Knee dislocations: Outcome of surgical treatment

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Dislocated knee is an emergency in orthopaedic trauma because they might have an associated vascular injury (1). Knee dislocations usually involve injury to both anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). In addition, a disruption of the medial (MCL) or lateral collateral ligament (LCL) injuries are common. The LCL injury often includes a disruption of the posterior lateral complex (PLC). Associated meniscal and articular cartilage injuries, osseous fractures, and injury to the common peroneal nerve will complicate the initial assessment and management. Clinical situation with the knee still dislocated, confirmed by plain radiographs, gives an obvious diagnosis. However, spontaneous relocation may occur, in which case, the diagnosis of the dislocation of the knee joint might be missed during the initial evaluation.

Earlier, acutely dislocated knees have been treated with prolonged immobilization, which has been associated with loss of motion, residual instability, and poor knee function (2). The previous studies have shown that surgical treatment of the torn ligaments is superior to conservative treatment by casting or bracing (2). The goal of surgical management of acute dislocations is an anatomic repair or reconstruction of both cruciate ligaments and LCL and posterolateral structures. Surgical management of MCL remains controversial.

Classification

Anatomical classifications are based on either the position of the displaced tibia on the femur, as described by Kennedy (3), or on the pattern of ligamentous and associated injuries (4,5). In Kennedy's classification system, five types of dislocation are described: anterior, posterior, medial, lateral, or rotational. Both cruciate ligaments might be disrupted in all these injuries. A rotatory knee dislocation occurs around one of the collateral ligaments (LCL) leading to a combined ACL and PCL injury and a tear of the remaining collateral ligament. Knee dislocations that spontaneously reduce are difficult to classify.

A more recent classification system assesses the pattern of ligamentous disruption and the presence or absence of an associated intra-articular fracture (table 1), providing a clearer guide to the nature and severity of the injury and options for treatment (4,5). Dislocation of the knee may be regarded as acute (seen < 3 weeks), or chronic (>3 weeks).

Initial evaluation and management

The vascular status of the limb must be determined quickly and managed appropriately. If the limb is ischemic, the knee should be reduced immediately through gentle traction-countertraction with the patient under anesthesia. After reduction, vascular examination should be repeated. If the limb remains ischemic, emergent surgical exploration and revascularisation is required. After reduction a formal angiogram should be done especially if the patient has a

Table 1. Current classification of dislocation of the knee based on the extent of ligamentous injury

Classification	Associated ligamentous injury
KD-I	Dislocation without both cruciates involved
KD-II	Dislocation with bicruciate disruption only
KD-III	Dislocation with bicruciate + posteromedial or posterolateral disruption
KD-IV	Dislocation with bicruciate + posteromedial and posterolateral disruption
KD-V	Dislocation with fracture
KD-V1	Dislocation without both cruciates involved
KD-V2	Bicruciate disruption only
KD-V2M	Bicruciate + posteromedial disruption
KD-V3L	Bicruciate + posterolateral disruption
KD-V4	Posteromedial and posterolateral disruption

Table 2. Descriptive characteristics of the patients in each group (N=35)

Variable	Early reconstruction group	Late reconstruction group
Number of patients	22	13
Age (years)[1]	36 (21–61)	39 (24–57)
Sex (female/male)	17 / 5	6 / 7

[1] Median and range

high velocity injury, is polytraumatized or has altered mental status. Compartment syndrome, open injury, and irreducible dislocation are other indications for emergent surgery.

A spontaneously reduced knee dislocation can be overlooked especially when evaluating a multiply traumatized patient. A complete physical examination of the knee, including neurovascular assessment, is essential for all high-energy trauma victims. If laxity of two or more of the major ligaments of the knee is found, even in low energy trauma cases, a probable diagnosis of knee dislocation should be made. The physical signs of these cases include a large knee effusion, and overall swelling of the extremity, an abnormal degree of recurvatum, varus/valgus instability with the knee in full extension, and grossly abnormal Lachman test in both directions.

Definitive treatment

The definitive treatment of knee dislocation remains controversial. Controversies persist regarding timing of surgery although early ligament surgery has produced better results than late reconstructions (6–9). Surgical techniques have varied. Generally simultaneous repair or reconstruction of both cruciate ligaments as well as grade III LCL and posterior lateral complex is most often recommended (8). The management of grade III MCL injury has varied from nonoperative treatment to surgical treatment (2,6,8). Several different grafts may be used for reconstruction (7–9,12). Recommendations for postoperative rehabilitation have varied from an immediate range of motion to immobilization for three to six weeks postoperatively (6,8,11,12).

Own study

The purpose of this retrospective study was to evaluate patient satisfaction, functional outcomes and muscle strength after acute and late reconstruction of the dislocated knee. Our hypotheses were that early reconstruction gives better stability and functional outcome than late reconstruction. Furthermore, the nonoperative treatment of acute grade III MCL injury with a hinged brace will render good knee stability when both cruciate ligaments are reconstructed early (7-21 days from the injury).

