

# Posterolateral Complex Reconstruction With Distal Femoral Varus Opening-Wedge Osteotomy for Unstable Neglected Multiligamentous Knee Injury With Valgus Malalignment

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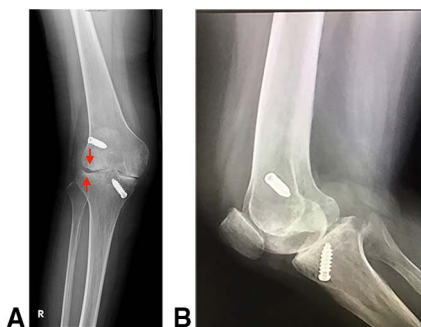
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## ABSTRACT

We presented a case of a 25-year-old woman with early posttraumatic degenerative change to the articular cartilage accompanied with valgus malalignment despite receiving anterior cruciate ligament reconstruction after a multiligamentous injury sustained 2 years earlier. Rapid deteriorating valgus malalignment may result from chronic instability and intra-articular bone loss. Simultaneous distal femoral varus osteotomy and posterolateral complex reconstruction were performed during a single surgery. Six months after the surgery, the patient could walk briskly and climb stairs without any discomfort. Salvage procedures and biological reconstruction could be the primary choice for young patients to recover their knee function while avoiding joint replacement.

**M**otor vehicle collisions and sport-related injuries are the two most common causes of multiligamentous knee injuries (MLKIs).<sup>1,2</sup> MLKI is defined as the disruption of at least two of the four major stabilizing ligaments of the knee. In acute multiligament knee injury patients, detailed evaluation with physical examination, MRI, stress radiographs, and angiography are necessary if the ankle-brachial index is less than 0.9.<sup>3</sup> Any missed ligament injury will result in incomplete preoperative planning, and associated lesions can compromise the newly reconstructed ligament because of residual instability. Furthermore, failure to completely address all contributing factors to knee instability will change the knee kinematics.<sup>3</sup> It is also well known that chronic valgus instability and valgus malalignment cannot be controlled by ligament reconstruction alone.<sup>4</sup> Reconstructing the ligaments and obtaining the correct mechanical alignment are advised for repairing MLKIs, especially in young patients. Although there are several treatment choices for osteoarthritis, arthroplasty is not suitable for osteoarthritis in young patients.

Much of the existing literature has focused on the evaluation and treatment choices for chronic posterolateral complex (PLC) deficiency in varus knee deformities.<sup>5-7</sup> No case report has discussed a coexisting valgus deformity with PLC insufficiency. Given the rarity of these injuries and the lack of literature

**Figure 1**

Preoperative radiograph of the right knee showed bone loss over the lateral femoral condyle and lateral tibial plateau depression fracture (A) and posterior migration of the tibia (B)

regarding preoperative planning, surgical reconstruction, and postoperative rehabilitation protocols, we present this case. We obtained the patient's informed written consent for publication of this case report.

## Case Report

This case describes a 25-year-old woman who was struck by a motorcycle 2 years ago. She decided to undergo anterior cruciate ligament reconstruction with artificial ligament augmentation and a reconstruction system instead of an autograft to avoid donor site morbidity. However, progressive right knee pain and the feeling of instability remained. After enduring it for 15 months, she came to sport medicine outpatient department for help. The degree of deformity and the frequency of swelling recurrences progressively increased, and she had been in extreme pain in recent months; thus, she came to our outpatient department for help.

## Physical Examinations

Right lower extremity revealed genu valgum deformity with apparent posterior sagging of the tibia, whereas the range of motion of the knee was complete. The posteriorly locked tibia impeded the performance of the anterior drawer test. The posterior drawer test and the posterolateral drawer test were both 3+. The varus stress test was 3+, and the valgus stress test was 2+. The McMurray test was negative, and the neurovascular test was intact without a presentation of footdrop.

## Imaging Evaluation

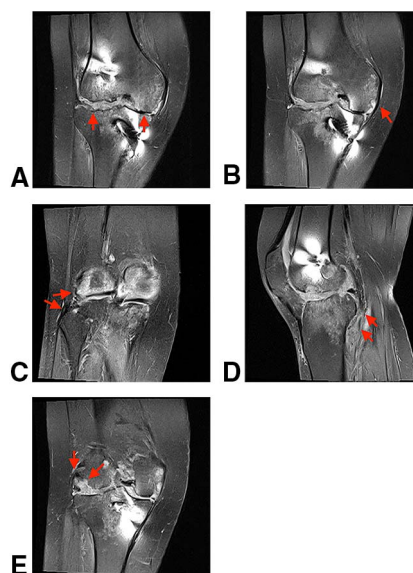
Preoperative lower limbs scanogram and right knee radiograph showed 17° of valgus deformity, a laterally deviated mechanical axis of 6.2 cm, 73.5° of lateral distal femur angle, and bone loss over the lateral femoral condyle and the lateral tibial plateau (Figure 1). MRI

showed extensive medial and lateral meniscus loss, decreased thickness of the medial collateral ligament (MCL), an lateral collateral ligament (LCL) partial tear, popliteus muscle atrophy with thinning of the tendon part, extensive chondral loss with cortical erosions in both femoral condyles, and an occult lateral tibial plateau fracture (Figure 2).

