INTRODUCTION
Patellar maltracking after total knee arthroplasty (TKA) often results in pain and complications. Each surgical step contributes to proper tracking. Computer-assisted surgery (CAS) can potentially benefit the patella by providing intraoperative feedback on patellar tracking, allowing the surgeon to make changes to component positioning and soft tissue balancing to improve tracking. To our knowledge, no study has reported the effects of arthroplasty on in vivo patellar tracking. The objectives of this study were therefore to: (1) test the clinical feasibility of a CAS system for measuring intraoperative patellar kinematics, (2) determine in vivo patellar kinematics before and after component placement, namely pre- and post-arthroplasty, and (3) establish whether arthroplasty resulted in any consistent, significant changes in patellar kinematics that could affect the surgical outcome.

METHODS
A patellar kinematics module was incorporated into an existing tibiofemoral CAS system (KneeLogics LCS, Praxim, Grenoble, France). During surgery, a patellar marker array was attached securely to the anterior surface of the patella. Pre-arthroplasty kinematics were recorded before opening the joint capsule by capturing continuous kinematic data of the patella, femur and tibia as the surgeon manipulated the leg through several range-of-motion (ROM) cycles. Post-arthroplasty kinematics were recorded in a similar manner after all components were implanted, with two towel clamps or three sutures used to close the incision. Institutional review board approval was obtained for this study.

Three experienced surgeons (ES, JLB, CDL), who routinely use the tibiofemoral CAS system, were selected to test the clinical application of the patellar system. Pre- and post-arthroplasty kinematics were measured for 18 patients (10F/8M, 66±8yrs, 11R/7L knees, 7 resurfaced/11 non-resurfaced patellae). Posterior-stabilized LCS Complete Rotating Platform knee components (Depuy, Warsaw, IN) were used in all cases.

Kinematic data were interpolated at one-degree increments of tibiofemoral flexion and averaged across the 3 to 7 cycles. All six degrees-of-freedom (DOF) of patellar tracking were analyzed. We compared the pre-arthroplasty and post-arthroplasty results at 15°, 45°, 90°, and 120° tibiofemoral flexion using a repeated-measures ANOVA with posthoc paired Student’s t-tests (α = 0.05/6 = 0.008 including the Bonferroni correction factor). We also compared gender differences and resurfaced vs. non-resurfaced patellae using an ANOVA followed by unequal-variance unpaired t-tests (α = 0.008). Tibiofemoral joint line changes were calculated from the heights of the tibial plateau and the insert thickness recorded in the CAS log files.

RESULTS
Clinical use of the patellar kinematics module by three surgeons for multiple patients with both non-resurfaced and resurfaced patellae demonstrated the feasibility of the system in vivo.

Mediolateral shift and tilt had the greatest magnitudes of absolute change due to arthroplasty (mean, 4.1 mm and 4.6°) relative to the total pre-arthroplasty range throughout flexion (averaging 2.1 mm and 5.8°). These changes were distributed almost equally medially and laterally, indicating no consistent bias by the surgeons (Fig. 1). Mediolateral changes were quite variable, with standard deviations averaging 5.0 mm and 5.6° respectively (Fig. 1).

The tibiofemoral joint line was elevated in all cases (mean, 4.2 mm) resulting in pseudo patella baja, i.e. more distal contact of the patella on the femoral component (Fig. 1). This led to significant changes in the proximodistal and anteroposterior patellar position as well as patellar flexion due to arthroplasty (p<0.008; Fig. 2).

Female patients had noticeably more lateral tilt than males, averaging about 10° more lateral consistently throughout flexion for both pre- and post-arthroplasty, reaching significance in deep flexion post-arthroplasty (p<0.004). No difference was observed between resurfaced and non-resurfaced patellae. There have been no revisions or clinical complications amongst the patients studied, with an average of 3.9 years since the time of surgery.

REFERENCES