The Relationship between Temporomandibular Joint Ankylosis and Condylar Fractures

Xing LONG[1]

Trauma is the predominant causal factor for temporomandibular joint (TMJ) ankylosis. However, the relationship between condylar fracture and TMJ ankylosis is complicated. It is believed that post-traumatic TMJ ankylosis arises from TMJ intracapsular changes, including damaged cartilage, displaced or disrupted discs, haematoma formation and subsequent fibrosis and calcification in the joint. In this review, the relationship between TMJ ankylosis and condylar fracture is discussed based on clinical characteristics and animal studies. The management of TMJ ankylosis is also reviewed and discussed.

Key words: *temporomandibular joint, ankylosis, condylar fracture*

The relationship between temporomandibular joint (TMJ) ankylosis and condylar fracture remains controversial. Although trauma is the predominant causal factor for TMJ ankylosis, the relationship between condylar fracture and TMJ ankylosis can not be clearly explained. Some authors have suggested that post-traumatic TMJ ankylosis arises from TMJ intracapsular changes, including damaged cartilage, displaced or disrupted discs, haematoma formation and subsequent fibrosis and calcification in the joint[1]. There are numerous reports that discuss risk factors related to post-traumatic TMJ ankylosis. However, almost no studies have focused on the pathogenesis of this condition[2]. Ferretti et al evaluated the joint morphology of TMJ ankylosis patients using coronal computed tomography and suggested that a medially dislocated condylar fracture was more likely to cause TMJ ankylosis than other condylar fractures[3].

Here we discus the relationship between TMJ ankylosis and condylar fracture from basic and clinical studies.

1 Department of Oral and Maxillofacial Surgery, School and Hospital of Stomatology, Wuhan University, Wuhan, P.R. China.

Corresponding author: Dr Xing LONG, Department of Oral and Maxillofacial Surgery, School and Hospital of Stomatology, Wuhan University, #237 Luoyu Road, Wuhan 430079, P.R. China. Tel: 86-10-87686110; E-mail: longxing_china@hotmail.com

Ankylosis of TMJ

Ankylosis is divided into intracapsular and extracapsular ankylosis. Most cases of extracapsular ankylosis do not involve TMJ structure. Intracapsular TMJ ankylosis affects TMJ structure, and even surrounding tissue, including the fibrous adhesions or bony fusion; it can be caused by trauma, infections and previous surgical treatment[4,5].

The infectious factors include local or systemic diseases such as mastoiditis and otitis media; the incidence of TMJ ankylosis of infective origin has decreased due to modern antibiotic therapy. Trauma, frequently associated with condylar fractures, has now become the most common cause of TMJ ankylosis. It has been hypothesised that intra-articular haematoma, scarring and the formation of fibrous tissue and bone fusion of the condyle, disc and fossa cause hypomobility of the mandible[1].

Intracapsular ankylosis can be classified into four different types[6]:
- type I: there is minimal bony fusion, but extensive fibrous adhesions around the joint
- type II: there is more bony fusion, especially at the outer edge of the joint surface, but no fusion within the more medial area of the joint
- type III: there is a bridge of bone between the mandible and the temporal bone
- type IV: the joint is replaced by a mass of bone.

Condylar fracture

Condylar fracture of the mandible is one of the most common types of facial fracture and accounts for 20% to 62% of mandibular fractures. Condylar fractures are classified into condylar head, condylar neck and sub-condylar fractutres, according to the anatomical location of the fracture[7]. Condylar head fracture is also called intracapsular fracture; the fractured condylar fragment can be minimally displaced or displaced out of the glenoid fossa. Condylar neck fracture is a fracture below the condylar head but above the level of the sigmoid notch, and it can be described as minimally displaced or dislocated. Subcondylar fracture is a fracture below the sigmoid notch and extending down towards the posterior border of the mandibular ramus.

Some authors have classified condylar fractures as intracapsular, high condylar neck and low condylar neck fractures[8]. Intracapsular fractures were rarely reported before the advent of combined conventional radiographic and computerised tomography (CT) examination. Intracapsular condylar fractures comprise three subtypes[9]:

- type A: the fracture passes through the medial condylar pole, without change to the vertical height of the mandibular ramus
- type B: the fracture passes through the lateral condylar pole, with loss of vertical height of the mandibular ramus
- type M: multiple fragments or comminuted fractures.

Arakeri et al have mentioned that ankylosis can result from sagittal fracture of the condylar head; the lateral fragment can be displaced upward, over the outer rim of the glenoid fossa, causing displacement of the disc and loss of mandibular movement. However, the role of sagittal condylar fracture in the aetiology of ankylosis is still controversial[2].

Animal model for condylar fracture and ankylosis

Based on clinical observations and animal experimental study, we have suggested that certain types of condylar fracture and disc play an important role in the development of TMJ ankylosis[10]. An animal model of type B intracapsular condylar head fracture using sheep was successfully established; the model showed progressive change toward ankylosis over time, consistent with the changes in the human TMJ[11]. The pathological examination after intracapsular oblique vertical split fracture showed the joint spaces were filled with fibrous tissue, cartilage tissue and bone at different stages[12]. Accord-

ing to the clinical observations and animal experimental study, we concluded that intracapsular condylar fracture – especially the condylar stump attached to the temporal bone, displaced condylar fragment and damaged disc and lateral capsule – play a role in the development of TMJ ankylosis.

