NON INVASIVE ASSESSMENT OF KNEE JOINT ROTATIONAL LAXITY IS RELIABLE BUT NOT NECESSARILY ACCURATE
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Introduction
The in vivo quantification of rotational laxity (RL) of the knee joint is of critical clinical importance due to the necessity for the early identification of disease progression and the evaluation of therapy outcome [Kupper, 2007]. While invasive approaches have been used to study RL, non invasive methods are attractive particularly in healthy or underage cohorts. This study aimed to elucidate the accuracy and reliability of non invasive skin marker assessment of RL when compared to the invasive fluoroscopic assessment (FA).

Methods
In vivo measurements of 5 knees (4 ACL ruptured, 1 healthy contralateral) were conducted with a customized device for objective measurement of RL in a seated position with the thigh strapped to the chair. A subject-specific internal and external axial torque was manually applied to the knee while synchronised fluoroscopic images of the knee and the skin marker movement were recorded. To calculate the tibio-femoral rotation, 3D models of femur and tibia were registered to the fluoroscopic images and functional knee axes of rotation were identified from the skin marker movements [Ehrig, 2007]. The calculated rotations of both methods were correlated and linear regressions calculated. The Root Mean Square (RMS) error between both methods was also calculated as a mean over the entire rotation cycle. Intra tester reliability was assessed after a period of three months under the same conditions.

Results
The slope values of the lines in the regression analysis indicate the relation between both methods at all angles (Figure 1). For the RMS error analysis, the difference between FA and skin marker assessment was highest at 0° of knee flexion reaching 9.6°, whereas the error decreased with increasing flexion angle, being this 6.5°, 6.1° and 5.7° at 30°, 60° and 90° respectively. Intra class correlations for both methods showed excellent reliability at every joint flexion angle with all ICC values over 0.9.

Discussion
Although a high reliability was observed in the skin marker assessment, the high RMS error values at every degree of knee flexion suggest that the unavoidable thigh movement has a strong influence in the calculated rotation. Since skin marker assessment is representative of many similar non invasive approaches presented in the literature [Mouton, 2012], the presented results suggest that the values obtained from these methods should be considered critically and not interpreted as the physiological tibio-femoral rotation. The calculated slopes could be potentially used as correction factors for the values from non-invasive assessments. Moreover the decision of using an invasive or a non-invasive approach should be taken according to the hypotheses to be analysed.

References