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TECHNICAL NOTE

Simple Arthroscopic Technique to Perform Retrograde Drilling for Osteonecrosis of the Femoral Condyles with the Use of Anterior Cruciate Ligament Guide

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ABSTRACT: This technical note describes a simple arthroscopic technique that was introduced without the need for further staff during an operation to address osteonecrosis of the medial femoral condyle. A 2.4 mm pin was positioned through the sleeve of an anterior cruciate ligament (ACL) tibial guide and marked with a steri-strip at its body, aiming at 5–10 mm distance between the tips of guide and the pin. The steri-strip serves as a marker and as a stop for inadvertent violation of the cartilage. The tip of the ACL was positioned just over the bone lesion, while the marked 2.4 mm pin was inserted through the ACL tibial guide from anterior surface of the femur. A stab incision was made and without advancing the sleeve to the bone, the pin was drilled to the marked position while cartilage integrity was confirmed arthroscopically. This arthroscopic technique is simple, fast and effective and is performed without the need for special equipment.

Keywords: Osteonecrosis; Knee Joint; Arthroscopy; Decompression; Greece.

Osteonecrosis of the femoral condyle is the second most common affected anatomic location, following the femoral head and accounts for approximately 10% of all cases.[1] It was first described by Ahlback *et al*. in 1968 as a distinct clinical entity primarily affecting older adult women.[2] Following the classification of osteonecrosis by Ficat and Mont, the disease progresses through four stages and is based on a combination of clinical and radiographic findings.[3,4] Although several risk factors for the pathogenesis of osteonecrosis have been identified, three main theories of pathophysiology have been proposed. The traumatic theory is based on a history of repetitive trauma over time, causing interruption of blood flow, critical ischaemia and finally bone collapse.[5,6] The ischaemic theory is that ischaemia can result from an occlusion of the epiphyseal vessels, causing bone necrosis and collapse.[5,6] Another theory is that there is an association with altered biomechanics of the knee joint following meniscal root tear and meniscectomy, which often occurs in younger and active males.[6]

Similar to the differing theories of pathophysiology, there is still debate concerning the current treatment options for this disease. In general, treatment includes non-operative management with pharmacologic agents, such as non-steroidal anti-inflammatory drugs and bisphosphonates, as well as operative treatment with joint preserving and joint-replacing surgeries.[6] The operative treatment with core decompression is suggested for early and pro-collapse stages of the disease.[6–8] In this regard, various techniques have been described for performing femoral condyle core decompression with the majority aided by arthroscopy, fluoroscopy and navigation systems, in order to safely drill the necrotic area.[1–3] Thus, the purpose of this technical note is to present a simple technique, which enables retroarticular core decompression with an anterior cruciate ligament (ACL) tibial guide and a marked pin, without the need of fluoroscopic or/and navigation assistance.

Technique Details

Two grams of prophylactic cephalosporin were administered intravenously within one hour before the surgery. The surgery was carried out with the patient in a supine position, while two posts were attached to the surgical table to facilitate access by the surgeon and the assistant; the first post was lateral to the proximal thigh and the second was used as a foot rest to maintain a 90 degrees of knee flexion. After the patient was positioned, a cotton cast was wrapped around the thigh in order to avoid skin wrinkles and a tourniquet was then applied circumferentially at a pressure of 300 mmHg.

Retrograde drilling was performed utilising an ACL tibial guide. The pin sleeve was placed and secured into the guide leaving enough space for the

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Figure 1: Photograph of the calibrated tibial guide. The pin was positioned through the transtibial anterior cruciate ligament guide and was marked with the use of a steri-strip.

extra articular course of the ACL guide. The 2.4 mm pin was positioned through the sleeve and marked with a steri-strip at its body, aiming at a 5–10 mm distance between the tips of guide and the pin, to avoid articular cartilage blow-out [Figure 1]. The steri-strip serves as a marker and as a stop for inadvertent violation of the cartilage.

The integrity of the cartilage was confirmed arthroscopically. The ACL tibial guide was inserted through the antero-medial or antero-lateral portal for the medial and the lateral femoral condyle lesions, respectively. The tip of the tibial ACL guide was positioned just over the bone lesion, without touching the healthy cartilage. Care was taken to prevent damage to the articular surface of the femoral condyle with the tip of the transtibial ACL guide [Figure 2]. The pin was inserted through the anterior surface of the femur. A stab incision was made and without advancing the sleeve to the bone, the pin was drilled to the marked position. The procedure can be repeated several times and at different knee angles, depended to the size and location of the lesion treated [Figure 3]. Advantages and limitations of this technique are listed in Table 1.

Case Study

A 47-year-old male patient presented to an Orthopaedic Department and Sports Injuries Unit in Thessaloniki, Greece, in 2021 with right knee pain and gradually became uncomfortable over a six-month period. He had a history of a previous sports injury in the previous year. Symptoms rapidly worsened with limited activity in the prior month. Physical examination showed focal tenderness over the medial femoral condyle and slight limitation in the range of motion of the knee with positive McMurray's and Thessaly test. Magnetic resonance imaging (MRI) showed characteristic high intensity portions in the subchondral area of medial femoral condyle, surrounded by diffuse high signal intensity and a medial meniscal tear [Figure 4]. The patient was diagnosed with osteonecrosis of the medial femoral condyle. Due to the presence of a large lesion limited to the medial femoral condyle, core decompression by retrograde drilling was recommended as an effective treatment option in initial osteonecrosis of the knee (still radiographically invisible). The inclusion criteria for this study were the presence of secondary osteonecrosis of stage I or stage II disease according to Ficat and Mont as modified for the knee.[3,4] Exclusion criteria included a history of major trauma, the presence of radiological collapse (stage III and IV) and post-arthroscopic osteonecrosis.

The arthroscopic procedure was performed as described above by the senior author (N.K.).

Post-operatively, the patient was encouraged to do passive and active range of motion as tolerated.

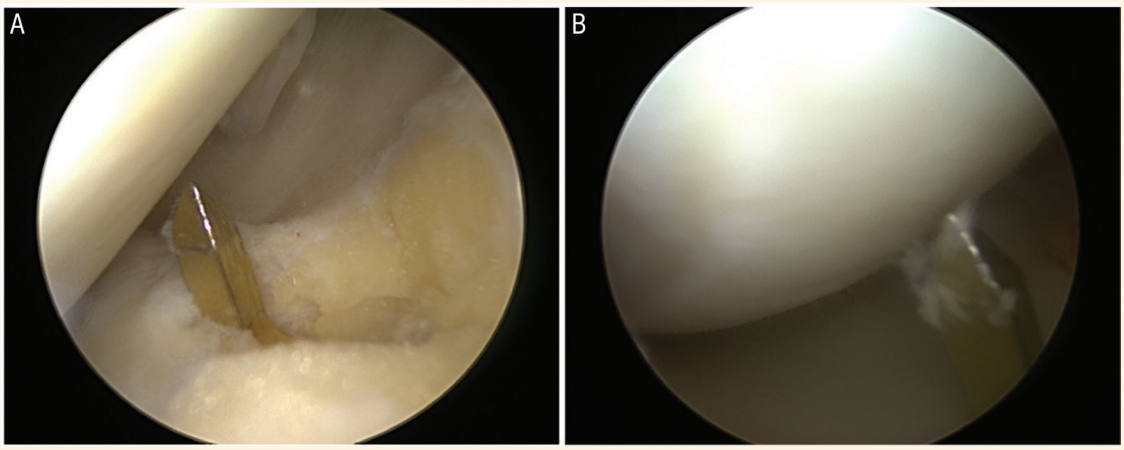

Figure 2: Intraoperative photographs from the anterolateral portal showing the tip of the anterior cruciate ligament guide placed over different areas of the medial femoral condyle with osteonecrosis.

