

# *To investigate the clinical application of three-dimensional rigid internal fixation in the treatment of anterior mandibular fractures*

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**Abstract:** The mandible is located in the lower part of the face, with a special bow shape and hard texture, and it is the only movable bone in the maxillofacial region. In recent years, maxillofacial fractures have been on the rise year by year, and the degree of injury is getting worse and worse, because the mandible is in a more prominent position in the maxillofacial region, and it is prone to fracture after being subjected to an external force. The traditional internal fixation method is to fix the mandible at the lateral side, which can achieve effective fixation in two-dimensional space and prevent the bending moment generated by the fracture, but it cannot effectively prevent the torsion generated by the fracture. And there was obvious torsion of the fractured segment in the fracture of the mandibular chin median and chin foramen region. Two-point fixation is preferred in the fixation of median union fracture, and the distance between the two points of fixation should be increased as much as possible in order to improve the stability of fixation without injuring the important anatomical structures. Therefore, the fixation of median and paramedian fractures of the mandible, in addition to fixing the fracture horizontally under the apical level to overcome the tension, the fracture of the mandible should be fixed at the lower margin to overcome the torque. Therefore, the three-dimensional fixation of the lower edge of the titanium plate to the lower edge of the mandible has a small displacement of the fracture segment, and the smaller the displacement, the more stable the fixation, and the more favorable to the healing of the fracture to reduce the occurrence of postoperative complications.

## 1. Introduction

Trauma has become the main cause of death in humans. More than 100,000 people die and millions are injured every year. Human maxillofacial anatomy is in a special position, protruded from the body surface and exposed to the external environment, which is susceptible to external impact and trauma [1]. Oral and maxillofacial trauma accounts for 7% to 20% of total body trauma. In maxillofacial bones, the mandible occupies a part of the lower and middle face, with a large area and prominent anatomical position, and is easily affected by various external forces. Therefore, the fracture probability of the mandible is higher than that of other parts of the maxillofacial bones.

## 2. Types of mandibular fractures

According to the purpose of diagnosis and treatment, there are various classification methods for mandibular fractures, which can be classified according to the characteristics of fracture nature, presence or absence of teeth, direction and Angle of fracture line, fracture severity, fracture displacement, fracture location, etc [2]. Because there are weak places on the mandibular anatomy, fractures are often caused by several weak places. The most common classification method of mandibular fracture is according to its anatomical location, which can be divided into: mandibular joint and paramental fracture, body fracture, mandibular Angle, ascending branch fracture, coracoid process fracture, condylar process fracture, alveolar process fracture, etc.

## 3. Clinical manifestations of mandibular fracture

The maxillofacial skeleton has important physiological functions and plays an aesthetic role in supporting facial appearance. Once it is improperly handled, it will not only affect people's physiological functions such as eating, chewing, and speaking; And it may change facial appearance to a greater extent, which can cause a series of physical and psychological problems. It increases the social burden, especially for mandibular fractures, if not treated in time, it may even lead to respiratory obstruction and endanger life. Facial fracture common signs: deformity, abnormal movement, rubbing sensation; The specific manifestations in the maxillofacial region are: facial swelling and deformity, limited mouth opening, malocclusion, and bone rubbing [3]. For the mandible with the attachment of the maxillary muscle group, it is easy to displace after fracture due to the different traction directions of the muscle group. Patients with nasal bone fracture may have unique clinical manifestations in other parts of the body, and may also have olfactory disorders, poor breathing, and other conditions. Periorbital fractures can cause periocular problems such as enophthalmos, diplopia, and visual impairment. Orbital wall fractures can cause damage to the eyeball, eye muscles, and optic nerve. Severe blowout fracture of the orbital floor can cause the eyeball or displacement of the eyeball to fall. The corresponding clinical manifestations of facial nerve injury after facial tissue edema and compression or trauma may occur. The facial nerve injury may have the symptoms of limitation of eyebrow raising, limitation of eye opening, shallow nasolabial fold, deviation of mouth, tympanic and cheek air leakage, and the damage of the upper and lower orbital nerves, leading to the corresponding numbness in the upper and lower orbit, chin and other parts.

### 3.1 Treatment of mandibular fracture

Mandibular fracture can cause muscle, nerve, blood vessel and other system damage, which increases the difficulty of treatment. Mandibular fracture affects the patient's facial appearance, chewing and speech function. In severe cases, it may be life-threatening due to obstructive asphyxia or inhalation asphyxia. Therefore, orderly, standardized and reasonable treatment should be given to patients with mandibular fractures. The goal of the treatment of mandibular fractures is to restore the occlusal relationship, anatomical structure and temporomandibular joint function to the original state as much as possible, and to fix the broken end of the fracture to make it in a relatively stable state.