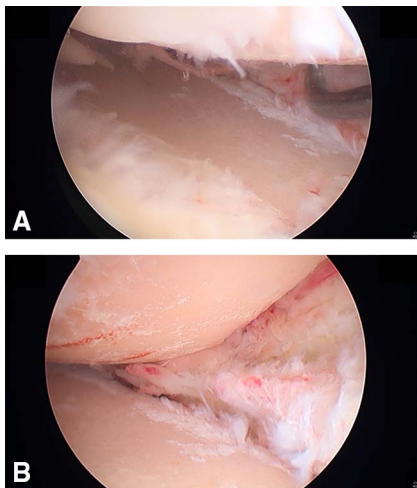
## Surgical Technique

The patient underwent right knee arthroscopic meniscus debridement, followed by distal femoral varus osteotomy and PLC reconstructions by using the LaPrade technique<sup>8</sup> using ipsilateral semitendinosus and gracilis tendon autografts. Arthroscopy showed grade 4 post-traumatic degenerative change in the lateral femoral condyle and tibial plateau, grade 3 posttraumatic degenerative change in the medial femoral condyle and tibial plateau, and a total loss of the medial and lateral menisci (Figure 3). The artificial anterior cruciate ligament (ACL) graft was firm and stable.

First, the loose bodies were excised, and the ruptured meniscus remnants were débrided with a motorized shaver. Microfractures were made on the femoral condyles and the tibial plateau. Second, distal femoral osteotomy (DFO) with a varus correction angle of 15° was performed with an Arbeitsgemeinschaft Fur Osteosynthesefragen

**Figure 2**

Preoperative MRI of the right knee showed extensive medial and lateral meniscus loss (A), decreased thickness of the MCL (B), LCL partial tear (C), popliteus muscle atrophy with thinning of the tendon part (D), extensive chondral loss with cortical erosions in both femoral condyles, and an occult lateral tibial plateau fracture (E).

**Figure 3**

Arthroscopy of the right knee showed extensive osteoarthritic changes in both the medial and lateral femoral condyle and tibial plateau and total loss of the medial and lateral meniscus (A, B).

Less Invasive Stabilization System (AO LISS) plate. The osteotomy site was grafted with an allogeneic femoral head. Finally, the popliteus tendon, LCL, and popliteofibular ligament were reconstructed with semitendinosus and gracilis autografts harvested from the ipsilateral leg (Figure 4). Varus and valgus stress were exerted postoperatively, and the knee was stable.

### Postoperative Rehabilitation

The goal was to decrease pain, inflammation, and swelling; to reestablish quadriceps control; and to restore a normal gait. After the surgical procedure, a fully extended functional knee brace was applied for the first postoperative week. Ambulation with partial weight bearing on the surgical leg was initiated on the second postoperative day. Quadriceps isometric exercises, straight-leg raising exercises, and passive range of motion should be initiated as early as possible. The protected range of motion was gradually increased from 0° to 90° during the first postoperative month and then from 90° to 120° during the second month. At 4 weeks, a series of closed kinetic chain exercises were demonstrated to the patients, who were strongly encouraged to exhibit cogent participation. At 6 weeks, patients were allowed full weight bearing with hamstring-strengthening exercises. The brace was unlocked, and the patient was advised to establish a normal gait and a passive range of motion. At 8 weeks, the active range of motion in the knee should progress to complete flexion and extension. Quadriceps and hamstring muscle strength training was especially emphasized during a home rehabilitation program. At 3 months, patients usually returned to their

normal daily activity and were allowed to exercise on a stationary bike or stand on only the repaired leg. Light sport activities began at 6 months. After 9 months, full activity, including athletic activities, was permitted.

