INTRODUCTION:
Osteoarthritis has been reported in up to 60% of patients after posterior cruciate ligament (PCL) reconstruction [1]. As persistent abnormal knee kinematics are a putative factor in the degeneration of cartilage following PCL injury [2], various surgical techniques such as double-bundle reconstruction or combined osteotomies have been recommended that would replicate more closely the native knee kinematics. However, prior to advocating promising surgical techniques that are potentially more efficient but unquestionably more complicated, obtaining a clear insight in the efficiency -or lack thereof- of the contemporary single-bundle PCL reconstruction technique to restore cartilage loading to normal might be helpful in the present-day debate regarding optimal PCL injury treatment.

The objective of this study was to investigate the effect of PCL reconstruction on the magnitude of in-vivo cartilage contact deformation during weightbearing flexion.

METHODS:
Seven patients (five males, two females; age range 20-51 years old) with an isolated PCL rupture in one knee and the contralateral knee intact were included in the study. First, both knees were imaged with an MR scanner to create 3D anatomical models of the femur, tibia and corresponding cartilage layers. Next, the patient performed a single-leg lunge while fluoroscopic images were recorded with a dual fluoroscopic system. Subsequently, the ruptured PCL was reconstructed using an Achilles tendon allograft. Two years following the PCL reconstruction, the patient repeated the single leg lunge activity while fluoroscopic images were recorded. Finally, the MR models and the pre- and postoperative fluoroscopic images were combined to reproduce the pre- and postoperative in-vivo activity, respectively.

The relative positions of the cartilage layers on the femur and tibia were determined from the series of models used to reproduce knee motion. When cartilage contact occurred during knee flexion, the articular surface meshes of the tibia and femur overlapped. Cartilage deformation was defined for each vertex of the articular surface mesh as the amount of penetration divided by the sum of the tibial and femoral cartilage surface thicknesses [2]. The cartilage thickness was calculated by finding the smallest Euclidian distance connecting a vertex of the articular surface to the cartilage-bone interface. A one-way repeated measures analysis of variance and Student-Newman-Keuls test was used to compare the magnitude of peak cartilage deformation of the intact contralateral, PCL-deficient, and PCL-reconstructed knees at every flexion angle. Significance level was set at p < 0.05.

RESULTS:
The magnitude of peak cartilage deformation was significantly increased in the medial compartment of the PCL-deficient knees, compared with that of the intact contralateral knees, between 75° and 120° of flexion. In the PCL-reconstructed knees, the average peak cartilage deformation appeared to have decreased between 75° and 120° of flexion, compared to the PCL-deficient knees. However, the magnitude of peak cartilage deformation remained significantly increased in the medial compartment, compared with that of the intact contralateral knees, between 75° and 120° of flexion (Figure 2A). In the lateral tibiofemoral compartment, we did not detect any significant differences in cartilage deformation between the intact and PCL-deficient knees (as was described previously [2]), as well as the PCL-reconstructed knees throughout the range of flexion (Figure 2B).

DISCUSSION:
The persistent increase in magnitude of cartilage deformation in the medial compartment following clinically successful reconstruction of the PCL could provide an insight in the development of tibiofemoral joint cartilage degeneration in patients after PCL reconstruction. These findings reinforce the need for restoring the normal function of the injured ligament, and hereby potentially the deformation of articular cartilage, if the goal of the surgical procedure is the prevention of osteoarthritis in the long-term.

REFERENCES: