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Anterior open-wedge hepta-lateral osteotomy for severe post-traumatic genu recurvatum: a case report and review of the literature

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Abstract
Severe post-traumatic genu recurvatum is an uncommon condition in orthopedics. The typical symptoms are pain, weakness, and instability. For severe and symptomatic genu recurvatum patient, the surgical correction should be performed to relieve symptoms and prevent progression of deformity. Many procedures were proposed to treat this condition, but there are some complications such as patella baja, secondary deformity, skin complication, and inadequate correction. Most of the procedures need an additional procedure such as tibial tuberosity transfer to correct the patellar height. In this case, the authors report a new technique in which the osteotomy was performed near the center of rotation angulation. And, the correction did not influence the patellar height.

Keywords Genu recurvatum · High tibial osteotomy · Patellar baja · Malunion

Introduction

Genu recurvatum is the condition that there is excessive extension of the tibiofemoral joint and the knee bends backward to the axis. The two mainly etiologies are congenital and acquired. The cause of acquired genu recurvatum includes trauma, postoperative complication, Osgood–Schlatter disease, and idiopathy. The situation that deformity occurs after the injury is also called genu recurvatum traumaticum [1, 13, 18, 19]. Some patients may not have any problems. However, the deformity can progress and produce the symptom in advance in which the common issues are cosmesis, pain, instability, and abnormal gait. Management depends on the severity and the knee structure injuries, soft tissue or osseous. Three types of the operation on the genu recurvatum are arthrodesis, tibial osteotomy and soft tissue procedure [2, 3, 7, 9, 12]. We report a malunion of the intra-articular fracture of the proximal tibia with severe recurvatum that was surgically corrected with the new open osteotomy technique. And, we also reviewed the related studies.

Case report

An 18-year-old man was presented with severe genu recurvatum and fixed equinus deformity of the left leg. Six months before coming to our hospital, he had a traffic accident and injured on the left knee. Then, he went to the first hospital, and the diagnosis was the fracture of left proximal tibia. His left leg was immobilized with long leg cast for 6 weeks. After the cast removed, he had no pain in the left knee, but he felt unstable at the knee joint while he was walking, and the sensation on the dorsal aspect of the left foot was absent. The patient was referred to our hospital. Physical examination showed 45° hyperextension of the left knee, knee flexion loss about 20°, fixed equinus deformity of the left ankle about 50° and 1.5 cm leg length discrepancy (Fig. 1). The radiographic study demonstrated the malunion of the intra-articular of the left proximal tibia (Fig. 2). The electrodiagnostic studies showed complete common peroneal nerve palsy.

First, the patient decided to receive the operation to correct the fixed equinus deformity. We performed the lengthening of Achilles tendon and transfer posterior tibial tendon for ankle

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Fig. 1 Physical examination showed 45° hyperextension of the left knee, knee flexion loss about 20°, fixed equinus deformity of the left ankle about 50°

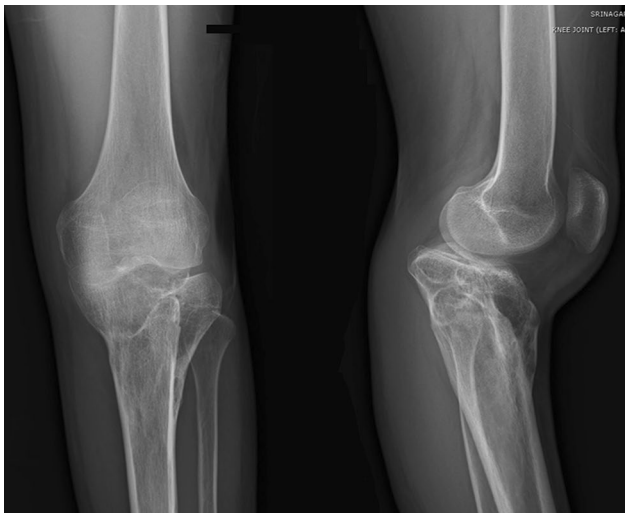

Fig. 2 The radiographic study demonstrated the malunion of the intra-articular of the left proximal tibia

dorsiflexion. After the surgery, the ankle was immobilization in the neutral position with the short leg cast for 6 weeks. Two months after surgery, the patient still had complained about the sense of unstable of the left knee during walking.

Therefore, authors decided to correct the deformity by reducing the tibial slope from 47° anterior incline to 6° posterior incline.

