

Arthroscopic treatment of a large lateral femoral notch in acute anterior cruciate ligament tear

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Abstract A 24-year-old professional soccer player suffered an acute anterior cruciate ligament tear associated with a radiologically evident impression fracture of the lateral femoral condyle, the so-called “lateral femoral notch sign”. Following MRI validation of the injury with detection of an additional lateral meniscus tear, arthroscopy was carried out 3 days after the injury. Due to the extended impression of about 5 mm, arthroscopically assisted closed reduction of the depression fracture was performed. A 3.2 mm tunnel was drilled at the lateral femoral condyle in a supero-inferior direction using an ACL tibial guide and the depressed area could be restored using an elevator. The resulting subchondral bone defect in the femoral condyle was filled with freeze-dried human cancellous bone allograft. As a one-stage procedure ACL reconstruction was carried out using a hamstring tendon technique. At 1-year follow up the patient has returned to full sporting function, including playing soccer with a radiographically reduced lateral femoral notch sign.

Keywords Lateral femoral notch · Impression fracture reduction · ACL-reconstruction

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Introduction

The lateral femoral notch is a radiographic sign that describes a depression in the lateral femoral condyle occurring in association with anterior cruciate ligament (ACL) tear. Morphologically it results from an impression fracture of the lateral femoral condyle near the terminal sulcus. The lateral femoral notch represents the most extreme form of bone contusion and microfracture, which in most cases are occult on plane radiographs, but visible with magnetic resonance imaging (MRI) [3, 6, 8]. First reports in literature attributed the lateral femoral notch to chronic ACL insufficiency [4, 9], which later on was reported to occur also in acute cases [1]. Very little literature exists regarding the treatment of a lateral femoral notch. Whereas in most cases the lateral femoral notch has only radiographic significance with no need for surgical treatment, extreme formations have clinical relevance due to deformation of the articular surface of the femoral condyle as possible precursor of osteoarthritis. However, if arthroscopically evident, the incongruity of the articular surface should be addressed and the depression fracture should be reduced. To our knowledge, there are only two case reports concerning fracture management. One reported on open reduction, autologous cancellous bone grafting and secondary ACL reconstruction using a bone–patellar tendon–bone graft [2]. The second case was treated arthroscopically using a bioabsorbable interference screw to fill up the intracondylar bone defect with contemporaneous ACL reconstruction using hamstring tendon [7].

We report on a one-stage procedure with arthroscopically assisted reduction of a large lateral femoral notch, cancellous bone allografting and primary ACL reconstruction.

Case report

A 24-year-old man sustained a knee twisting injury while playing soccer. The injury occurred on landing after a jump and as described by the patient represented a valgus stressed, flexed and externally rotated position of the knee. At foot impact after landing the patient felt a popping in his right knee with immediate pain and effusion. He could not play on. Initial clinical examination by the team physician showed a positive Lachman sign with no valgus or varus instability. The range of motion was limited to 90° of flexion due to acute pain and considerable articular effusion. Tenderness was present at the lateral joint line. Plane radiographs of the injured knee revealed an area of depression at the lateral femoral condyle (Fig. 1), the so called “lateral femoral notch” without interruption of the subchondral cortex. An arthrocentesis was carried out and 100 ml of blood were obtained. No fat droplets, as usually found in intra-articular fractures of the distal femur and proximal tibia, were present in the bloody effusion due to the integrity of the articular cartilage. MRI was performed the next day and showed an additional acute ACL tear and a radial tear at the intermediate zone of the lateral meniscus. A bone bruise was present directly underneath the area of impression at the lateral femoral condyle (Fig. 2).

Three days after the injury, knee arthroscopy was carried out revealing a coronally impressed groove of 5 mm depth and cartilage fracture (Fig. 3). The decision was taken to attempt arthroscopically assisted reduction of the impression fracture. A 3.2 mm tunnel was drilled starting laterally through the femoral condyle in a supero-inferior direction towards the depressed area. For this purpose, an ACL tibial guide device (Smith & Nephew, London, UK) was used to center the depressed area. The ACL tibial guide was inserted laterally through an additional stab incision with the knee in 30° of flexion (Fig. 4). A 3.2 mm cannulated drill was used to avoid unnecessary bone damage. By means of an elevator, which was introduced through the 3.2 mm bone tunnel to the subchondral area, the regular, convex shape of the lateral femoral condyle could be restored almost anatomically (Fig. 5). To fill up the intracondylar bone defect, 3 cm³ of freeze-dried human cancellous allograft bone (DIZG, Berlin, Germany) was used. At the same sitting, ACL reconstruction and partial lateral meniscectomy were performed, arthroscopically assisted. We performed ACL reconstruction using a hamstring graft (semitendinosus and gracilis tendons) in a single-bundle technique. The Biotransfix[®]-system (Arthrex, Naples, FL, USA) was used for femoral fixation and a bioabsorbable interference screw (Calixo[®], Smith & Nephew) for graft fixation at the tibial side.



Fig. 1 Primary injury lateral radiograph of the right knee depicts cortical depression at the lateral femoral condyle, the so-called “lateral femoral notch” (arrow). The subchondral femoral cortex is not interrupted

Postoperatively the knee was immobilized in a long-leg hinged knee brace non-weight bearing for 6 weeks. During this period progressive exercises to improve range of motion were performed under the guidance of a physiotherapist.

After 3 months the patient began with cycling and jogging. Full return to sports activities was allowed 6 months after the injury.

One year after the operation the patient was followed up clinically and radiologically. Full range of motion was achieved from 0° to 135°, the Lachman test was negative with absent anterior drawer sign. No varus or valgus instability was present. The patient was able to exercise all sports activity to the same level as before the injury and was pain free. The radiographs showed almost anatomical alignment of the lateral condylar hemisphere (Fig. 6) without any signs of degenerative change. The intracondylar bone defect was no longer visible. No radiological widening of the femoral or tibial tunnel had occurred.

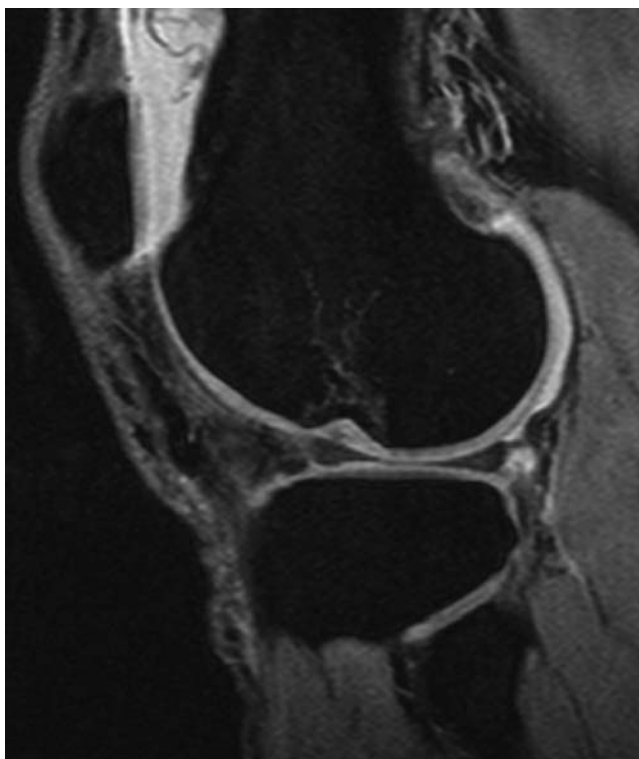


Fig. 2 Preoperative sagittal MRI-scan shows the lateral femoral notch. Neither the hyaline cartilage nor the subchondral cortical bone is interrupted

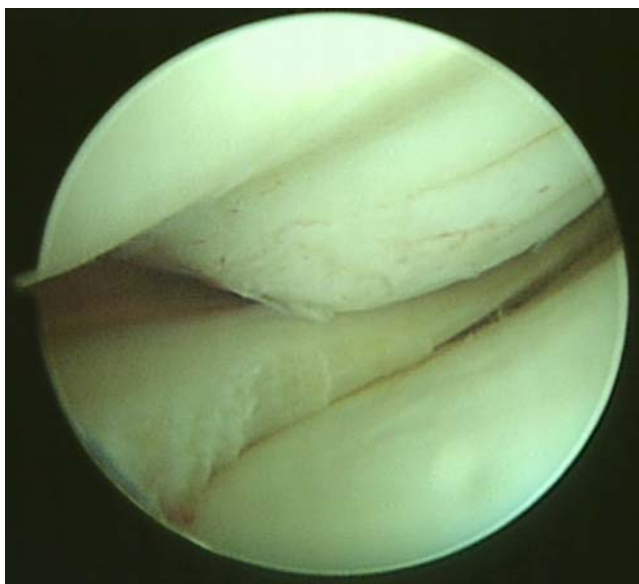


Fig. 3 Arthroscopic documentation reveals a coronally extended depression at the lateral femoral condyle with cartilage fissuration. The radial lateral meniscus tear has already been resected