Patients

Forty-seven patients with a multiple ligament injury caused by knee dislocation were operated in our hospital between 1995–2003. The indication for early (within 3 weeks from injury) or late reconstruction was a bicruciate ligament injury confirmed by clinical assessment and MRI (acute injuries). In addition most patients had a grade III collateral ligament injury. Thirty-five patients were able to participate in the study. 22 patients were operated early (within 3 weeks) and 12 later on (table 2). The mean follow-up was 56 months (range 12 to 92). The study was approved by the local ethical committee and the patients gave their informed consent to participate.

Operative technique

Senior surgeons experienced in arthrosopic knee surgery performed all the reconstructions. All patients were examined under anesthesia. Cruciate ligaments were determined with Lachman, drawer, and pivot shift tests. The collateral ligaments and posterior lateral complex were assessed by applying valgus or varus stress in the coronal plane at both full extension and 30° of knee flexion, and with rotation tests. After examination diagnostic arthroscopy and necessary meniscal and articular cartilage surgery were performed, followed by bicruciate reconstruction and repair or reconstruction of grade III lateral collateral ligaments and PLC. Acute grade III MCL injuries were treated nonoperatively with a hinged brace when both cruciate ligaments were reconstructed early.

Bone-patellar tendon-bone (BPTB) autograft or allograft or double-looped semitendinosus and gracilis autograft were used to reconstruct the ACL. For PCL reconstruction, BPTB allograft or autograft or Achilles tendon allograft were used. The acute bony avulsions of the LCL were repaired. Acute grade III midsubstance tears of the LCL were either repaired or reconstructed with allograft tissue (Achilles tendon, hamstring tendon, or tibialis anterior tendon). PLC was reconstructed either by tendon autografts or allografts (hamstring tendons or tibialis anterior tendon). Acute grade III MCL injuries were treated nonoperatively. No late reconstructions of the MCL were performed.

A transtibial technique for ACL and PCL reconstruction were used. The PCL tibial tunnel was drilled first with a PCL guide set at 60° through the anteromedial portal. The tip of the PCL guide was positioned in the distal and lateral third of the tibial PCL insertion site. The ACL tibial tunnel was drilled with a ACL tibial guide through the anteromedial portal. A 15 to 20 mm wide medial tibial cortical bridge remained between these two tunnels. The posterior edge of the anterior horn of the lateral meniscus was used as a guide to the center of the ACL. The tibial PCL tunnel was drilled using a 11 mm or 12 mm drill bit and the ACL tunnel with a 10 mm drill bit.

The ACL femoral tunnel was drilled before drilling the PCL femoral tunnel. The ACL femoral tunnel was drilled with transtibial technique. The femoral PCL tunnel was drilled with PCL femoral guide with outside-in technique through the superomedial approach. The femoral ACL tunnel was drilled using a 10 mm drill bit (BPTB-graft) and the PCL tunnel with a 11 mm drill bit. The edges of the PCL tunnels were rounded with a Gore Smoother crucial tool (Smith&Nephew, Andover, MA, USA).

The PCL graft (BPTB or Achilles) was passed retrograde through the tibial tunnel and fixed into the femoral tunnel. After this the ACL graft was passed through the tibial tunnel and fixed into the femoral tunnel. The PCL graft was fixed with a 10 x 20 mm bioabsorbable interference screw and the ACL graft with a 9 x 25 mm biabsorbable interference screw, both with inside-out technique. The PCL graft was tensioned and fixed to the tibia while reproducing the normal step-off of the medial tibial plateau in relation to the femoral condyle. The distal part of the graft was fixed with a 10 x 35 mm or 11 x 35 mm bioabsorbable interference screw with the knee held in 90° of flexion. Then the ACL graft was fixed with a 9 x 25 mm bioabsorbable interference screw with the knee in 0 to 30° of flexion.

Clinical assessments and follow-up

One independent senior author (HH) performed all the assessments. The knee stability was measured clinically and with a KT 1000 (Medmetric, San Diego, CA, USA) and Telos stress radiography (anterior-posterior) (Telos machine, SAMO, Bologna, Italy). Isokinetic knee muscle strength was evaluated by Biodex dynamometer (Biodex medical systems, Shirley, New York, USA). The International Knee Documentation Committee (IKDC) subjective knee evaluation form, Lysholm score, Tegner activity level and Kujala patellofemoral scoring chart were completed. Weightbearing radiographs (AP and lateral view) were obtained to evaluate possible osteoarthritis of the knee. Osteoarthritis was classified according to Ahlbäck (10).

Results

The side-to-side difference in anteroposterior knee laxity (KT-1000) was on an average 1.5 mm in the acutely treated group and 2.08 mm in the chronic knee injury group.