### 3.2 Intermaxillary fixation

Refers to the reduction and fixation of the broken end of bone by ligating and fixing the upper and lower dentition through dental arch splints or other traction devices, with the main purpose of fixing the broken end of fracture and restoring the patient's occlusal relationship [4]. Traditional

intermaxillary fixation can cause great pain to patients, cause damage to the soft tissues in the mouth, and make it difficult for patients to exercise chewing and speech functions. The stability required for fracture healing cannot be provided, and it is easy to cause malposition of the fracture segments of the mandible to heal, resulting in occlusal disorder. In addition, during intermaxillary fixation, the patient was unable to open his mouth due to swelling of the oral soft tissues. It is easy to cause obstructive asphyxia and crisis the life of the patient. Traditional intermaxillary retention devices, such as dental arch splints, ligature wires, and bindings, etc. Although it has the advantages of good economy and relatively simple use, it also has many disadvantages, such as poor fixation effect and long time.

### **3.3 Two-dimensional double-plate internal fixation technique**

For median and paramedian mandibular fractures, usually two plates are placed on the labial side of the mandible, and the two plates are parallel to achieve effective fixation in two-dimensional space. When the median and paramedian mandible fracture occurs, the continuity of the mandible is interrupted, and the retraction of the suprahyoid muscle group, masseter muscle and temporal muscle can easily lead to mandibular retrusion and the widening of the entire dental arch [5]. Compared with vertical linear fractures, oblique fractures are more common in clinical practice. The difference in curvature between the labial, buccal and lingual cortical bones of the mandible makes it more prone to oblique split under force. Since most of the suprahyoid muscles are attached to the lower margin of the mandible and the lingual side, this type of fracture causes great differences in force on the labial and lingual sides, and the displacement of the fracture end is more obvious than that of the median vertical linear fractures. The effect on dental arch morphology was also greater. During the operation, the surgeon can not directly see the lingual fracture line, so ignoring the lingual fissure leads to a series of complications. Lingual cleft will cause the increase of mandibular width, so that the mandibular dental arch becomes wider and the occlusal relationship is abnormal. When the mandibular width increases, the position of the condyle in the glenoid fossa will change, which will lead to the dysfunction of the temporomandibular joint and the change of the patient's facial appearance. This fixation method can prevent the bending moment and shear force, but can not prevent the torque, which is obvious in the middle of the mental region and the mental foramen region of the mandible.

### **3.4 Three dimensional double plate internal fixation technique**

When the mandible is fractured in the middle and paramedian, a bone plate is placed on the lip side and a bone plate is placed under the lower margin of the mandible to achieve effective fixation in three-dimensional space. After the fracture of the mandible, when the mandible is subjected to the interaction of forces, the bending moment and shear force appear at the broken end of the fracture, and the torque effect will also occur. In order to achieve the purpose of strong internal fixation, the internal fixation should resist not only the bending moment force in the direction of the two broken ends, but also the torsional force in the direction of the buccal tongue, so as to ensure the braking of the broken end of the fracture [6]. In the case of three-dimensional double plate fixation, the lower margin of the mandible is fully exposed by the intraoral approach combined with the extra-oral approach or the intraoral approach during the operation, and whether the fracture is reduced or not and whether the lingual fissure is closed is determined by the lip and the lower margin of the mandible. Therefore, domestic and foreign scholars [11] tried to fix a small horseshoe-shaped version consistent with the mandible shape at the lower edge of the mandible to counter the mandible's abduction and achieve the effect of closing the lingual space.

## **4. Common postoperative complications**

### **4.1 Occlusal disorder and occlusal interference**

Occlusal disorder and occlusal interference are mainly caused by failure of anatomical reduction and malunion [7]. Rigid internal fixation is performed under the direct vision of the soft tissue, and the broken end of the fracture can theoretically achieve anatomical reduction. However, in practice, anatomical reduction is often affected by the degree of injury, the location of fracture, the size of fracture displacement, the condition of neuromuscular damage, and the difficulty of some patients to cooperate under local anesthesia. In particular, there is a large amount of granulation tissue formation at the time of fracture. At the same time, it is accompanied by bone resorption, which makes it more difficult to complete anatomical reduction. In addition, the bending failure of the titanium alloy plate and the displacement of the fracture end during fixation are also the common causes of such complications.

