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Clinical Paper
TMJ Disorders

Clinical investigation of early post-traumatic temporomandibular joint ankylosis and the role of repositioning discs in treatment☆

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Abstract. This study investigated the development of temporomandibular joint (TMJ) ankylosis after condylar fracture and the functional results of surgery that included repositioning of the articular discs. In a total of 18 patients, there were 13 cases of fibrous ankylosis (type I) and 11 of partial bony ankylosis (type II). CT scans for both groups and MRI scans for type I patients were analysed. Intraoperative inspection of the damaged disc, the sites of adhesion or bony fusion, and remaining intra-articular movement was recorded. After release arthroplasty and repositioning of discs, follow-up was for 1 to 3.5 years (mean 2.2 years). Post-traumatic TMJ ankylosis was highly associated with sagittal and comminuted condylar fractures. Type I ankylosis usually formed in the 4th to 5th month post-trauma with mean interincisal opening distance of 18.3 ± 5.5 mm. Progression from type I to II ankylosis occurred 1 year post-trauma and caused a reduction of 5 mm in the range of mouth opening. The disc was displaced for each of the involved joints, and intra-articular adhesions or ossification initiated at the site where there was no intervening disc present. After surgical repositioning of the disc, stable joint function and mouth opening from 30 to 45 mm were obtained in all patients but one (recurrence due to dislocation). Sagittal and comminuted condylar fractures predispose the TMJ to ankylosis, and the displacement of the articular disc plays a critical role. Early surgical intervention to reposition the disc was successful for early trauma-induced TMJ ankylosis.

Key words: temporomandibular joint; ankylosis; condylar fracture.

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Condylar fractures have been documented to be a leading cause of temporomandibular joint (TMJ) ankylosis[1,2,4,7,17]. TMJ ankylosis, as one of the most serious complications secondary to condylar fractures, can create malocclusion, difficulty with speech, severe facial disfigurement and aggravating psychological stress. Although a variety of techniques for treatment of TMJ ankylosis have been described, none have met with overwhelming success. Restoring full TMJ function remains a considerable challenge. Postoperative reankylosis is unpredictable and has been recently reported at around 6–8%[2,3,17].

Post-traumatic TMJ ankylosis may have several causative factors. Among these, disc displacement may be one of the most prevalent. The displacement of the disc causes the absence of a barrier, which would normally hinder the establishment of a bony bridge triggered by the post-traumatic responses[6,7,9]. On the basis of this concept, various modified interposition arthroplasties using synthetic material have been used in the surgical management of TMJ ankylosis. From a biological point of view, the intact disc is perhaps the most optimal interposition material. In support of this, the authors of the present study used repositioning of the displaced disc as an integral component of the approach to treating early TMJ ankylosis arising from condylar fractures.

Materials and methods

Eighteen patients, 14 male and four female, were included in this study. The ages of the patients were varied, ranging from 4 to 52 years with a mean age of 28 years. Of the 18 patients, seven were under 18 years of age and two were above 50 years of age. These patients were treated from January 2001 to October 2004 in the Department of Oral and Maxillofacial Surgery, Peking University School and Hospital of Stomatology. This study was approved by the Ethics Committee of the same University. Patients provided written informed consent.

The joints were classified into one of two stages of TMJ ankylosis by a combination of radiological imaging and clinical signs. Type I ankylosis was defined as dense fibrous adhesions within the joint; type II ankylosis was defined as partial bony fusion within the joint[16]. Using these criteria, unilateral type I ankylosis was seen in six patients and bilateral type I ankylosis occurred in three patients. Unilateral type II ankylosis was present in six patients and bilateral type II ankylosis occurred in two patients. Only in one patient was bilateral ankylosis present with type I on one side and type II on another side. Of seven pediatric patients, only one was diagnosed as type I ankylosis with both sides involved and the others were diagnosed as type II ankylosis (one side involved in four patients and both sides involved in two patients).

In all instances, there was a positive history of condylar fracture and radiographs available to confirm condylar fracture(s). Initial management of the condylar fracture in 16 patients was non-operative treatment and in two patients (both had a unilateral condylar fracture) open reduction and internal fixation were used. In six patients, persistent restriction in mouth opening took place after fracture treatment, and in the other 12 cases the mouth opening improved initially, but was followed by a gradual and progressive diminution in the range of jaw movements. In addition, 15 patients presented with concomitant fractures of symphysis or parasymphysis and/or mandibular body. After initial treatment of mandibular fractures, 12 patients had prefracture occlusion and the other three patients had malocclusion with widening of the mandibular arch.

