A Diagnostic Algorithm for Patients with Pain after Anterior Cruciate Ligament Reconstruction: A Case Report

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Introduction

Reconstruction of the anterior cruciate ligament (ACL) is one of the most frequently performed procedures in orthopaedics.[1] Although most of the patients show a satisfactory outcome reflecting stable and pain free knees, some complain about persistent or recurrent instability or pain after ACL reconstruction.[2]

The state-of-the-art diagnostic follow-up in these patients includes a thorough history and clinical examination, blood work (CRP and leucocytes), joint aspiration or biopsies from a diagnostic arthroscopy, conventional radiographs (anterior-posterior and lateral weight bearing, tunnel view and skyline view of the patella), computerized tomography (CT), and magnetic resonance imaging (MRI). To date, single photon emission tomography and combined conventional CT (SPECT/CT) was used only in a few cases.[3,4]

With this case, we strive to present the diagnostic work-up in a patient with pain after ACL reconstruction and introduce SPECT/CT as a new diagnostic imaging modality. Furthermore, the possible clinical value of SPECT/CT as new diagnostic imaging modality is highlighted.

(J Med J 2012; Vol. 46 (4):375- 380)

Received	***Accepted***
January 3, 2011	*May 10, 2012*

Case Report

A 19-year-old student sustained a twisting injury of his left knee while playing football. Subsequently, a single bundle ACL reconstruction on his left knee using bone patellar tendon bone autograft (BTB) was performed. Due to the persistent instability and symptoms of collapsing, he underwent a revision surgery two years later. At that time, a quadriceps tendon autograft (QT) was used.

Afterwards, the patient's symptoms improved only partially. However, after another twisting injury playing soccer, the instability and pain returned which finally led the patient to quit his football career.

At initial presentation to our clinic, the Lachman, the pivot shift and the Slocum test showed a markedly increased anterior translation. No firm endpoint was present. The MRI showed that the interference screws used for the tibial and femoral fixation had not degraded. Mild oedema was found around the interference screws. The quadriceps tendon graft was in suspicion of a partial tear. Metal artifacts were present and limited the view of the tibial tunnel.

The SPECT/CT clearly indicated an increased tracer uptake (Tc-99m-HDP) within the femoral and to a lesser degree the tibial tunnel, which was

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particularly seen around the interference screws. Interestingly, there was a markedly increased tracer uptake of the lateral tibial condyle, which was interpreted as a sign of graft failure. The 3D reconstructed CT data (obtained from SPECT/CT) showed a high and deep position of the femoral tunnel. The tibial tunnel showed an anteromedial tunnel aperture. In summary, the diagnosis of a graft failure due to tibial tunnel widening was established.

The patient was scheduled for a two-step revision surgery. It was discovered at the revision surgery that the ACL graft was torn at the tibial attachment. In addition, there was a 2x1cm ICRS grade 2 lesion of the medial femoral condyle.

As a first step, the patient underwent bone grafting of the tibial tunnel with Integra™ Cancellous Bone Allograft. The second surgery would be a revision ACL reconstruction six months later.

Figure (1): Anterior-posterior and lateral weight bearing radiographs of the left knee joint at initial presentation to our clinic indicating a posterior tibial tunnel position on sagittal views. The femoral tunnel position is hardly visible.

Figure (2): The MRI (PDW FS sagittal, T1 TSE sagittal, PDW FS axial, PDW FS coronal) showed an oedema around the not degraded interference screws. A partial graft tear of the ACL was suspected.

Figure (3): Sagittal, axial and coronal views of the left knee in 99mTc-HDP-SPECT/CT showed increased tracer uptake within the femoral bone tunnel, tibial bone tunnel, and lateral tibial condyle.

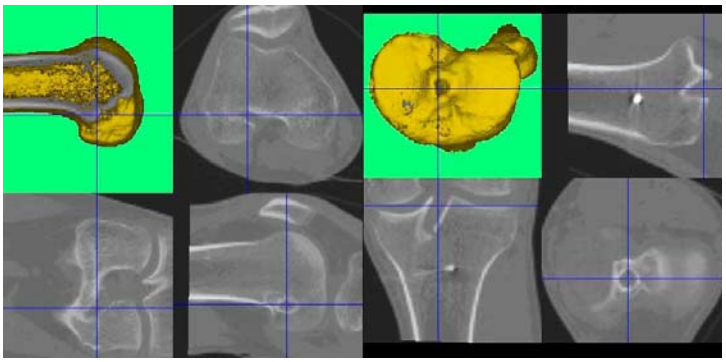

Figure (4): The 3D reconstructed CT data (obtained from SPECT/CT) showed a high and deep position of the femoral tunnel. The tibial tunnel showed an anteromedial tunnel aperture. In summary, the diagnosis of a graft failure due to tibial tunnel widening was established.

