INTRODUCTION:
The current study compared in-vitro tibiofemoral axial rotational constraint between 2 posterior stabilized mobile-bearing knee prosthesis and their fixed-bearing counterparts. It was demonstrated that both mobile-bearing knees induced significantly less constraint torque compared to their fixed-bearing counterparts. Highly-constrained design of the fixed-bearing knees substantially limited their range of axial rotation. The current results provided further evidence that mobile-bearing knee prosthesis could reduce load transmitted to the bone-implant interface and potentially promote post-operative component integration and long-term fixation.

METHODS:
Two size 3 mobile-bearing TKA systems and their fixed-bearing counterparts were tested: Sigma PS mobile-bearing and Sigma PS fixed-bearing; Sigma TC3 mobile bearing and Sigma TC3 fixed-bearing. Three tibial inserts were included in each system. The experimental setup is shown in Fig. 1. The femoral construct was attached to the actuator of a servo-hydraulic MTS system. The tibial construct was secured on a translational table that was mounted on the base plate of the MTS system. The translational table was free to translate in anterior/posterior direction. All articulating surfaces were lubricated with polydimethylsiloxane. Test started with femoral component positioned at the dwell of the inserts and tibiofemoral axial rotation at 0 degree. With a 667 N tibiofemoral compressive force applied and held, the femoral component was rotated externally at 100 degree/min for 20 degrees or until the constraint torque reached 9.4 Nm, whichever occurred first. Four tibiofemoral flexion angles were tested: 0, 45, 90, and 120 degrees. Two-tailed Student t-tests were performed to evaluate the difference between the peak constraint torque of fixed-bearing and mobile-bearing. Significance level was defined as 0.01.

RESULTS:
Representative torque-rotation relationship at 0 degree flexion was depicted in Fig. 2. The peak constraint torque of both Sigma PS and Sigma TC3 fixed-bearing was significantly greater than that of their mobile-bearing counterparts at all tibiofemoral flexion angles (p<0.001) (Fig. 3 and 4). Sigma PS fixed-bearing reached the torque limit of 9.4 Nm before the femoral component fully rotated externally to 20 degrees or until the constraint torque reached 9.4 Nm, whichever occurred first. Four tibiofemoral flexion angles were tested: 0, 45, 90, and 120 degrees. Two-tailed Student t-tests were performed to evaluate the difference between the peak constraint torque of fixed-bearing and mobile-bearing. Significance level was defined as 0.01.

DISCUSSION:
Mobile-bearing knee prostheses have been shown to reduce stresses transmitted to the fixation interface, which could improve implant stability and decrease the incidence of implant loosening. Russo et al. reported improved fixation at the bone-implant interface with mobile-bearing knees, which was attributed to stress reduction provided by constraint reduction with a mobile tibial insert. Bottlang et al. showed that under 10 degree tibial external rotation, the mobile-bearing knee induced 33% less compressive strain than the fixed-bearing knee. The mobile-bearing knee also reduced torque in the proximal tibia during knee rotation by 68-73% compared with the fixed-bearing knee. The current results were consistent with previous findings. It was observed that during tibiofemoral axial rotation, mobile-bearing reduced peak torque significantly at all flexion angles for both Sigma PS and Sigma TC3.

SIGNIFICANCE:
The current study provided further evidence that mobile-bearing knee prosthesis could reduce load at the bone-implant interface and potentially promote post-operative component integration and long-term fixation.

REFERENCES:
1. Kutzner et al. 2010 J Biomech
2. DePuy Sigma PS Patient Weight Study