The indication for a surgical intervention to release the ankylosed joint was a range of maximal mouth opening less than 25 mm between the incisors and a restriction in mouth opening persisting for more than 2 months without significant improvement from opening exercises and physiological therapy.

Radiological analysis

Radiographs and CT scans taken immediately after fracture were obtained for retrospective analysis of the initial fracture patterns and displacement. Panoramic and posteroanterior skull radiographs as well as CT scans were taken for each of the 18 cases that went on to fibrous or bony ankylosis to reveal the architecture of joint ankylosis and its intrinsic relationship to the original fracture patterns. MRIs were taken only for the cases with type I ankylosis to determine the location of the articular disc and its anatomic relationship to the displaced fragments. With the patients' consent, MRIs were taken 6 months postoperatively for two patients with unilateral type I ankylosis and one patient with bilateral type II ankylosis to observe the retention of the repositioned discs.

Surgical treatment

Type I ankylosis was treated by a releasing arthroplasty with removal of the fibrous adhesions along with the displaced or comminuted condylar head, followed by the repositioning of the disc to its original anatomic location using stainless wire suturing of the disc to the posterior and lateral border of the fossa (Fig. 1). Type II ankylosis was treated by resecting the bony ankylosis tissue with retention of the medially displaced head which had been in malunion to maintain the ramus height and occlusion. Subsequently, the same procedure as in type I ankylosis was performed for repositioning of the disc after shaving the upper articular surface and condylar stump (Fig. 2). If the disc was unable to be repositioned due to severe damage or if highly degenerated, a temporal muscle myofascial flap was instead inserted into the gap by reflecting it downwards into the fossa like a cushion. Malocclusion in three patients who had malunion of symphysis or parasymphysis fracture was corrected simultaneously by open reduction and internal fixation. In this procedure, a reconstruction plate was used to control mandibular width. For all instances, an average mouth opening of more than 35 mm was obtained at surgery.

For a comparison with the radiological findings, macroscopic visualization at the time of operation was recorded on disc position and its anatomic relationship to the fractured fragments in the type I ankylosis group and to intraarticular bony fusion sites in the type II ankylosis group.

No intermaxillary fixation was applied after the operation. Beginning from the 7th or 10th day after surgery, patients were advised to do mouth opening exercises by means of special equipment (a duck rostra-like jaw dilation prop) and were given physical therapy using ultrasonic wave or infrared ray with calcium or iodide infiltration deep into the joint.

The follow-up duration of the patients ranged from 1 to 3.5 years with an average of 2.2 years. The range of mouth opening and TMJ function were assessed at patients' last visits.

Results

Two patterns of condylar fractures, sagittal (16/24 joints, 67%) and comminuted fractures (8/24 joints, 33%) were the cause of the 24 ankylosed joints. The first detection of TMJ hypomobility was commonly at the 4th or 5th month after fracture. The average maximum interincisal dimension

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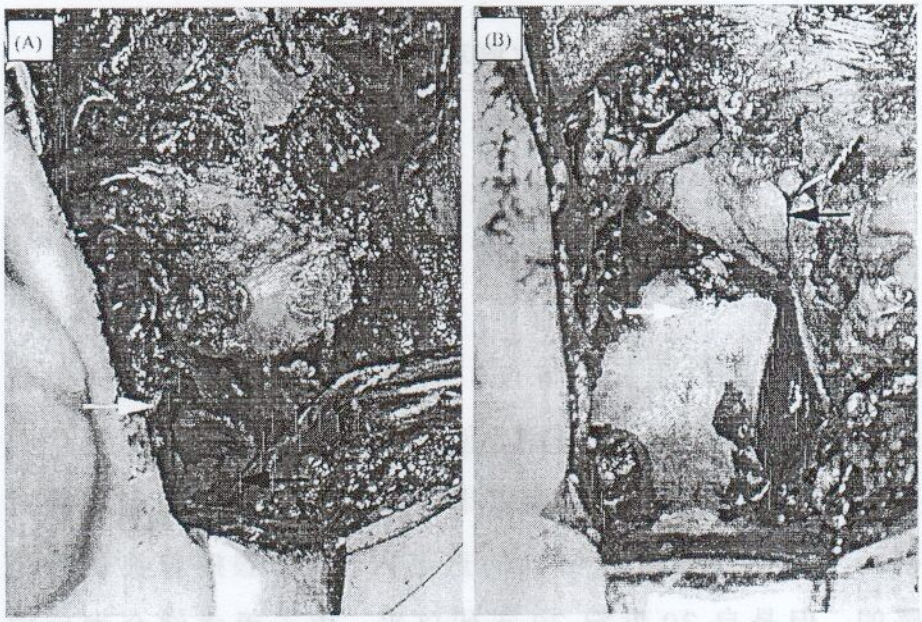

Fig. 1. Operative view of repositioning disc in releasing arthroplasty of type I ankylosis. (A) The disc (black arrow) was surgically exposed on the anterior-medial side of ramus stump (yellow arrow). (B) The intact disc (black arrow) was repositioned to location over the upper articular surface and then sutured by using stainless wire to the posterior and lateral border of the fossa. The yellow arrow is the damaged condyle.

was 18.3 ± 5.5 mm for type I joints and 13.6 ± 8.1 mm for type II joints (the individual with both type I and II ankylosis was included in the type II group for this measure). The progression from type I to type II ankylosis occurred, on average, during the 1st year. The hypomobility increased with an average further reduction in maximum interincisal dimension of approximately 5 mm.

Type I ankylosis

Thirteen joints fell into the type I ankylosis group, nine being secondary to sagittal fractures and four being secondary to

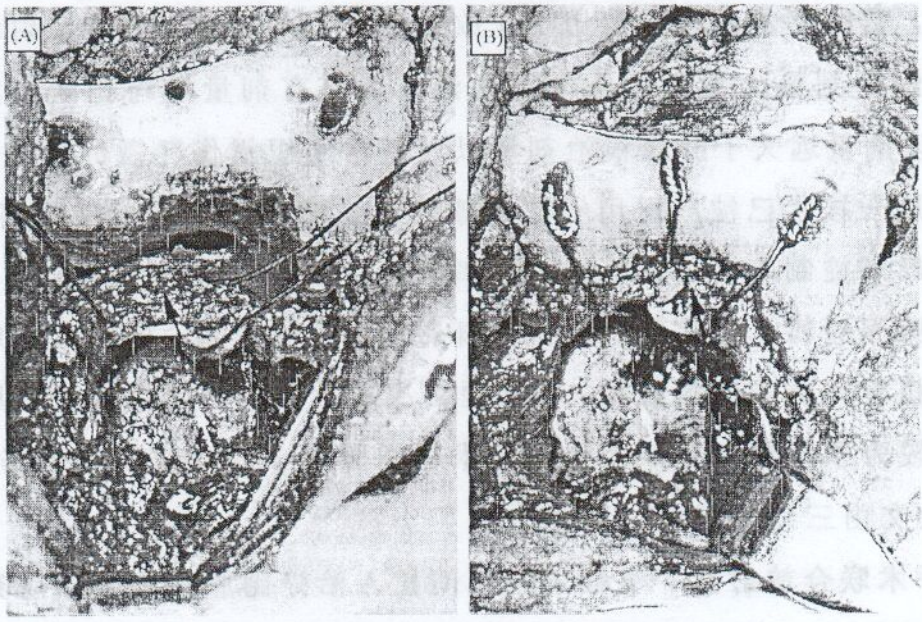

Fig. 2. Operative view of repositioning disc in excision arthroplasty of type II ankylosis. (A) After resecting the lateral bony fusion, the disc (black arrow) was found to be displaced medially. (B) The repositioned disc (black arrow) was sutured by using stainless wire to the lateral border of the fossa. The yellow arrow in both (A) and (B) is the medially displaced fragment which has been in malunion.

