INTRODUCTION:
Up to 50% of all secondary procedures are caused by patellofemoral complications after total knee arthroplasty (TKA). Among the different categories, patella instability is one of the most significant short term complications. Clinically, prosthetic design has been shown to significantly affect patellofemoral stability. The purpose of the current study was to biomechanically compare the lateral patellofemoral stability among different TKA prosthetic designs.

METHODS:
Three different femoral component designs were evaluated: MG I, PFC Sigma, and LCS. Each femoral component was tested with three appropriate patella components at each of three tibiofemoral flexion angles: 15°, 30°, and 45°. A multi-axial MTS test system was utilized to conduct the test. The femoral component was cemented onto the femoral fixture and the construct was mounted on the axial actuator. The patella component was fixed to the patella fixture and the construct was secured to a translational table which was moved medially-laterally by an auxiliary actuator with respect to the femoral component (Figure 1). The test started with the patella component at the lowest point on the femoral component. To find this location, a 49 N axial compressive force was applied to the patella component and the translation table was manually moved in the medial-lateral direction until the patella component reached the lowest point on the femoral component. During the testing, with a compressive force applied and held, the patella component was moved laterally at 130 mm/min for 30 mm. The compressive force was 412 N at 15°, 1100 N at 30°, and 1785 N at 45°. Maximum lateral force to subluxate the patella component and maximum axial displacement (normal to the back surface of the patella component) were used for data analyses. A one-way ANOVA and post-hoc Tukey test were performed at each flexion angle to evaluate the difference between different femoral components. The significance level was defined as 0.01 to control for type I error.

RESULTS:
At 15°, the maximum lateral forces of Sigma and LCS were greater than that of MG1 (p<0.001). There was no significant difference between Sigma and LCS (p=0.064). At both 30° and 45°, Sigma had the greatest lateral force (p<0.01) and LCS demonstrated a greater value than MG1 (p<0.001).

DISCUSSION:
15 – 45° of knee flexion was believed to be the range where patella dislocation most likely occurs clinically. Senavongse et al. has reported biomechanical evidence to support this concept. The current results suggested that PFC Sigma and LCS had greater lateral patellofemoral constraint during early knee flexion than MG1. Therefore, PFC Sigma and LCS could provide some advantages in preventing patellofemoral subluxation/dislocation after TKA over MG1. This was consistent with the clinical finding where MG1 showed a considerably greater patella subluxation/dislocation rate than Sigma. Three MG1 design features have been proposed to account for the high subluxation/dislocation rate: (1) a narrow and short anterior flange; (2) a shallow trochlear groove; (3) an abrupt anterior to distal transition with a small radius of curvature. Extra caution should be used to avoid these problematic characteristics for future TKA prosthetic designs.

REFERENCE: