

Rebound ACL Case Study

Acute anteromedial knee instability with complete tear of the ACL and complete tibial injury of the MCL and POL



Priv.-Doz. Dr. med. Dr. rer. nat.
Thomas Stein

Executive senior physician in the department for Sport traumatology

Knee- and shoulder surgery

Berufsgenossenschaftliche Unfallklinik Frankfurt am Main

Member of Ligament committee German Knee society (DKG)

Member of Research committee Society for Arthroscopy and Joint Surgery (AGA)

Frankfurt, Germany

Indication

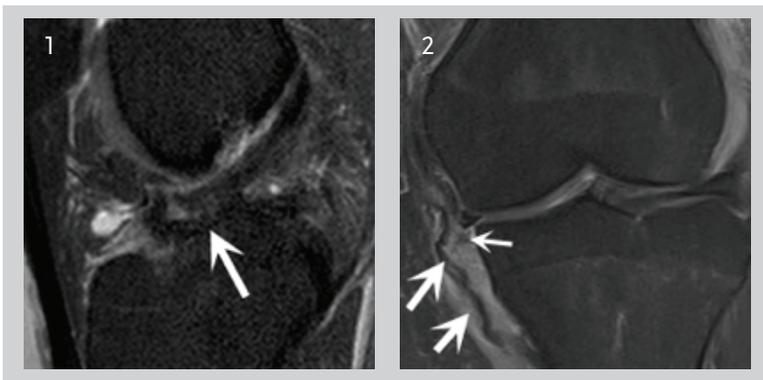
A 27-year-old man was brought to the local emergency room after a motor cycle accident. The leg was initially stabilized in a conventional brace. The patient described an isolated knee injury, but he was not able to recapitulate the exact injury sequences. The effort to consider the mechanism of injury let assume, that the lower leg experienced a combined valgus and external rotation force effect.

The first preclinical survey demonstrated an acute anteromedial knee pain with probable anteromedial knee sub- dislocation and spontaneous reduction without any signs of nerve and blood vessel abnormalities.

Diagnostics

The initial inspection and palpation showed no injury of the integument, but a swollen capsule with existing joint effusion with tenderness of palpation at the medial tibial insertion of the MCL. The joint effusion and the pain limited the range of motion (ROM) to 0-5-90. The examination of the ligament status revealed in 0° and 30° flexion a complete and painful instability of the medial ligament complex, whereas the lateral collateral ligament and the biceps femoris tendon showed no abnormalities. The examination of the anterior cruciate ligaments (ACL) detected positive results for the anterior Lachman test and the anterior drawer test (ADT). The pivot shift test was not possible given the joint effusion and painful, limited range of motion. All test for posterior cruciate ligament (PCL) and the posterolateral complex (PLC) were negative. The first clinical survey indicated an acute anteromedial knee instability with a complete tear of the anterior cruciate ligament (ACL) and complete tibial injury of the medial collateral ligament (MCL) and the posterior oblique ligament (POL).

The standardized conventional radiographs (CR; knee anteroposterior view and lateral view) excluded knee associated fractures or high grade osseous defects, but indicated a dorsolateral tibial head impression and a lateral femur condyle impression. These injury pattern are supposed to indicate to a high grade ACL injury.



Diagnostics

The magnetic resonance imaging (MRI) assessment confirmed the initial clinical diagnosis and showed an acute two-ligament-injury with a tibial insertion- near ACL- rupture (figure 1) in combination with complete tibial avulsion injuries of the MCL and the POL (figure 2 small arrow = deep layer MCL; big arrow = superficial layer MCL). The lateral ligament complex and the PCL were normal. There were signs of lateral meniscus contusion and an impressions fracture at the dorsolateral tibia head outside of the weight bearing line. There were no signs of extended cartilage defects of high grade meniscus injuries.

Treatment Overview / Treatment Goal

The acute anterolateral two-ligament-injury (with an acute tibial ACL- rupture in combination with complete tibial avulsion injuries of the MCL and the POL) of a young and high demanding patient displays an indication for surgical intervention.

