxillary fixation, open reduction has recently drawn attention. In particular, condyle fracture is satisfactorily treated by closed reduction. Many researchers recommended closed reduction because of problems of surgical approach, such as infection, injury of nerve and blood vessel, and scar formation.^[22] However, compared to previous open reduction, it has been currently more widely used by minimizing complications such as TMJ pain and arthritis, and mouth opening limitation via accurate reduction of bony fragment with the development of surgical instruments and surgical approaches.^[23]

However, it is still controversial over the selection of either closed or open reduction to treat condyle fracture depending on displacement severity and fracture site ^[24] reported that open reduction should be conducted if fractured mandibular condyle is severely displaced, and that closed reduction may be conducted considering various factors such as elderly or pediatric patients, difficulty in the conduct of open reduction under systemic anesthesia, no other facial fracture, and secured stability of occlusion.

OPEN REDUCTION METHOD:

There are various operation methods of open reduction for mandibular condyle fracture depending on fracture site and degree of bone fragment displacement. In general, they include preauricular approach, postauricular approach, submandibular approach, Risdon approach, combined approach, and retromandibular approach. Treatment type should be selected considering patient's age, preference, fracture type, fracture of other sites, and teeth status.^[25]

ADVANTAGE:

Open reduction has advantages of the reduction of the displaced bony fragment to the most ideal anatomical site by a direct approach to the fracture site. In addition, it can prevent complications such as respiration disorder, pronunciation disorder, and severe nutritional imbalance by shortening intermaxillary fixation period via rigid fixation.

DISADVANTAGE:

Open reduction is an invasive treatment, which may cause injury of nerves or blood vessels during operation, and postoperative complications including infection. In addition, it has permanent scar though the surgery is conducted after designing the incision line considering aesthetics.

OPERATIVE PROCEDURE

PREAURICULAR APPROACH:

Preauricular approach reduces condyle fracture by incising 3 to 4 cm from the inferior border of the tragus toward external auditory canal along the skin crease of the anterior part of the external ear. It provides an easier approach to high condylar fracture such as intercapsular fracture, easy reduction of the injured soft tissues of the TMJ, and reduction via a direct inspection of the appropriate relationship among the condyle, disc, and joint with eyes. In particular, preauricular approach is very useful for the case of the condyle fragment anteromedially displaced by the pulling of the medial pterygoid. However, an approach to the mandibular angle fracture is very difficult if the mandible should be pulled inferiorly to find the displaced proximal segment. Furthermore, as the amount of exposing the mandibular ramus is very limited, rigid fixation using mini-plate is hard to be conducted if fracture site is positioned inferiorly to the mandibular condyle neck.^[26]

POSTAURICULAR APPROACH:

The postauricular approach is a method that reduces the condyle fracture by incising from a site 3 mm posterior to the postauricular curved region along the curved region, and by incising the mastoid process inferiorly and the upper ear-attached region superiorly. It can be used for the reduction of high condyle fracture. This method has advantages of excellent aesthesis due to the approach from the posterior side of the ear, avoiding injuries of the facial nerve branch and superficial temporal artery, low risk of parotid injury, and securing the surgical field for the TMJ region. Meanwhile, it has disadvantages of a narrow surgical field for mandibular condyle neck fracture, difficulty in using surgical devices, complications such as external auditory canal stenosis, tinnitus, infection and necrosis of auricular cartilage, permanent auricular paresthesia due to injury of the external auditory canal, and longer wound closure time compared to the preauricular approach.^[27]

SUBMANDIBULAR APPROACH:

The submandibular approach reduces condyle fracture by conducting incision from a site 2 to 3 cm inferior to the mandibular inferior border, parallelly to the mandibular inferior border or along with the skin crease. Due to its easier approach to the mandibular ramus, inferior mandibular condyle, and coronoid notch, it is commonly used for mandibular condyle fracture. However, it has disadvantages of requiring excessive traction for reducing mandibular condyle fracture, requiring rigid fixation using percutaneous trocar for reducing high condyle fracture due to difficulty in an direct approach to the site of the fracture line formed, and requiring deep tunneling for mandibular condyle fracture due to a long distance from the incision line to the fixation site, and requiring the use of mini-plate due to poorly secured surgery field. Furthermore, it has disadvantages of the possible risk of the injury of inferior alveolar branch of the facial nerve, submandibular scar formation, difficulty in approaching the high condyle fracture site, and difficulty in examining the internal structure of the TMJ.^[28]

RISDON APPROACH:

Risdon approach is a method like submandibular approach. It can easily approach to the inferior region, ramus, gonial angle and posterior body of the mandibular condyle. If the upper flap is intensively retracted, even mandibular condyle inferior and neck fractures can be exposed. Reduction of bone fragments can be easily conducted by traction the mandibular gonial angle inferiorly. Meanwhile, like submandibular approach, Risdon approach requires excessive traction for high condyle fracture.^[29]