Treatment of TMJ ankylosis

It is difficult to manage TMJ ankylosis because of the high rate of recurrence. Surgical treatments are variable and not very satisfactory[5,7,13,14]. The most popular surgical treatments for TMJ ankylosis include gap arthroplasty, interpositional arthroplasty and joint reconstruction with autogenous or alloplastic materials[7,13,15].

Gap arthroplasty for type I and II ankylosis involves making a gap of 3 to 5 mm between the articular fossa and the condyle, and for type III and IV, the removal of the mass of bone to create a false joint. For type I, the fibrous adhesions can be released using TMJ arthroscopy. We have reported a case of bilateral TMJ fibrous ankylosis associated with ankylosing spondylitis that was successfully treated with TMJ arthroscopy[16].

Interpositional arthroplasty using autogenous or alloplastic material at the gap site is a method for preventing bony fusion recurrence, and interpositional material is not required if the disc is intact[5,15,17]. Various interpositional materials have been used, including temporal muscle, skin, homologous cartilage, silicon sheet, acrylic marbles, dermis[18], silicone[17] and cartilage[19]. The temporalis muscle is the most widely used interpositional material[20]; autogenous auricular cartilage has also been used as an interpositional graft after gap arthroplasty for TMJ ankylosis[21]. However, there are significant disadvantage to using autogenous or alloplastic material in interpositional arthroplasty, owing to side effects at the donor site, resorption of autogenous material and foreign body reaction[17,21].

There are several methods that have recently shown good results for the treatment of traumatic TMJ ankylosis. Nitzan et al reported four cases of type III ankylosis with resection of the ankylosed sites leaving the displaced condyle and disc in their medial position. The remainder of the condylar stump was contoured, giving the condylar neck and head the final shape of an inverted 'J' and creating a large gap between the glenoid fossa and the stump. The follow-up showed excellent results[22]. That study proposes a hypothesis regarding the value of saving the fractured condyle and disc in the displaced position of the ankylosis. In our previous study the displaced condylar fragment was removed and the remains of the disc were mobilised by separat-

ing the bony fusion between the condylar stump and the lateral side of the fossa or eminence, indicating that bony ankylosis of TMJ mainly occurred in the lateral and posterior region of the joint; in addition, the disc is also dislocated medially and anteroinferiorly with the fragment[10].

TMJ reconstruction may be necessary for patients with extensive osteotomy and shortage of mandibular ramus height. There are a number of different methods for TMJ reconstruction, such as costochondral grafts, clavicular osteochondral grafts, iliac crest grafts, coronoid process grafts, alloplastic condylar implants and distraction osteogenesis[5,23-26].

Treatment of condylar fracture

There is still some controversy over the management of mandibular condylar fractures. Fractures have been treated with either closed or open reduction, but with no difference in outcomes[27-29].

Non-surgical methods are the most widely used approach for the treatment of condylar fractures in paediatric patients[8,30-32]. In our previous study, screw-based semi-rigid intermaxillary fixation combined with an occlusal splint was used to treat paediatric mandibular condylar fractures. This kind of method provides early movement of the mandible with functional stimulation for remodelling of the fractured condyle[32]. De Riu et al point out that non-surgical methods can cause facial asymmetry and inclination of the occlusal plane in the long term because of incomplete anatomical restoration[26]. Open reduction and rigid internal fixation reduce the condylar fragments to anatomic position, resulting in earlier bone healing and providing a more rapid and complete joint functional recovery. However, there are complications related to the surgical approaches and the methods of reduction and fixation.

Complications occur after the treatment of condylar fractures regardless of whether they are treated surgically or non-surgically. For surgical approaches, temporary or permanent facial nerve damage and visible scarring have been reported[33]. Preauricular incision is the preferred choice for fractures of the condylar neck and head. The method of fixation is also determined by the type of fracture. Many methods have been described for the surgical treatment of condylar fractures, including the use of wire, lag screws, plates, screws and external fixators[34]. Plates and screws have become the most frequently used method for osteosynthesis for condylar fractures. However, double miniplates are not suitable for higher fractures or with extraoral surgical access, because facial nerve damage may occur. Long

screws are suited to the sagittal condylar fracture, not only because of their advantages over miniplates or Kirschner wires for restoration of ramus height, but also because of their great biomechanical stability[35].

Conclusion

Ankylosis is most likely caused by intracapsular injury followed by insufficient jaw movement and a long period of intermaxillary fixation[36]. It is clear that intracapsular condylar fracture, destruction of the condylar cartilage, capsular injury, displaced or broken disc and limited mandibular movement have resulted in TMJ ankylosis[10]. Management of TMJ ankylosis and condylar fracture is very important for preventing occurrence or recurrence of ankylosis.

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