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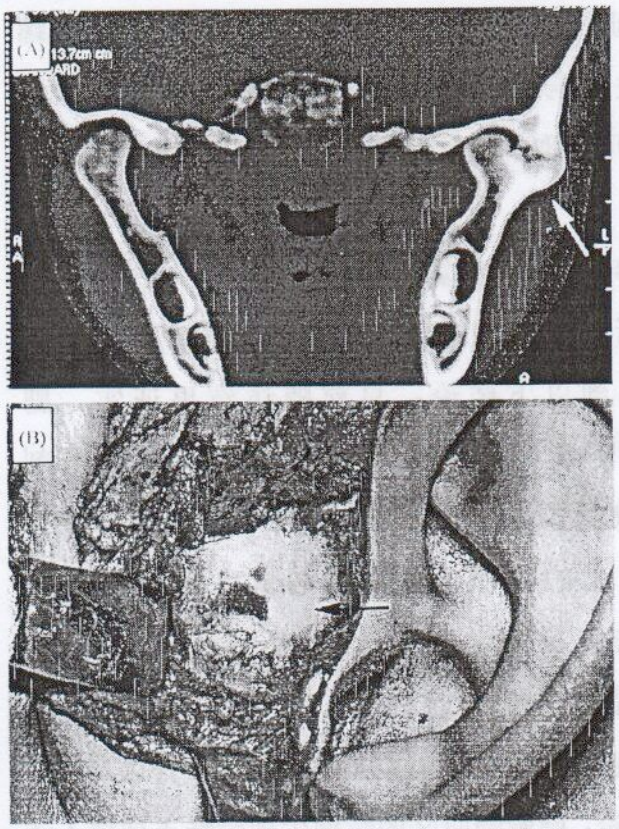

Fig. 3. Coronal CT image and operative view of the bony fusion in type II ankylosis secondary to sagittal fracture. (A) The CT image showed a bifid condylar head with its outer part ankylosed to the lateral aspect of fossa (arrow). (B) Visualization at the time of the operation confirmed formation of a well-established bony ankylosis (arrow) on the lateral surface.

comminuted fractures. Coronal CT showed a reduced joint space in those who had sagittal fractures and an irregular condylar articular surface with callus formation in those who had comminuted fractures. The joint spaces were filled with fibrous tissue and the articular surface of the glenoid fossa was intraoperatively detected to be irregular after removal of the fibrous tissue. The joint was capable of rotation, but could not translate.

Type II ankylosis

Eleven joints fell into the type II ankylosis group, seven being secondary to sagittal fractures and four being secondary to comminuted fractures. A bifid or enlarged condyle was the typical appearance on CT scans (Fig. 3A), and a bony bridge had formed (Fig. 3B), but localized to a limited area. In those associated with sagittal fractures, bony fusion frequently appeared between the lateral edges of the upper and lower articular surfaces. The displaced medial half of the condyle was articulating against the skull base with the disc interposed between. In those associated with comminuted fractures, bony fusion emerged in the central or slightly deeper zone under the fossa where the upper articular surface fused to the fractured fragments rather than directly to ramus stump. There was a fibrous/callus structure like a pseudojoint present between the fractured fragment and ramus stump.

For each of the 24 involved joints, it was verified at the time of operation that the disc had been displaced anteriorly or anteromedially together with the attached fragment, which was highly coincident with MRI findings in orientation of the disc (Fig. 4). In addition, discs were intact in all of the joints and were found lying on the inner side of the ramus stump. It was particularly noted that the disc was not involved in the formation of ankylosed tissue; there in fact existed a layer of fibrous tissue between the disc and bony ankylosis tissue. In 21 joints, it was possible to fully reposition the discs to their original anatomic positions. In another three joints, the discs were only partially repositioned due to the difficulty encountered in trying to draw out and mobilize them. In these cases, temporal myofascial flaps were sutured to the lateral border of discs. In all cases, discs were successfully salvaged and were free of the medial attachment from the surrounding tissue.

During follow-up, considerable improvement in mandibular movement was achieved with stable joint function and a range of mouth opening from 30 to 45 mm in all patients except one, which was a unilateral type II ankylosis. In this case, ankylosis recurred 6 months postoperatively and a second releasing arthroplasty was performed. During the surgery it was noted that the surgically repositioned disc had again become displaced.

During follow-up there were two cases of bilateral type II ankylosis, in which occlusal disturbances were present. They presented with slight class II malocclusion due to the change in ramus height after joint surgery. Orthodontic treatment was advised for both. In the investigated patients, no facial deformities associated with joint complications were found.

