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Simple arthroscopic technique to perform retrograde drilling for osteonecrosis of the femoral condyles with the use of ACL guide

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Abstract

A simple arthroscopic technique was introduced without the need for further staff during the operation. A 2.4 mm pin is positioned through the sleeve of an ACL tibial guide and it is 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 mark and as a stop for inadvertent violation of the cartilage. The tip of the ACL is positioned just over the bone lesion, while the marked 2.4 mm pin is inserted through the ACL tibial guide from anterior surface of the femur. A stab incision is made and without advancing the sleeve to the bone, the pin is drilled to the marked position while cartilage integrity is confirmed arthroscopically. Our arthroscopic technique is simple, fast and effective and it is performed without the need of a special equipment.

Keywords: Avascular necrosis; Osteonecrosis; Knee joint; Arthroscopic; Decompression.

Introduction

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 adulthood woman.[2] Following the classification of the osteonecrosis by Ficat[3] and Mont,[4] the disease progresses through four stages and is based on a combination of clinical and radiographic findings. Although several risk factors for the pathogenesis of osteonecrosis have been identified, three main theories of pathophysiology have been advanced. The traumatic theory is based on a history of repetitive trauma over time, causing interruption of blood flow, critical ischemia and finally bone collapse.[5,6] The ischemic theory in which ischemia 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 occur in younger and active male.[6]

Like the pathophysiology, there is still debate concerning the current treatment options for this disease. In general, treatment include non-operative management with pharmacologic agents, such as non-steroidal anti-inflammatory drugs (NSAIDs) 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, there have been described various techniques for performing femoral condyle core decompression with the majorities aided by arthroscopy, fluoroscopy and navigation systems, in order to safe 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

The arthroscopic procedure was performed by the senior author. Two grams of prophylactic cephalosporine was administered intravenously within 1 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 lateral to the proximal thigh and the second as a foot rest to maintain a 90 degrees of knee flexion. After the patient was positioned, cotton cast was

wrapped around the thigh in order to avoid wrinkles and a tourniquet was then applied circumferentially at a pressure of 300 mmHg.

Retrograde drilling is performed utilizing an ACL tibial guide. The pin sleeve is placed and secured into the guide leaving enough space for the extra articular course of the ACL guide. The 2.4 mm pin is positioned through the sleeve and is marked with a steri-strip at its body, aiming at 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 mark and as a stop for inadvertent violation of the cartilage.

The integrity of the cartilage is confirmed arthroscopically. The ACL tibial guide is 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 is positioned just over the bone lesion, without touching the healthy cartilage [Figure 2]. The pin is inserted through the anterior surface of the femur. A stab incision is made and without advancing the sleeve to the bone, the pin is drilled to the marked position while cartilage integrity is confirmed arthroscopically. 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 visited our department with right knee pain and gradually uncomfortable for 6 months. He had a history of a previous sports injury in the previous year. Symptoms rapidly worsened with limited activity in the last 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 diagnosis was avascular necrosis 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). Written informed consent was obtained from the patient in order to use his images for publication purposes. The inclusion criteria for this study were the presence of secondary osteonecrosis of stage I or stage II disease according to Ficat[3] and Mont[4] as modified for the knee. Exclusion criteria included a history of major trauma, the presence of radiological collapse (stage III and IV) and post-arthroscopic osteonecrosis.

Post-operatively, patient was encouraged to do passive and active range of motion as tolerated. Partial weightbearing restriction for 6 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 remains asymptomatic with full participation in sport activities.

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 avascular necrosis 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 2 decades, several treatment options for early stages of osteonecrosis have been proposed, including core decompression, vascularized and non-vascularized bone graft, cell-based therapies (bone marrow mesenchymal stem cells and/or platelet-rich plasma) and osteotomies.[5,8] The use of vascularized 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 avascular necrosis 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 for texture analysis of soft-tissue and subchondral bone pathology, while can increase the diagnostic performance for detecting the presence of knee osteonecrosis.[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 avascular necrosis of the femoral condyles.[5,7,14] Regarding retrograde core decompression by precise drilling into ischemic lesions of the femoral condyle, while remaining articular cartilage intact is always challenge. In conventional technique, the exact locating of the drill was made by multiple checks of drilling course and depths with the use of digital fluoroscopy.[15] The advantage of using fluoroscopy is to detect the exact position of the drill bit in which the drill has to be 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 minimize this risk, computer-assisted and navigation based techniques have been developed, regarding retrograde core decompression of avascular necrosis of femoral condyle. These techniques have been showed that improve intra-operative precision with the less possible radiation.[5,15]

Our surgical technique is a commonly performed arthroscopic surgical procedure in our 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, eliminate the expose in radiation and there is no need for further staff during the operation.

Conclusion

We present a technical note of case with avascular necrosis of the medial femoral condyle, which is treated with retrograde core decompression. Fluoroscopy- and navigation-based techniques require extra space, have radiation exposure and they are time consuming. Our technique is simple, fast and effective, without the need of 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.

Conflict of Interest

The authors declare no conflicts of interest.

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Author Contribution

NK, AVV and TD was involved in conceptualization, design, data collect and analysis and drafting the manuscript. All authors approved the final version of the manuscript.

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Table 1: Advantages and limitations of the surgical technique

Advantages
The procedure is minimally invasive
The operation time is minimized due to the absence of intra-operative fluoroscopy use
Both the patient and the operative staff do not expose in extra radiation
There is no need for extra staff to use the C-arm fluoroscopy machine
Minimize the sterility risk from the use of C-arm fluoroscopy machine
Limitations
The procedure is not indicated in later stages of avascular necrosis (bone collapse)
An additional assistance is needed during the surgery

Figure 1: Calibrated tibial guide. The pin was positioned through the transtibial ACL guide and was marked with the use of a steri-strip.