Surgical technique

Surgical approach

We approached the proximal tibia with the medial and split anterolateral incision. The patellar tendon was identified and protected, and we performed an anterior open-wedge heptalateral osteotomy at the left proximal tibia.

Osteotomy and fixation

The osteotomy was begun medially below to the tibial tuberosity and extended upward and posteriorly (Fig. 3). After the osteotomy was performed, the adjustable bone spreader was inserted into the osteotomy site anteriorly. Then, we corrected the alignment gently until the intended alignment could be achieved, and there was no hyperextension of the knee. The tibial shaft was anteriorly translated to decrease the tension of the skin on the spike of the tibial tuberosity and prevent secondary deformity. The reduction was maintained with the adjustable bone spreader. Two iliac strut grafts were placed at the anterior aspect of the osteotomy site. We fixed the proximal tibia with the 3.5-mm LCP® Medial and Lateral Proximal Tibial Plates (Synthes®, West Chester, PA, USA).

Rehabilitation

Immediately the pain reduced in few days after surgery, the range of motion exercise was encouraged. Weight bearing was avoided for 6 weeks. Bone union achieved in 3 months (Fig. 4). At 1-year follow-up, the patient can walk independently without pain. The range of motion is normal (Fig. 5).

Discussion

Traumatic genu recurvatum is not the uncommon condition in orthopedics practice. The deformity usually occurs when there is malalignment of osseous or ligamentous injuries. Treatment is based on the severity of the deformity and knee structure injuries [7, 9, 19]. In minor deformity, the patient can use the brace to relieve the symptoms [10, 16]. However, the deformity can progress in some patients in advance. If the deformity becomes more severe and produces symptom, surgery may be indicated [12, 19].

In case deformity is related to the abnormal alignment of the proximal tibia, proximal tibial osteotomy may be performed to correct the deformity. The excellent overall outcome after performing corrective osteotomy was 83% [19]. There are many types of the procedure, but there is still no

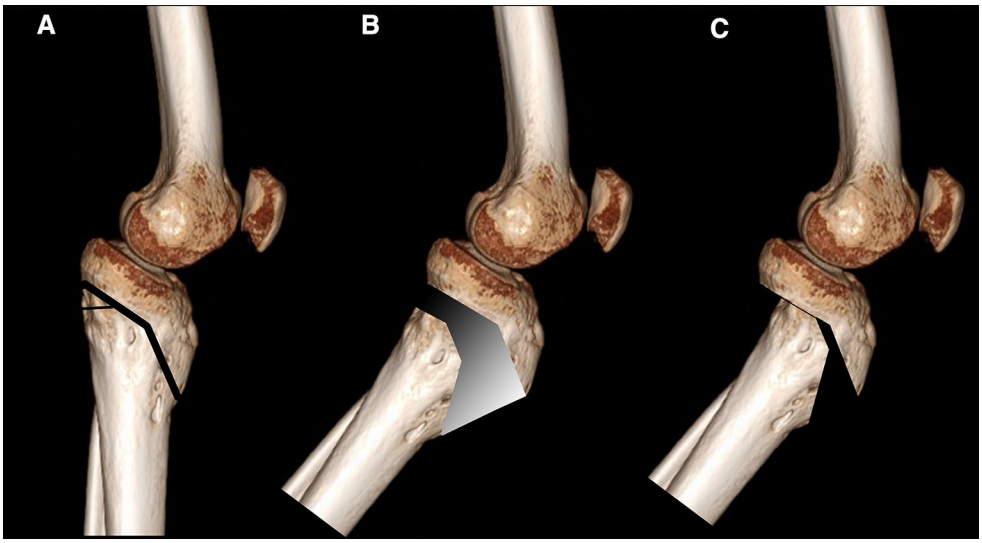

Fig. 3 Pictures demonstrated the anterior open-wedge hepta-lateral osteotomy at the left proximal tibia