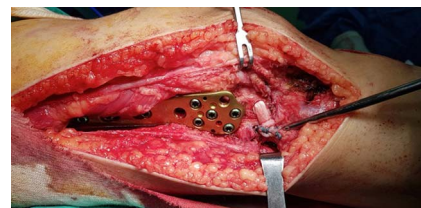
### Postoperative Follow-up

The preoperative mechanical tibiofemoral angle was 17° valgus, and it improved to 5° valgus at the final follow-up. The preoperative mechanical lateral distal femoral angle was 73.5°, and it improved to 89.5° at the last follow-up (Figure 5). The Lysholm score and International Knee Documentation Committee (IKDC) were 52 and 45 preoperatively, and they improved to 87 and 89, respectively, at the 24-month follow-up postoperatively. Currently, the patient does not have symptoms from posterior instability, and the physical examination showed grade 1 posterior laxity with a relatively stable knee and good functional recovery. There was no need for a second-stage posterior cruciate ligament (PCL) reconstruction for the patient.

### Discussion

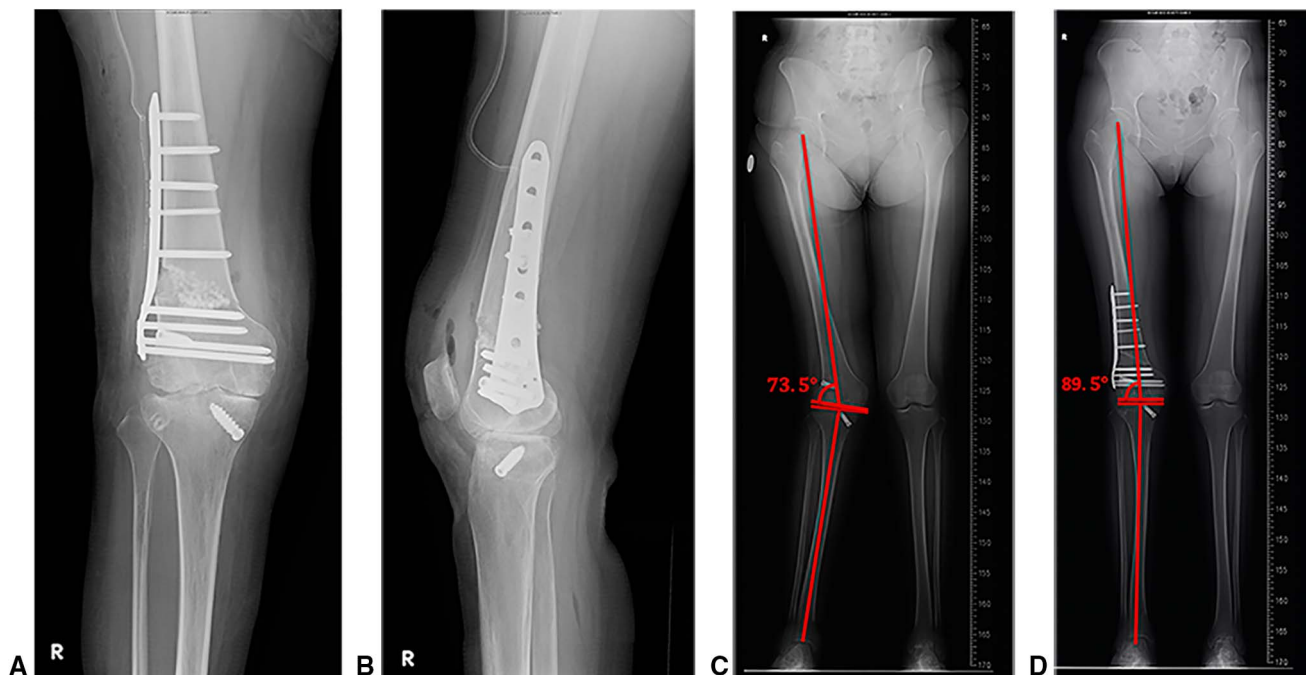
To the best of our knowledge, this is the first case report of posttraumatic MLKIs treated by allograft anterior cruciate ligament reconstruction only and presented with valgus malalignment and chronic PLC disruption because of residual instability postoperatively.

The genu valgum was determined according to the malalignment test described by Paley et al.<sup>9</sup> According to the obtained measurement, the patient was assigned to the classification of condylar malalignment owing to depressed lateral tibial plateau and lateral femoral condyle. To address the intra-articular defect, Paley<sup>10</sup> was the first to mention intra-articular osteotomy for the treatment of valgus deformity and instability secondary to lateral femoral condylar hypoplasia. Feldman et al<sup>11</sup> reported a retrospective report of five patients who had lateral femoral condylar hypoplasia with or without concomitant lateral hemiplateau depression treated by

**Figure 4**

Intraoperative image of the lateral distal femoral osteotomy and posterolateral complex reconstruction.