Discussion

Over the past decade, a series of clinical surveys has revealed that condylar fractures cause 69–74% of TMJ ankylosis cases in China[18,19] and 80–98% in other areas of the world[2,15,17]. It should be noted that ankylosis is very rare in patients who suffer condylar fractures, with an incidence of approximately 0.4%[5]. In this study, ankylosis occurred only in patients who had either a sagittal or a comminuted condylar fracture, and such fractures should therefore be considered as 'high risk'.

The current management of sagittal or comminuted condylar fractures is still controversial. By reconstructing the series of events in the developing course of postfracture TMJ ankylosis, this study suggests that treatment of these fractures should include close follow-up for a minimum of 18 months. Even though the decision for surgical intervention to release fibrous ankylosis is always a challenging one, restriction of mouth opening to less than 20 mm that persists over 2 months is a potential indication. Preoperative CT scanning to find the fracture patterns and MRI to locate the disc are helpful to determine treatment planning.

It is universally believed that there is a greater predisposition towards TMJ ankylosis in younger individuals. This study included two patients older than 50 years and a lower proportion of young patients. The affected joints in the two older

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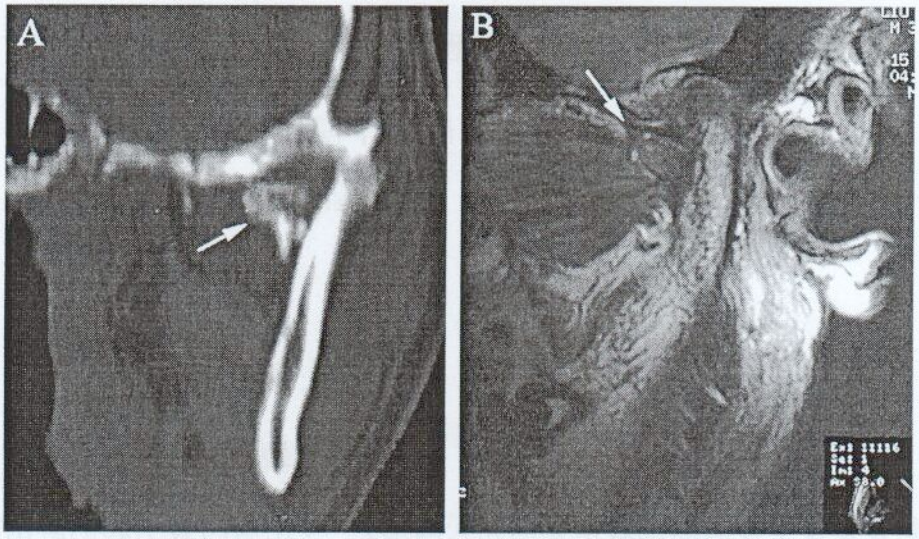

Fig. 4. Disc displacement on CT and MRI image. (A) A coronal CT scan showed that condylar fracture was in a sagittal pattern and the fragment (arrow) was medially displaced. (B) Oblique coronal MRI showed that the disc (arrow) was displaced together with the attached fragment and moved in an anteromedial direction.

patients resulted from failed surgery. The high proportion of younger patients in the type II ankylosis group supports a propensity of pediatric condylar fractures towards ankylosis.

The unpredictability in occurrence of TMJ ankylosis after condylar fracture is due to a poor understanding of the etiological mechanisms involved. Damage to the articular surface and removal of the disc have been shown as necessary conditions for the formation of TMJ ankylosis in an animal model[8,10,11,12,14]. The results of the present study corroborate this for TMJ ankylosis development occurring after sagittal or comminuted condylar fractures. This study demonstrated that ossification was initiated at the site where there was no disc interposition and the damaged condylar head closely approximated the glenoid fossa. Although the initial sites of ossification might be different in cases of ankylosis after sagittal and comminuted fractures, disc displacement appears to play a critical role in the initiation of the ankylosis, as reported by other authors[5,6,13,14]. This led to the basic concept of constructing a barrier to block the formation of a bony bridge linking the condylar stump to the articular surface. The articular disc proved very useful for this purpose in most of the patients in the current study. Similar work was also reported recently by Long et al.[7], who concluded that recurrence of traumatic TMJ ankylosis can be prevented by preservation of the disc. The current study provides more direct evidence that repositioning the disc is indeed an ideal approach for the treatment of early TMJ ankylosis. The second surgery in the one failed case suggests that holding the disc in the correct position is critical for the therapeutic outcome.

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