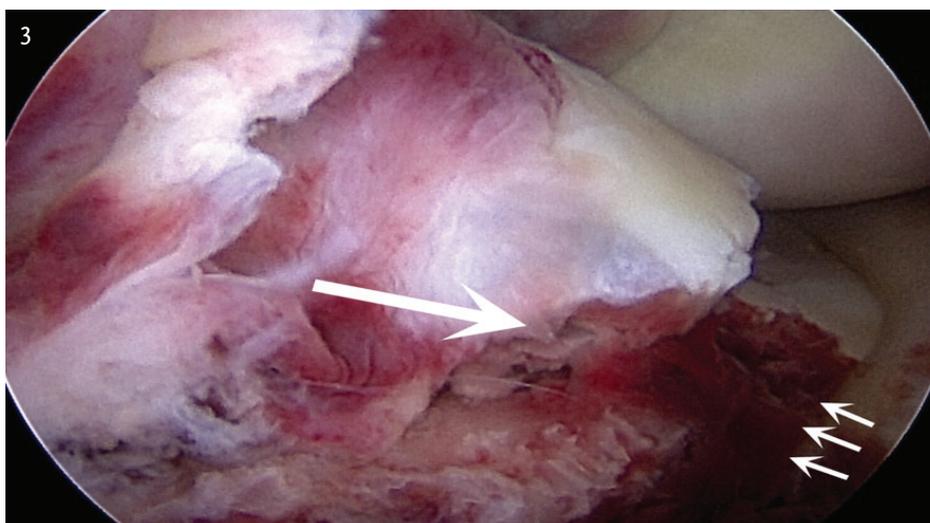
The analysis of the MRI excluded an injury of the posterior structures (posterior capsule and PCL/ popliteus tendon), what allows an early surgical intervention. Principally, an injury of the posterior capsule permit an early arthroscopic therapy because of complications following posterior intraoperative fluid extravasat and a secondary compartment situation. In case of posterior capsule injuries, the arthroscopic intervention showed be planned between the 10th to 14th day after injury. Before surgical intervention of an two-ligament injury, injuries of the posterior vessels and nerves has to be excluded by an angiography and specific neurologic examination.

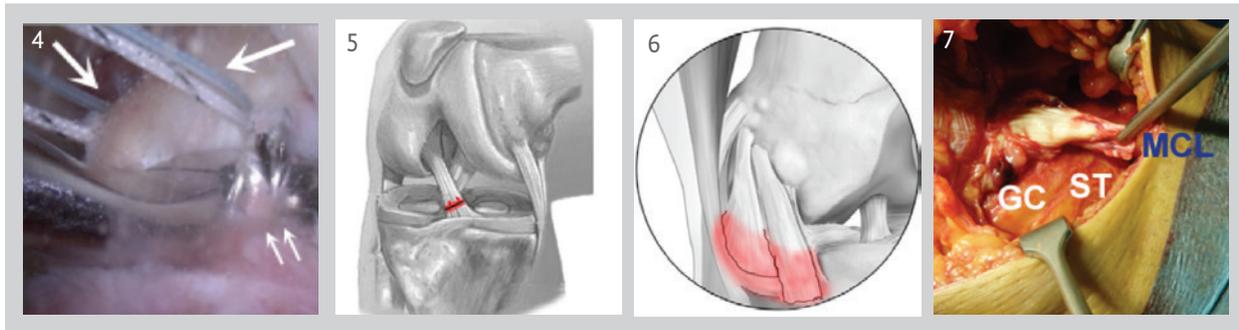
The surgical goal is the one-step, two-ligament repair with arthroscopic transtibial ACL- refixation with additive transarticular augmentation and an open anatomic refixation of the superficial and deep layer of the MCL and the refixation of the POL.

The postoperative rehabilitation protocol contents the initial stabilization with a dynamic ACL varus (lateral off- load) brace for 12 weeks with partial weight bearing from the 9th postoperative week. The dynamic stabilization including muscle building physiotherapy and neuromuscular practices starts after the brace application.

Surgical Treatment

Arthroscopic procedure: The intra-operative situs showed an acute periosteal avulsion of the ACL (figure 3 big arrow=proximal remnant, small arrows=tibial insertions area). Without applying a tourniquet, the portal placement is set analogue to an ACL reconstruction with an high para-tendinous anterolateral and a deep suprameniscal anteromedial portal, additionally the high anteromedial portal will be placed. Using the tibial and femoral drilling guides, two 2.4mm drill wires are placed at the femoral and at the tibial ACL- insertion area.