Figure 5



Postoperative knee radiograph (A, B) and a comparison of the lower limb scanogram (C, D).

intra-articular osteotomy. Intra-articular osteotomy provided satisfactory correction of the genu valgum without the creation of an oblique joint line.<sup>11</sup> However, in this case, a bone tunnel for PLC reconstruction would require an intact lateral femoral condyle, tibial plateau, and fibular head. Intra-articular osteotomy would violate the passage of the bone tunnel needed for the LaPrade procedure.<sup>12</sup> Therefore, either varus-producing high tibial osteotomy or DFO were considered. Kerkhoffs et al<sup>13</sup> reported a case series of 23 patients with painful posttraumatic lateral depression and valgus malunion of the proximal part of the tibia treated by proximal tibial varus osteotomy. Twenty of 27 (87%) patients showed good to excellent subjective results after five years of postoperative follow-up. High tibial varus-producing osteotomy can provide satisfactory long-term results in active patients with painful and disabling posttraumatic lateral depression and valgus malunion of the proximal part of the tibia.

In this case, the preoperative valgus angle was 17° and the mechanical lateral distal femoral angle was 73.5°, which indicated that the malalignment was mainly from femoral condylar depression. It is more logical to make a correction with a varus-producing DFO than an osteotomy on the morphologically normal tibial side. In addition, Coventry<sup>14</sup> suggested that varus-producing DFO is preferable in patients whose valgus angulation exceeds 12° over closing wedge varus osteotomy of the proximal

part of the tibia. Finally, we chose to correct the alignment with varus-producing DFO. The patient's postoperative scanogram returned to 5° valgus angulation postoperatively without presentation of joint line obliquity.

In patients with chronic MLKIs who failed reconstruction, recent evidence suggests that both maintaining joint alignment and ligamentous stability are equally important.<sup>15</sup> The knee, in this case, became stable after addressing the alignment and PLC reconstruction, but slight posterior sagging still persisted despite a normal PCL. We decided to adopt a staged surgery for PCL reconstruction if posterior translation of more than 10 mm during posterior drawer test or isolated grade III PCL tears confirmed by MRI despite nonsurgical management.<sup>16</sup> Although one-stage reconstruction may seem ideal for correcting all components of instability, the possibility of arthrofibrosis should be considered cautiously. Fanelli et al<sup>8</sup> suggested that delaying reconstruction for 2 to 3 weeks may decrease the incidence of arthrofibrosis. In addition, this is a salvage surgery, and the creation of a normal coronal alignment while avoiding any possible risks of arthrofibrosis and starting an immediate rehabilitation program is of paramount importance.

Vicenti et al<sup>17</sup> reported a meta-analysis of four studies comparing repair and reconstruction in MLKIs. A higher failure rate (39% versus 8%) and a lower return-to-sport rate (25% versus 51%) were found in patients who underwent the repair of the PLC compared with



reconstruction. In the setting of combined injury to both ACL and PLC, failure to identify and address PLC injury was highlighted as a key factor in ACL reconstruction failure.<sup>18,19</sup> A meta-analysis result from Bonanzinga et al<sup>20</sup> suggested reconstruction of both ACL and PLC provided better objective functional outcome than ACL reconstruction with PLC managed either nonsurgically or direct repaired. Therefore, anatomic reconstruction of PLC with the LaPrade technique was chosen rather than direct repair.

The revision of ACL reconstruction remains challenging for both patients and surgeon. Luckily, previous allograft did not stretch out in this case. If allograft failure should happen, choose upon autograft for revision was 2.78 times less likely to sustain a subsequent graft rupture compared with allograft.<sup>21</sup> Quadriceps tendon and bone-patellar tendon-bone remained optional in this case. Mouarbes et al<sup>22</sup> reported a meta-analysis suggesting that quadriceps tendon was a better choice compared with bone-patellar tendon-bone and hamstring-tendon because less harvest site pain and better functional outcome was found.

Valgus deformity coexisting with PLC disruption and thinning of the MCL are rare, and no literature detailing the treatment of this type of injury exists. We described our approach to treat a young, active patient who went on to regain excellent function 8 months postoperatively. Our tendency for this kind of injury is to correct the alignment first, combined with ligament reconstruction to restore knee stability during a one-stage procedure. Delaying reconstruction of PCL 3 weeks later may be adopted if grade III PCL avulsion were confirmed by either physical examination or image despite being managed nonsurgically.

## Conclusion

For young patients with MLKIs and valgus malalignment, simultaneous distal femoral varus osteotomy and PLC reconstruction could be the first choice to recover their knee function and prevent the need for joint arthroplasty.

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