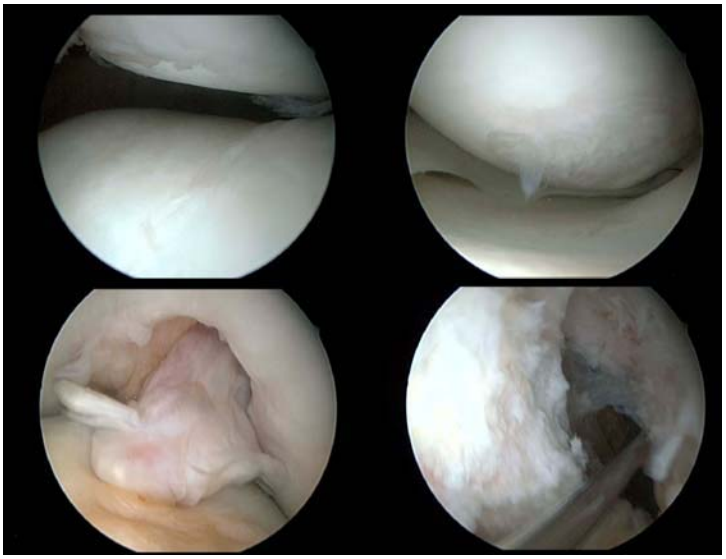

Figure (5): At the revision surgery, the ACL graft was torn at the tibial attachment. In addition, there was a 2x1cm ICRS grade 2 lesion of the medial femoral condyle.

Discussion

With this case report, we strive to describe and propose a novel diagnostic algorithm including SPECT/CT in patients with pain after ACL reconstruction. After thorough history and detailed clinical examination, conventional radiographs might be helpful to identify gross malposition of the tunnels or extensive tunnel widening. In addition, MR imaging is considered to be a very sensitive and specific imaging modality.[5,6] Several studies highlight the clinical importance identifying probable causes of pain after ACL reconstruction such as graft impingement, cyclops lesions, tunnel widening, cysts, hardware failure or infection.[7,8] Sanchis-Alfonso et al.[9] and Nakayama et al.[10] reported that MRI has a near perfect sensitivity, specificity and accuracy in assessing graft integrity. However, it was also reported that there was no correlation between the MR intensity changes of the ACL graft and the clinical findings.[11] Hence, identifying the graft integrity is not always without misinterpretation.

However, MRI has proven helpful diagnosing the occurrence of cyclops lesions.[12] Bradley et al. reported a sensitivity and specificity of 85% when diagnosing these lesions after ACL reconstruction.[13]

In contrast to the former studies in particular, Marchant Jr. et al. noted that CT is by far superior to MRI when evaluating tunnel widening.[14] This finding is also supported by others.[15,16]

The 3D - reconstructed CT images provide the orthopaedic surgeons with high-resolution structural information of the tunnel position and graft placement.[17] SPECT provides a sensitive but less specific screening tool for an altered bone metabolism after ACL reconstruction.[18] However, due to the insufficient ability to localize the increased tracer uptake, SPECT has not gained much popularity among orthopaedic surgeons. With the introduction of hybrid imaging machines such as SPECT/CT, this has changed. SPECT/CT obtains multi-slice CT and SPECT in one imaging modality offering accurately co-registered anatomical and metabolic data of the knee joint, in particular the tunnel areas, after ACL reconstruction. Using SPECT/CT, the increased tracer uptake can be accurately localized to anatomical structures such as the tibial or femoral bone tunnels. SPECT/CT also visualizes overloading of the medial, lateral or patellofemoral joint compartment.

As previously shown by Hirschmann et al., SPECT/CT is clinically helpful in patients with a foreign body reaction due to the fixation of the graft with the bio-interference screws.[4]

In addition, Konala et al. highlighted the value of SPECT/CT for the postoperative follow-up of concomitant osteochondral lesions.[3]

To date, the clinical use of SPECT/CT is limited by the fact that it is yet not commonly available in every part of the world. Furthermore, the radiation dose, which is about 4-5mSv, has also been weighted against the diagnostic benefit in mostly young patients.

Despite these limitations, we believe that SPECT/CT is a valuable part of the orthopaedic surgeon´s diagnostic armamentarium and should be carefully considered in cases of unexplained pain after ACL reconstruction.

Conclusion

Pain and instability are possible outcomes after ACL reconstruction.[19] Many causes may be underlying this pain.[4, 20] Due to its valuable combination of metabolic and structural information, SPECT/CT should be considered as part of the diagnostic algorithm in painful knees after anterior cruciate ligament reconstruction.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

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خوارزمية تشخيصية للمرضى الذين يعانون من الألم بعد اعادة بناء الرباط الصليبي الأمامي: تقرير حالة

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الملخص

يعد إعادة بناء الرباط الصليبي الأمامي (ACL) واحد من الإجراءات الأكثر تكرارا في جراحة العظام. وعلى الرغم من أن معظم المرضى يظهروا نتيجة مرضية تعكس حالة من عدم الألم في الركبتين، إلا أن البعض يشكو من عدم الاستقرار المستمر أو المتكرر أو الألم بعد إعادة بناء الرباط الصليبي الأمامي. تتضمن المتابعة التشخيصية لهؤلاء المرضى تاريخ طبي شامل لهم وفحص سريري، والخزعات من تنظير التشخيص وصور الأشعة التقليدية والتصوير المقطعي المحوسب (CT) والتصوير بالرنين المغناطيسي (MRI). ولتاريخ هذه الدراسة، يتم استخدام التصوير المقطعي CT والفوتون التقليدي المختلط (SPECT/CT) في القليل من الحالات. في دراسة هذه الحالة، نسعى إلى تقديم عمل تشخيصي في المرضى الذين يعانون من ألم ما بعد إعادة البناء وإدخال ACL SPECT / CT كطريقة للتصوير التشخيصي الجديد.

الكلمات الدالة: إعادة بناء الرباط الصليبي الأمامي، خوارزمية تشخيصية.