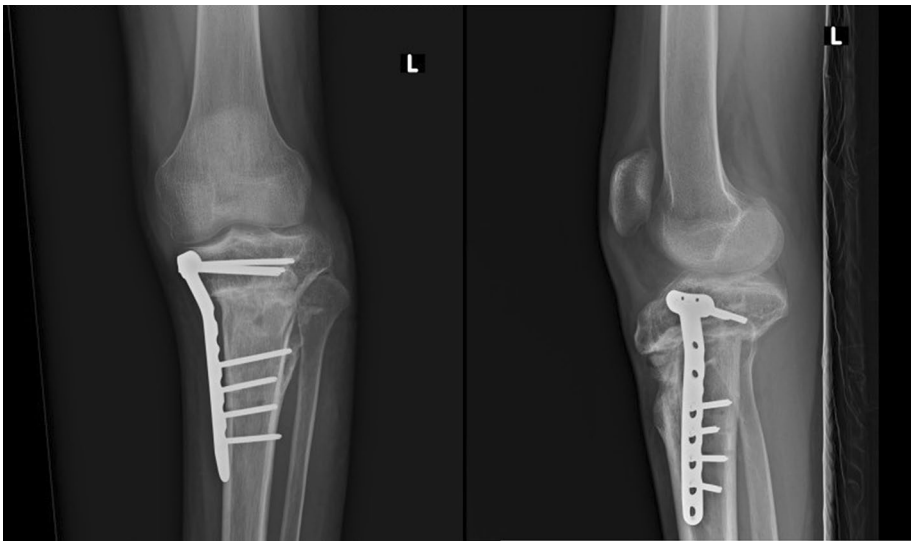

Fig. 4 The radiographic study showed the alignment of proximal tibia after performing surgical correction

standard procedure to treat this condition. Some authors performed osteotomy at the tibial tuberosity and reflex upward. Then, the author performed the anterior open-wedge osteotomy at the level of the patellar tendon insertion [18]. An open-wedge osteotomy was proposed in which the osteotomy was performed above the tibial tuberosity. The author called this technique subarticular osteotomy [2]. Closed-wedge osteotomy was performed in some cases in which this technique could provide rapid union [3]. There were many methods to fix or maintain the correction until the union could achieve such as cast, plate and screws, external fixator and Ilizarov apparatus [4–6, 14, 18]. Treatments can be classified according to open- or closed-wedge osteotomy, the location of the osteotomy and acute or gradual correction [2–6, 9, 13, 14, 19].

The open-wedge osteotomy is more simplified than closed-wedge osteotomy because it is easy to adjust the correction during operation and can correct leg length. But, there are many considerations on this technique such as location of the osteotomy, secondary deformity, inadequate correction, anterior bone gap, nonunion, fixation method, infection and skin complication [17, 20].

Patellar baja is the most frequent problem after performing open-wedge osteotomy when the location of the osteotomy is proximal to the insertion of patellar tendon. Therefore, the tibial tuberosity transfer is necessary to correct patellar height in this group [12].

In case osteotomy is performed distal to the tibial tuberosity, frequent problems may occur such as secondary deformity and a small correction. Hence, the osteotomy is distal and

Fig. 5 At 1-year follow-up, the patient can walk independently without pain. The range of motion is normal

Table 1 Advantages and disadvantages of each anterior open-wedge technique for genu recurvatum

Location of osteotomy	Advantages	Disadvantages
Proximal to tibial tuberosity	Near to the center of rotation angulation Higher degree of correction Lesser secondary deformity	Patellar baja Need tibial tuberosity transfer in some cases
Distal to tibial tuberosity	Simple bone cut Simple surgical approach	More secondary deformity Lesser degree of correction Anterior skin complication Prominent spike from the tibial tuberosity Need fibular osteotomy in some cases

far from the center of rotation angulation [8, 15]. Recently, a study reported good to excellent result after performing the simple open-wedge osteotomy in which the osteotomy was distal tuberosity. But, authors still needed to transfer the tibial tuberosity in patient with severe deformity (Table 1) [11].

Patients with genu recurvatum and valgus malalignment may be treated by anterolateral open-wedge proximal tibial osteotomy and fixation with a plate with allograft filling of the osteotomy gap [6, 7].

We reported a new technique in which the osteotomy was performed distal to tibial tuberosity aiming to preserve the insertion of the patellar tendon. Then, the direction of the osteotomy was upward and backward which could reach to the center of rotation angulation. The advantages of this technique were high degrees of correction, and patella height could be retained as the preoperative height, but the bone cut was quite tricky from others. This patient showed good result with this technique. However, the higher quality of study design should be performed to evaluate this technique in the future.

Conclusion

For the patient with severe traumatic genu recurvatum and the preoperative patellar height is still in the normal range, our surgical technique shows the good result after surgical correction. The bone cut can preserve patellar height and provide the high degree of correction.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Khon Kaen University Ethic Committee in human research, Khon Kaen University.

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