Discussion

Bone bruises or microfractures are frequent concomitant lesions in acute ACL tears, evident in most cases only with



Fig. 4 Schematic graph of positioning of the ACL tibial guide to center the drill wire into the depressed area. The tibial guide is inserted into the knee joint from laterally through an additional stab incision with the knee in 30° of flexion

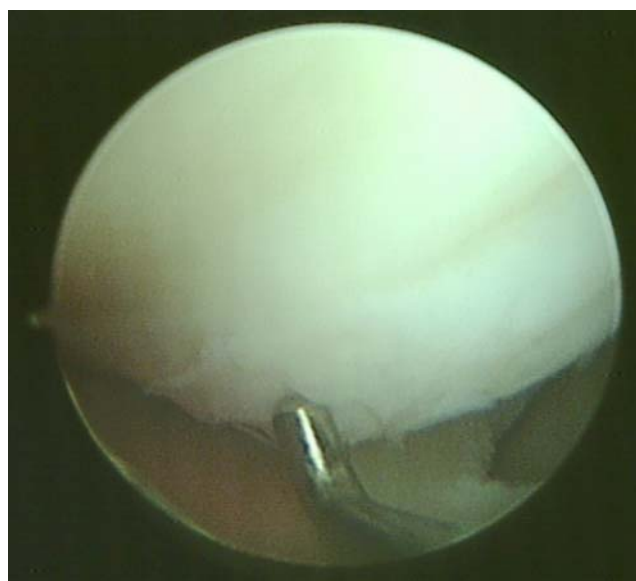


Fig. 5 Following percutaneous reduction of the impression fracture the lateral femoral condyle shows an almost anatomic convex shape. The *hook* indicates site of cartilage damage

MRI-scan. An impression fracture at the lateral femoral condyle of larger extension, the so-called lateral femoral notch, is rare but significant for acute ACL tears [1, 2, 5]. The lateral femoral notch results in incongruity of the lateral articular surfaces, and, in the context with associated



Fig. 6 Lateral radiograph of the right knee at 1-year follow-up reveals nearly anatomic alignment of the reduced lateral femoral notch (*arrow*). The subchondral cancellous bone structure is homogenous without signs of remaining defect. Widening of the femoral or tibial bone tunnel was not observed

ACL tear, has to be seen as precursor in the pathology of secondary osteoarthritis, aside from a possible source of pain. Thus, we consider isolated ACL reconstruction not sufficient for the treatment of these complex knee injuries. In addition, the unreduced lateral femoral notch exerts a valgus stress on the ACL graft, potentially putting at a biomechanical disadvantage. Therefore, apart from ACL reconstruction we judge fracture reduction of a large lateral femoral notch to be crucial in restoring a stable and painless knee joint.

In this case report, minimally invasive treatment of a lateral femoral notch was possible. The articular convexity of the lateral femoral condyle could be restored nearly anatomically. Using a minimally invasive technique, correct positioning of the reduction tools in the center of the depression is of crucial importance. For this purpose we used an ACL tibial guide, which was inserted from laterally through an additional stab incision. Thus, the drill wire could be directed tangentially to the lateral wall of the

femoral condyle from superior to inferior. This angle allows adequate reduction of the depressed area with an elevator.

In the only previously published arthroscopically treated case, a bioabsorbable interference screw was used to fill up the intracondylar bone defect following fracture reduction [7]. For the purpose of addressing the bony defect, we used freeze-dried human cancellous bone allograft. The patient was informed before the procedure about a possible necessity for bone grafting, when reduction of the depression fracture should be performed. As a professional soccer player, he refused cancellous bone harvesting from the iliac crest. Instead, he preferred human cancellous bone allografting. Nearly anatomical reshaping of the lateral femoral condyle was achieved with osseous healing of the defect.

In contrast to an open managed case reported by Garth [2], we performed fracture management and ACL reconstruction as a one-stage procedure. The only difference in postoperative management was to avoid weight bearing for 6 weeks. But as documented with our case, no negative influence on the postoperative progress was observed, and the final outcome was excellent.

In cases with a large lateral femoral notch, we believe reduction of the depression fracture to provide a biomechanically improved situation, when ACL reconstruction is performed. As seen in this reported case, contemporaneous ACL reconstruction allows an all-arthroscopic one-stage procedure and can provide a successful outcome. Human cancellous bone allografting led to bony healing of the reduced impression fracture.

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