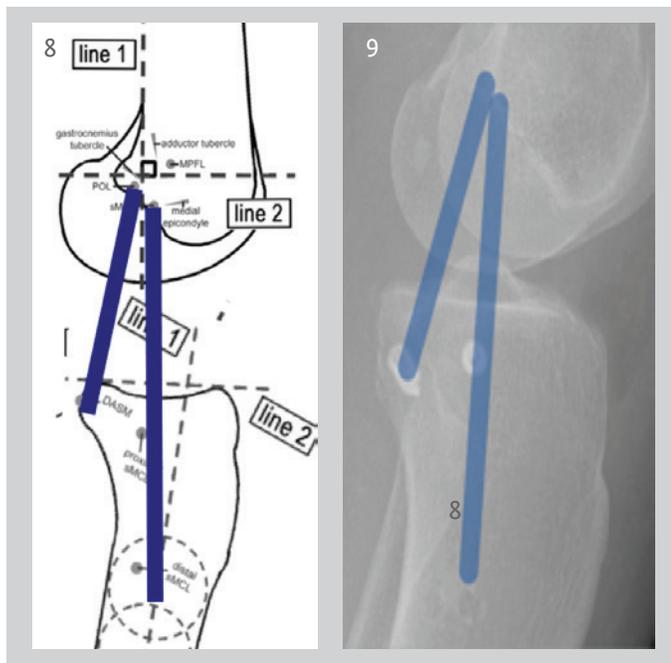
Transarticular augmentation: For the transarticular augmentation, the FW No5 is used. At first, the two FW No5 are transfemorally shuttled by the two femoral drill wires. The drill wires were placed trough the anatomic insertion area of the native ACL, one posterior and one anterior to the uninjured proximal part of the native ACL. To exclude converging drill channels, the applications of the two drill wires were performed separately in 110 and 120 degrees of flexion. After transfemoral FW pull out, the two tibial FW ends were transtibially placed using the SutureRetriever and the two initially drill holes for the ACL-refixation. Picture 4 shows the distal ACL- refixation (big arrows) and the implanted 2.4mm drill wire with the tibial drill guide for the additive trans- articular augmentation (small arrows).

Concomitant injuries: If the diagnostic arthroscopy revealed concomitant lesions at the end of the arthroscopic suture placement meniscus and chondral injuries can be treated. Picture 5 shows the graphic injury of the ACL and picture 6 shows the graphic injury pattern of the MCL and POL (modified from: Wijdicks et al., JBJS am 2010).

Open medial stabilization: After painting the anatomical landmarks and applying the tourniquet, the open medial approach was set distal to the joint line and between the two tibial anatomic insertion areas of the MCL and POL. After longitudinal incision of the deeper fascia, the tibial remnants of the MCL and POL are mobilized. Picture 7 shows the tibial avulsion of the superficial MCL, which is dislocated into an extra- anatomic position (above the insertion of the hamstrings).

Using the exact lateral knee view of the conventional radiographs, the following three anatomic points are marked at the medial tibia: 1) insertion area of the deep MCL, 2) insertion area of the superficial MCL and 3) insertion area of the POL.

Pictures 8 (modified from: Wijdicks et al., JBJS am 2010) and 9 show the insertion areas of the dMCL, the sMCL and the POL. The postoperative radiograph (pic 9) documented the anatomic repair.