COMBINED APPROACH:

This method reduces both inferior and superior fractures of the mandibular condyle by applying preauricular approach and submandibular approach simultaneously. This method is very useful as mandibular sub-condyle fracture is reduced using submandibular approach, and the superior fractures of the TMJ or mandibular condyle neck is approached via preauricular approach and bone fragments are reduced while putting in traction the mandible inferiorly. Meanwhile, due to the use of two approaches, combined approach has disadvantages of relatively longer operation time, large scar formation, high risk of the injury of facial nerve, and risk of secondary TMJ disease due to scar formation on the TMJ capsule by preauricular approach.^[30]

INTRAORAL APPROACH:

Intraoral approach reaches the mandibular condyle in a way similar to vertical ramus osteotomy. The incision line is formed along the anterior mandibular ramus and buccal sulcus. For the achievement of surgery field and device approach, the temporalis muscle attached to the mandibular ramus and the periosteum of the buccinator located at the body should be completely dissected to elevate them. This method has advantages of no scar formation and the minimum injury of facial nerves. Meanwhile, an approach using devices is difficult though operation field is secured using an endoscope. Furthermore, percutaneous trocar should be used for rigid fixation using metal plate after reduction. It has disadvantages of difficulties in the maintaining of bone fragment stability and in the observation of the internal structure of the TMJ for mandibular subcondyle fracture.^[31]

Retromandibular approach

Retromandibular approach reduces condyle fracture by dissecting the skin and subcutaneous tissue vertically to the mandibular angle using the 3-cm incision line to the 5 mm inferior to the auricular lobe. This method provides easy reduction and rigid fixation for mandibular subcondyle fracture. Percutaneous trocar is not required as the method can tract the tissues anteriorly and superiorly at the sigmoid notch. It also provides reduction and rigid fixation for high condyle fracture, where incision length is small. Furthermore, this method has advantages of insignificant scar formation due to the incision made at the posterior mandibular ramus, and the sufficient exposure of bone fragments to the upper part of the mandibular ramus. However, it has disadvantages of risk of the injury of facial nerves and bleeding caused by the injury of blood vessels.^[32]

Paediatric population

For the treatment of mandibular condyle fracture in pediatric patients, anatomical structure and physiological and psychiatric development should be considered as they differ between pediatric and adult patients though pathogenesis and clinical manifestation are similar between the two groups. Pediatric patients have the facial bone covered with thick soft tissues, elastic bone structure, and the thin cortical bone and also have a large amount of premature trabecular bone. Thus, no severe impact occurs upon receiving trauma. In general, incomplete fracture with a greenstick type occurs.^[33]

As teeth alignment has a status of primary or mixed dentition, and most of the growing crown of the permanent tooth has not been completely established yet, the ratio of bone tissue to the tooth is relatively low. Thus, un-erupted teeth are easily included in the fracture line, and complications such as the fracture, loss, delayed eruption of the growing tooth may occur if unerupted permanent teeth are injured. If the intermaxillary fixation period is maintained for 2 weeks or more, mandibular growth disorder and the injury of the teeth undergoing eruption may occur. Thus, in pediatric patient, open reduction of the condyle is invasive for itself, and has a risk of facial nerve injury. Furthermore, no significant difference in prognosis is found compared to closed reduction. Thus, a non-surgical approach is recommended, in which intermaxillary fixation period should be 2 weeks or less.^[34]

Accordingly, the authors principally conduct functional therapy after closed reduction for intracapsular fracture in the treatment of mandibular condyle fracture. Intermaxillary fixation is maintained for 2 weeks in patients aged less than 5 years, and for 2 to 4 weeks in patients aged 5 years or higher depending on physical development and patient compliance. In the case of extracapsular mandibular condyle fracture, closed reduction is conducted, followed by functional therapy after 2-week intermaxillary fixation in patients aged 5 to 8 years. Meanwhile, open reduction is preferentially considered in patients aged 8 years or higher. If open reduction is impossible, closed reduction is conducted, followed by 4-week functional therapy after 3 to 6-week intermaxillary fixation. Then, occlusion and TMJ dysfunction are carefully observed every 3 months.

CONCLUSION:

In the treatment of unilateral mandibular condyle fracture, conservative treatment using closed reduction and surgical treatment using open reduction are used. However, it is still controversial over indications. Thus, treatment type should be selected considering patient's age, fracture type, patient's systemic status, other fracture, teeth, and possibility of occlusal restoration by intermaxillary fixation, and existence of foreign materials. In the final determination of treatment plan, the advantage, disadvantage, and risk of each treatment, and risk of complications should be sufficiently discussed with patients and patient's guardians. In addition, the treatment plan of mandibular condyle fracture should be established considering the aforementioned various factors rather than the criteria for absolute indications using the treatment guideline suggested by the authors.

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