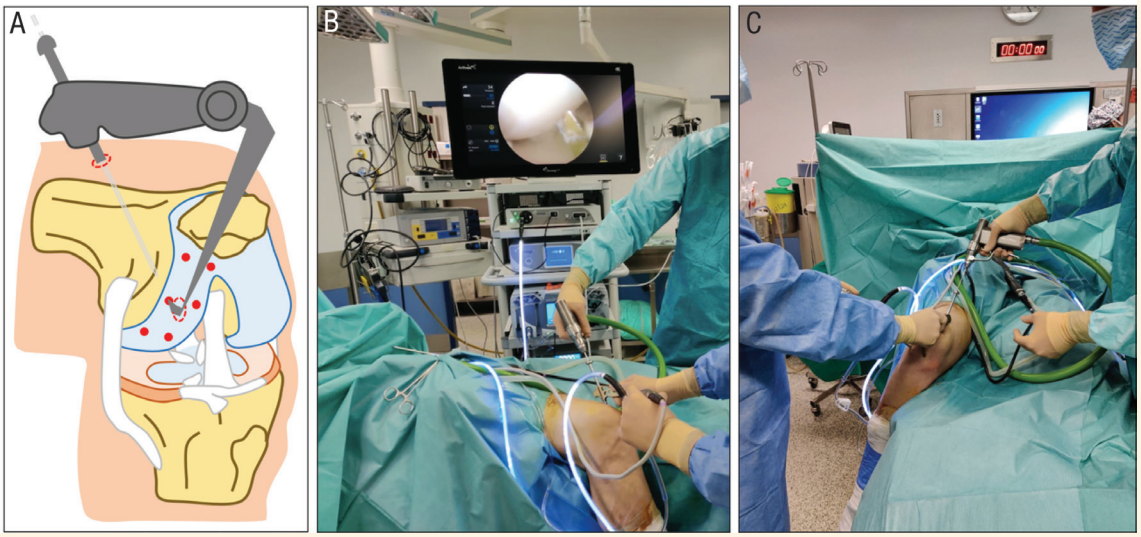

Figure 3: An (**A**) illustration showing the technique and intraoperative photographs (**B** and **C**) showing the surgical technique with retroarticular core decompression for osteonecrosis of the medial femoral condyle.

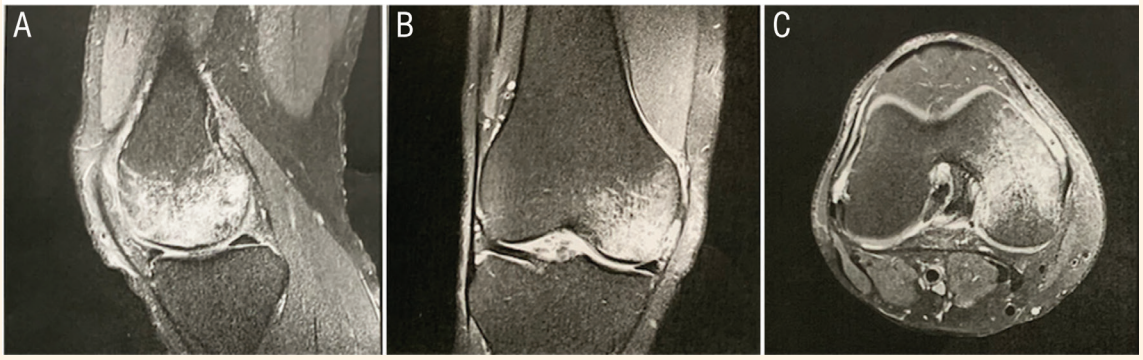

Figure 4: Magnetic resonance imaging of the right knee showing extensive osteonecrosis in (**A**) sagittal, (**B**) coronal and (**C**) transverse views. The bone marrow edema was located in the medial femoral condyle.

Partial weight-bearing restriction for six weeks, in combination with pain killers and muscle strengthening exercises, were recommended, followed by a gradual return to activities based on symptoms. Six months post-operatively, the patient remained asymptomatic with full participation in sport activities.