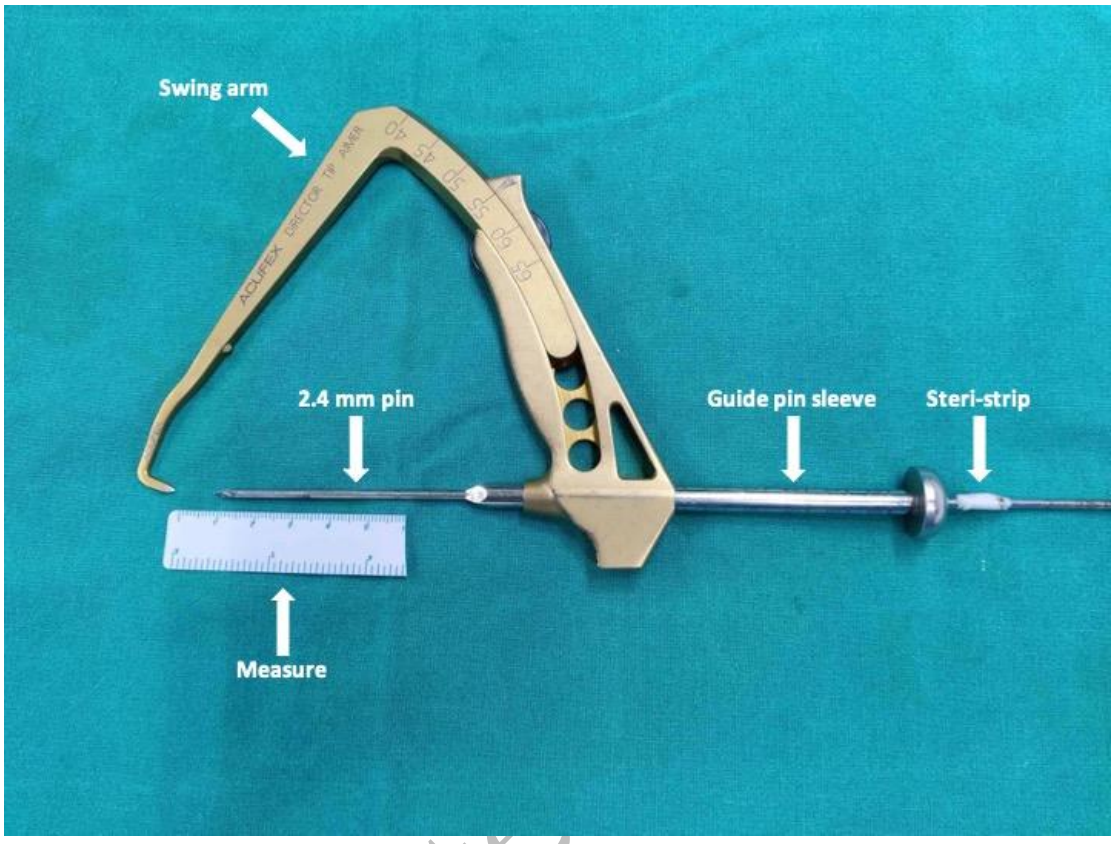

Figure 2: Retroarticular core decompression of the medial femoral condyle with avascular necrosis. Care is taken to prevent damage to the articular surface of the femoral condyle with the tip of the transtibial ACL guide. View from the anterolateral portal showing the tip of the ACL guide placed over different areas (A and B) of the affected medial femoral condyle.

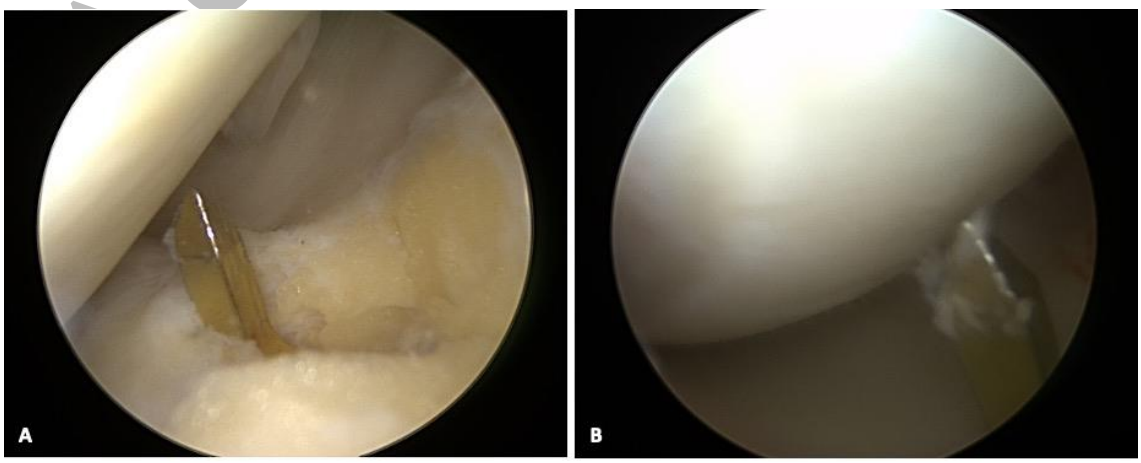

Figure 3: Illustration (A) and intraoperative pictures (B and C) of the surgical technique with retroarticular core decompression for avascular necrosis (also known as osteonecrosis) of the medial femoral condyle.

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