For the whole group (n=35) IKDC knee symptom score was on an average 52.3, for the acutely treated group 59.1 and for the chronic knee injury group 40.1. IKDC grades A and B were interpreted as a good result. In the acutely treated group we had 18/22 good results in Lachman, and anterior and posterior drawer tests, and 20/22 good results in the collateral testing. As compared to the chronic knee injury group the figures were 10/13 and 12/13, respectively (table 3).

Table 3. Overall IKDC scores at the final follow-up (N=35)

	Early reconstruction group (N=22)		Late reconstruction group (N=13)	
Rating	N	%	N	%
A (normal)	4	18	3	23
B (nearly normal)	14	64	7	54
C (abnormal)	4	18	3	23
D (severely abnormal)	0	0	0	0

At the follow-up Lysholm score was on an average 74.3 for the whole group, 80.9 for the acutely treated group, and 63.1 for the chronic injury group. Tegner activity level was also better in the acutely treated group than in the chronic injury group, on an average 4.1 and 3.0, respectively. Kujala patellofemoral score was better in the acutely treated group being 69.6 whereas it was 55.3 in the chronic injury group.

The isokinetic muscle strength was significantly better in the acutely treated group than in the chronic knee injury group, the peak torque at the angle speed 60/180 was on an average 160.1 and 104.7, respectively. The statistical significance of our findings will be calculated later on.

Radiological evaluation showed only one case with osteoarthritis, classified grade 3 in the Ahlbäck's classification. This patient was in the chronic treatment group.

Discussion

Traumatic knee dislocations are uncommon orthopaedic injuries. Dislocation involves injury to multiple ligaments of the knee. Associated neurovascular, meniscal, and osteochondral injuries are general and can complicate treatment. Most authors recommend operative treatment for acute knee dislocation (2,6–8). The goal of surgery is to improve stability, retain motion, and achieve knee function. Generally, reconstruction of both cruciate ligaments and grade III LCL injury and posterior lateral complex is the most reliable method of restoring ligamentous stability (6–8). For acute grade III MCL injury, both primary surgical repair within 3 weeks and nonoperative treatment with a brace has been recommended (2,6–8,11).

Harner et al. reviewed the results of surgical treatment of both cruciate ligaments and grade III collateral ligament injuries (12). Nineteen patients underwent surgery < 3 weeks after the initial injury (acute treatment), and 12 patients ≥ 3 weeks after the initial injury. The patients in the acute treatment group had higher subjective scores and better objective restoration of knee stability than patients treated later on. They found no statistical difference in ROM between patients treated acutely versus chronically. In the present study the stability of the knee was on an average good in both groups, even though a little bit better after acute treatment than after late reconstruction. The functional outcomes, and the muscle strenght were better in the acute treatment group than in chronic knee injury group.

Biomechanical studies in the 1980s showed that both MCL (10) and ACL (11) are important stabilizers against valgus stress. Grood et al. (13) found in human cadavers that at 25 degrees of knee flexion, the MCL contributes approximately 78 % of the restraining force. This decreases as the knee goes into extension, and at 5 degrees of extension, it provides 57 % of valgus restraining force. In knee extension, the posteromedial capsule and ACL increase their contribution to valgus restraint. Inoue et al. (14) stated that the MCL contributed only 21 % of resistance to valgus stress and the ACL was the primary stabilizer against valgus stress of the knee.

Early reconstruction of both cruciate ligaments stabilizes the knee joint in anterior posterior direction but also significantly against valgus stress. Our second hypothesis was that the nonoperative treatment of acute grade III MCL injury with a hinged brace renders good knee stability when both cruciate ligaments are reconstructed early. The preliminary results of our series seem to support this treatment protocol. Fanelli and Edson (8) also reported stable MCL healing with bracing (4 to 6 weeks) followed by bicruciate reconstruction in 7 out of 8 acute combined ACL-PCL-MCL injuries.

Acute midsubstance tears of the LCL may be repaired or may need to be augmented with tendon autograft or allograft. Distal bony avulsion of the LCL can be successfully repaired by using nonabsorbable sutures passed through drill holes of the proximal end of the fibula. After 2 to 3 weeks from injury, soft-tissue contracture of the LCL limits the primary ligamentous repair, often making reconstructive procedures necessary.

We conclude that early ligament surgery (within 7–21 days of injury) seems to produce better results

compared to late reconstructions. Early, bicruciate reconstruction with repair or reconstruction of lateral structures (LCL and PLC) offers the best chance for an optimal outcome. Primary repair of grade III LCL and PLC injuries may be performed if surgical treatment is undertaken during the second or the third week after injury. The nonoperative treatment of acute grade III MCL injury with a hinged brace rendered good knee stability when both cruciate ligaments were reconstructed early. Delayed surgical treatment of collateral ligament injuries usually requires reconstructive procedures. The risk of an associated injury of the popliteal artery should be kept in mind in the early phase.

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