Written informed consent was obtained from the patient in order to use his images for publication purposes.

Discussion

The pathophysiology of the osteonecrosis of the femoral condyles is not well understood but there are a number of risk factors outlined in the literature which indicate that the pathogenesis of osteonecrosis is likely multifactorial.[5,6] Common risk factors include sickle cell disease, myeloproliferative disorders, alcohol consumption, long-term corticosteroid use, tobacco smoking, prior trauma and meniscectomy.[5]

Over the past two decades, several treatment options for early stages of osteonecrosis have been proposed, including core decompression, vascularised and non-vascularised bone graft, cell-based therapies (bone marrow mesenchymal stem cells and/or platelet-rich plasma) and osteotomies.[5,8] The use of vascularised bone grafts has been associated with possible disadvantages, including the extensive surgical time, prolonged rehabilitation and possible donor site morbidity, such as numbness, weakness and ankle pain (e.g. fibula bone graft).[8] Also, high-tibial osteotomy requires careful pre-operative planning and an experienced surgeon, with the potential risk of non-union, tibial plateau fracture, lateral cartilage degeneration and a further operation for elective hardware removal.[9] Therefore, retrograde core decompression remains an accepted treatment option by most orthopaedic surgeons as the preferred option for the treatment of osteonecrosis of the femoral condyles.

Knee arthroscopy is currently the gold standard for diagnosing concomitant intra-articular knee pathology.[6] MRI, computed tomography and various adaptive segmentation of knee radiographs have assisted texture analysis of soft-tissue and subchondral bone pathology as well as increased the diagnostic performance for detecting the presence of knee osteonecrosis by providing a visual assessment of the cartilage and accurate information about focal or diffuse partial/full thickness chondral lesions.[10] Although, knee arthroscopy is a common and safe surgical procedure without associated major complications, the overall complication rate was up to 2% varying with the age of the patient, the duration of the tourniquet time and the complexity of the procedure.[11,12] However, knee arthroscopy at the time of core decompression of femoral condyles provides an accurate way to confirm the presence or absence of osteochondral defects, collapsed lesions of the femoral condyle and combined disorders, such as cruciate ligament and meniscal injuries.[13]

Over the last years, many different procedures have been proposed for the treatment of osteonecrosis of the femoral condyles.[5,7,14] Retrograde core decompression by precise drilling into ischaemic lesions of the femoral condyle while remaining articular cartilage intact is always a challenge. In conventional technique, the exact location of the drill is determined by multiple checks of drilling course and depths with the use of digital fluoroscopy.[15] The advantage of using fluoroscopy is that the exact position of the drill bit can be detected and it can be determined whether it has been properly inserted in order to avoid damage of articular cartilage and of extra-articular soft tissues.[15] On the other hand, the use of digital fluoroscopy exposes both the patient and operative staff to enormous radiation, while it puts sterility at risk.[5,15] In order to minimise this risk, computer-assisted and navigation-based techniques have been developed, regarding retrograde core decompression of osteonecrosis of the femoral condyle. These techniques have been shown to improve intra-operative precision with the least possible radiation.[5,15]

The described surgical technique is a commonly performed arthroscopic surgical procedure at the authors' institution and makes it easy to perform retrograde core decompression of the femoral condyles with the use of ACL guide and a 2.4 mm pin marked with a steri-strip at its body. This method reduces the overall surgical time of the procedure and eliminates the expose to radiation during the operation.

Conclusion

This technical note presents a case of osteonecrosis of the medial femoral condyle, which is treated with retrograde core decompression. Fluoroscopy- and navigation-based techniques require extra space, have radiation exposure and are time consuming. The described technique is simple, fast and effective, without the need for special equipment. Nevertheless, future studies should include more patients, in order to better evaluate the results of this arthroscopic technique and to clarify possible complications during this procedure.

AUTHORS' CONTRIBUTION

NK, AVV and TD were involved in conceptualisation, design, data collection and analysis and drafting the manuscript. All authors approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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