

# Closed reduction of displaced or dislocated mandibular condyle fractures in children using threaded Kirschner wire and external rubber traction

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**Abstract.** Most surgeons agree that closed treatment provides the best results for condylar fractures in children. Nevertheless, treatment of the paediatric mandibular condyle fracture that is severely displaced or dislocated is controversial. The purpose of this study was to investigate the long-term clinical and radiological outcomes following the treatment of displaced or dislocated condylar fractures in children using threaded Kirschner wire and external rubber traction. This procedure can strengthen the advantage of closed reduction and make up for the shortcomings of open reduction. From March 1, 2005 to December 25, 2011, 11 children aged between 4 and 12 years with displaced or dislocated mandibular condyle fractures were treated using threaded Kirschner wire and external rubber traction under portable C-arm fluoroscopy. All patients had unilateral displaced or dislocated condylar fractures. The follow-up period ranged from 24 to 42 months (mean 29.3 months). Normal occlusion and pain-free function of the temporomandibular joint, without deviation or limitation of jaw opening, was achieved in all patients. This closed reduction technique in displaced or dislocated condylar fractures in children offers a reliable solution in preventing the unfavourable sequelae of closed treatment and the open technique, such as altered morphology, functional disturbances, and facial nerve damage.

**Key words:** mandibular condyle fracture; children; threaded Kirschner wire; closed reduction.

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Mandibular fractures in children differ greatly from mandibular fractures in adults because of the incomplete dentition and the growth of the mandible.<sup>1,2</sup> In particular,

the management of condylar fractures in children continues to be a matter of debate. It has been suggested that these fractures can lead to serious problems if not properly

managed, including growth disturbances of the mandible on the fractured side, temporomandibular joint (TMJ) dysfunction, and facial asymmetry.

Generally, the treatment of condylar fractures in children has been non-surgical, with a re-establishment of the normal occlusion with or without maxillomandibular fixation (MMF), followed by physiotherapy.<sup>3-5</sup> However, displaced or dislocated condylar fractures from the glenoid fossa require extensive remodeling to achieve normal anatomical relationships in the TMJ. Follow-up studies of dislocated condylar fractures have demonstrated frequent findings of mandibular asymmetry, incomplete remodelling of the condylar process, and objective and subjective findings of TMJ dysfunction.<sup>3,6,7</sup> For these reasons, a few surgeons have advocated open reduction and internal fixation (ORIF) in these cases.<sup>8-10</sup> Open treatment of the condylar fracture can be a difficult procedure and it carries the risk of facial nerve injury, facial scarring, and joint stiffness.<sup>9</sup> ORIF can sometimes cause a growth disturbance, either due to the surgical manipulation of the fracture segments or to the placement of rigid hardware across the condylar growth center.<sup>7,9,11</sup>

Ultimately, the treatment goal remains the same whether surgical or non-surgical treatment is chosen, i.e. the restoration of normal function with minor side effects.

In facial bone fractures, a few surgeons have used fluoroscopic reduction and percutaneous manipulation using Kirschner wire to supplement the shortcomings of open reduction.<sup>12,13</sup> Threaded Kirschner wire in particular, can hold the bony segment strongly because it has a threaded tip. When reducing fractures using a threaded Kirschner wire percutaneously, the surgeon can pull the fracture segment and reduce the fracture in a way similar to open reduction. This concept was applied in the study institution for the clinical reduction of the displaced or dislocated paediatric condylar fracture, which can cause various complications.

The purpose of this study was to investigate the long-term clinical and radiological outcomes following the treatment of displaced or dislocated condylar fractures in children using threaded Kirschner wire percutaneously and external rubber traction. This procedure can strengthen closed reduction and make up for the shortcomings of open reduction.

### Patients and methods

From March 1, 2005 to December 25, 2011, 11 children aged between 4 and 12 years with displaced or dislocated mandibular condyle fractures were treated with closed reduction using threaded

Kirschner wire and external rubber traction. The inclusion criteria for this method were medially displaced or dislocated condylar fractures that could not be treated with open reduction or manual reduction in children. Condylar fractures for which the threaded Kirschner wire could not be inserted into the displaced condylar segment because of small fragments or the presence of multiple segmental fractures were excluded. All patients were followed up for more than 2 years and assessed by clinical and radiological examination. The definitive diagnosis of the condylar fracture was based on computed tomography (CT). All patients had unilateral condylar fractures, including high-neck fracture with displacement or dislocation and low-neck fracture with displacement or dislocation (Table 1).

The criteria of clinical success were as follows: satisfactory occlusion, maximal inter-incisal distance of >35 mm, deviation from the midline during mouth opening of <3 mm, no sign of ankylosis, no functional or growth disturbance, and no radiographic evidence of condylar deformity.

### Surgical technique

Under general anaesthesia, intermaxillary fixation (IMF) was established before surgery using an arch bar or IMF screws and the power of the masticatory muscle was completely relaxed. Using a portable C-arm that was draped and brought into the operating field, the condylar segment was visualized. To obtain the appropriate views, the head was manipulated and turned in conjunction with the fluoroscopic view of the C-arm. Under the guidance of the C-arm, threaded Kirschner wire was inserted percutaneously into the fractured condylar segment within a 5–7 mm anterior portion of the tragus. If the fracture site was situated in the lower portion of the condyle, the insertion point of the

Kirschner wire was positioned in the tragal notch area. During the initial insertion of threaded Kirschner wire using a mechanical drill, there is a risk that the facial nerve or a vessel pedicle could become rolled up into the threaded Kirschner wire. Therefore, at first, the threaded Kirschner wire was inserted into the vicinity of the fractured condylar segment by hand or in low speed mode and then pinned up into the bony segment with the mechanical drill.

After the threaded Kirschner wire had been inserted into the displaced condylar segment, a primary closed reduction was performed, pulling the threaded Kirschner wire carefully. When the closed reduction of the displaced condylar segment had been properly performed, the exposed distal tip of the threaded Kirschner wire was bent and rubber traction was applied; this customized equipment was made using a plastic cup, foam dressing material, a rubber band, and a wooden tongue depressor (Fig. 1).

When an insufficient closed reduction was performed, for example when there was counteraction of the masticatory muscle or disturbance of the fractured distal segment intraoperatively, the pull strength of the rubber was reinforced by adding a wooden tongue depressor inside the rubber or rubber band for 1–3 postoperative days until the displaced or dislocated fractured condylar segment had returned to the original position. In the case where the young patient could not tolerate the pain caused by the external rubber traction, the pull strength of the rubber was increased very slowly.

Intermaxillary fixation was removed after 3 weeks and physiotherapy was initiated. The external rubber traction and threaded Kirschner wire were removed within 3–4 weeks. All patients received a liquid diet for 3 weeks and then a soft diet for at least 2 weeks. Postoperative radiological examinations were obtained every day until complete

Table 1. Patients and fracture characteristics.

Patient	Age, years	Sex	Condyle fracture type	Follow-up, months
1	4	M	High-neck, dislocation	42
2	7	F	Low-neck, displacement	32
3	5	M	Low-neck, displacement	36
4	8	M	Low-neck, dislocation	27
5	12	M	High-neck, dislocation	24
6	11	M	High-neck, displacement	26
7	8	F	Low-neck, dislocation	31
8	6	M	High-neck, displacement	36
9	5	M	High-neck, dislocation	28
10	11	F	High-neck, dislocation	25
11	9	M	Low-neck, displacement	34

F, female; M, male.

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