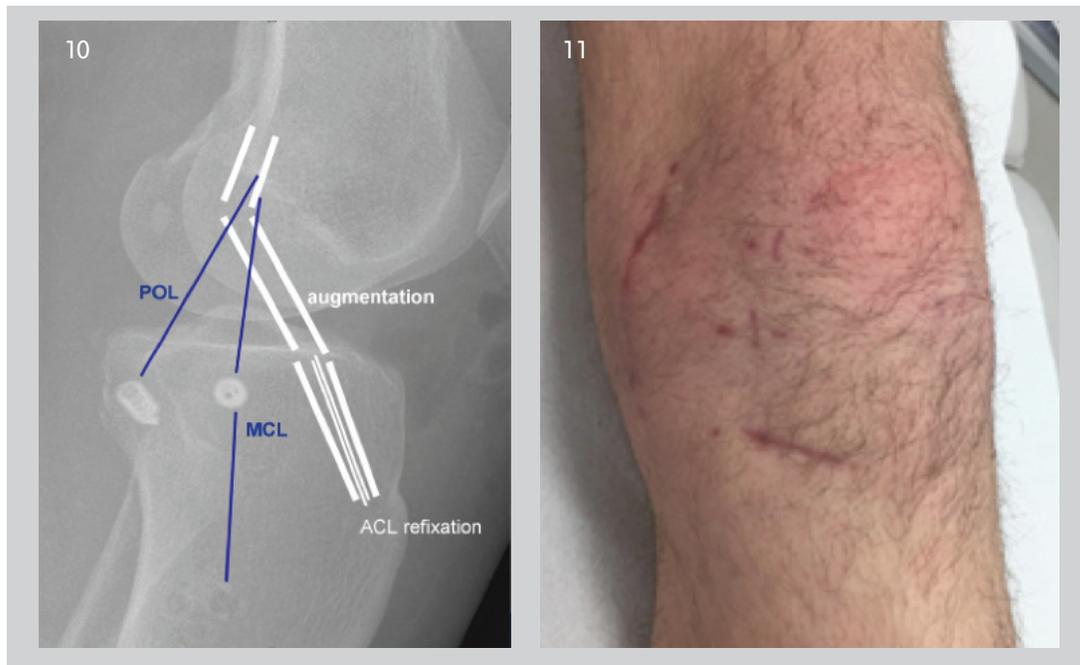


At the points (1) and (3) suture anchors (5.5 FT CorkScrew double loaded with FW No2 / Arthrex) are placed and the FW No2 is shuttled through the distal portion of the ligament remnants in Krackow- stich- technique. A 3.5mm drill hole is set at point (2) to insert the 4.5mm BioComposite PushLock anchor at the end of the medial ligament repair.

After placing the knee in 30 degree of flexion, varus and internal rotation, sutures are knotted in following order:

- a) transarticular FW
- b) transtibial ACL- refixation
- c) POL
- d) dMCL
- e) sMCL (setting the 4.5mm BioComposite PushLock anchor with the FW of the dMCL- fixation)
- f) Closing the fascia at the medial open approach

Picture 10 shows the overview of suture placements. All trans- tibial suture placements were set superior to the pes anserinus tp preserve the hamstrings for a later ACL (pic 11).



Post-Surgical Rehabilitation

The initial conventional brace is applied directly in the operation room after wound closing. The custom- made rebound orthosis can be assessed at the contralateral knee after surgery. To support the repaired medial ligament complex, there will applied n dynamic anterior support with additional varus position (lateral off load). After reduction of swelling and effusion, the custom- made orthosis can be applied.

The postoperative rehabilitation protocol contents the initial stabilization with this specific dynamic ACL varus brace for 12 weeks with partial weight bearing (PWB) from the 9th postoperative week and full weight bearing (FWB) from the 12th week. The dynamic stabilization including muscle building physiotherapy and neuromuscular practices start after the brace application.

ITEM	PHASE I (week 1 – 2)	PHASE II (week 3-6)	PHASE III (7-12 week)	PHASE IV (week 13-52)	PHASE V (week 53 -)
Orthosis	Conventional–24h/ day	Rebound–24h/day	Rebound–24h/day	—	—
Weight bearing	No WB	No WB	7+8 No WB 9+10 PWB 11 - FWB	FWB	FWB
ROM	0 -0- 30 passive	0 -0- 60 active	7-10 0-0-90 active 7-10 0-0-90 active	0 -0- free active	0 -0- free active
Physio	PRICE Muscle activation EMS NO CPM	Muscle activation EMS NO CPM	Muscle activation EMS NO CPM	dynamic stabilization muscle building neuromuscular practices Autologue ACL or MCL reconstruction if persisting or secondary instability	Return to sport: 90% of muscular strength neuromuscular recovery ligament stability dynamic stabilization Autologue ACL or MCL reconstruction if persisting or secondary instability

Reasons To Use The Rebound ACL Brace

The custom-made orthosis specifically protects the repaired structures. The ligamental healing process (ACL + MCL + POL) in addition with functionally high demanding rehabilitation protocol can be increased by the dynamic anterior support (for the ACL- repair) and the varus position (for the MCL-and the POL- repair).



Clinical Outcome

The applied treatment strategy results in a good ligamental consolidations. The ACL shows minimal remaining partial instability (Lachman+/ ADT+) without rotational instability. The medial ligament complex showed a full ligamental stability in 0° flexion and partial instability in 30° flexion. The goal of the postoperative rehabilitation remains to decrease the persisting dynamic instability and neuromuscular deficits.

Conclusion

The treatment of multi- ligament injuries of the knee should be performed in one-step, ligament-preserving techniques with an anatomic repair and a specific rehabilitation protocol according to the the injury patterns. The dynamic orthosis support the knee kinematic in the early post-operative interval enable by valgus or varus modification and ACL or PCL support an injury- specific protection of the repaired structures.

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