### **4.2 Nerve injury Facial nerve injury**

The cause of nerve injury is related to the anatomy of the mandible. For example, the inferior alveolar nerve in the mandibular canal is shaped [8]. The mandibular canal is located in the mental foramen area and mandibular Angle area, which are anatomically weak in the mandible. When these areas are prone to fracture, it is easy to cause damage to the inferior alveolar nerve, resulting in sensory dysfunction in its control area, such as numbness, discomfort, pain and other symptoms in the affected tongue, gingiva, lower lip and other areas, which has a great impact on the psychological and physiological function of the patient. So the fracture of the mandible is treated at the same time. Repair and protection should be given as much as possible during the operation.

### **4.3 Influence of children's jaw**

Development in children with mandibular fracture should be based on the specific conditions of the patient, the development of different treatment methods. In clinical conservative treatment, most of the children with mild fracture displacement, no obvious occlusal disorder and little facial deformation are commonly retained for cranio-maxillofacial bandages, dental arch splints and orthodontic brackets. If the fracture displacement is obvious and affects the patient's speech and occlusal function, rigid internal fixation can be selected. After micro-titanium plate internal fixation, the feeding and language functions of children are not affected, and oral hygiene is maintained, which alleviates the pain of children. Especially, with the application of polymer absorbable bone plate, the pain of second operation is relieved. It has now become the main treatment for mandibular fractures in children [9].

### **4.4 Relationship between mandibular fracture and infection**

Infection is a common disease. It can be seen in various fracture types and various surgical methods. The main clinical manifestations are local swelling, obvious tenderness, accompanied by limited mouth opening, and in severe cases, pus and whole body fever [10]. There are many reasons for the occurrence of infection. In addition to the source of infection, it is also related to the fracture injury site and unstable retention. It is necessary to strictly perform aseptic operation, thoroughly wash the wound, remove residual bone fragments and blood clots, completely stop bleeding, place drainage devices in the operation area when necessary to prevent the formation of wound effusion, rationally use antibiotics after operation, and pay attention to maintaining oral cleanliness [11].

#### 4.5 Relationship between mandibular condylar fracture and traumatic temporomandibular joint ankylosis

Patients with condylar fracture are prone to temporomandibular joint ankylosis, which has a serious impact on the patient's mandibular chewing, speech and other functions. It will cause great harm to the patient physically and psychologically. At present, the pathogenesis of traumatic temporomandibular joint ankylosis has not been fully understood. However, condylar fracture after trauma has been widely recognized as the main cause of condylar fracture. Among the types of condylar fracture, intracapsular and sagittal fractures are more likely to cause traumatic TMJ ankylosis. The patient presented with limited mouth opening. Severe cases are characterized by trismus. Due to the weakening of masticatory function and the destruction of the condyle of the growth center, the patient's lower face deformity can be caused, which is common in children. In addition, due to the disorder of mandibular development, the lower face deformity can be caused, and there is no development space for the dental arch, which makes the dental arch narrow and causes the disorder of the occlusal relationship [12].

#### 5. Conclusions

With the rapid development of medicine, the application of some new treatment methods can make the patient's maxillofacial injury return to the pre-injury state as far as possible, without affecting the patient's participation in social activities and avoiding psychological problems [13]. The traditional method of internal fixation is to fix the lateral surface of the mandible, which can achieve effective fixation in two-dimensional space and prevent the bending moment caused by the fracture segment, but can not effectively prevent the torque caused by the fracture segment. However, in the middle of the mandibular symphyseal region and the mental foramen region, the fracture segment has obvious torsion [14]. On the premise of not damaging important anatomical structures, the distance between the two points should be as large as possible to improve the stability of fixation. Therefore, the fixation of the median and paramedian mandibular fractures should not only be fixed at the subapical level to overcome the tension, but also at the lower edge of the mandible to overcome the torque. Therefore, the three-dimensional fixation of the lower edge titanium plate fixed to the lower edge of the mandible has a small displacement of the fracture segment, and the smaller the displacement, the more stable the fixation, and the more conducive to fracture healing and reduce the occurrence of postoperative complications. Oral and maxillofacial fracture is rising due to the economic growth, and is often combined with other parts of the injury, the doctor must have a global concept, the treatment of maxillofacial fracture should be timely and efficient, on the basis of saving the patients life, reduce the occurrence of facial deformity and oral physiological dysfunction [15].

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