INTRODUCTION: The study objective was to initially determine the 3D patellofemoral mechanics and correlate it with in vivo sound detected using a sensor device for subjects having a TKA and a non-implanted knee under in vivo, weight bearing conditions.

METHODS: Fifteen patients (average age 71.8 ±7.4 years) having one implanted leg (mobile bearing Hi-Flex PS), performed deep knee bend to maximum flexion under fluoroscopic surveillance. The study was approved by the Institutional Review Board and the informed consent form was obtained from all subjects. The 3D femorotibial and patellofemoral kinematics were derived for both knees using a previously published 3D-to-2D registration technique (Fig. 1) [1,2]. The 3D bone models were recovered from CT scans, while implant models were obtained from the manufacturer. The rotations were described using the Grood and Suntay convention [3]. The patellofemoral kinematics and sound data were synchronized and recorded under fluoroscopic surveillance, for 10 patients. Then a subset of five subjects having a TKA was re-analyzed for their contralateral (non-implanted) knee. Acceleration magnitudes and frequencies that propagated through the patellofemoral interaction were detected. The signal was then converted to audible sound and correlated with the 3D kinematics.

RESULTS: On average, the subjects achieved more flexion with their TKA (103.4° ±15.9°) than with their contralateral knee (96.3° ±18.3°) (Fig. 2). The patellofemoral kinematics varied between the TKA and non-implanted patella groups; the resurfaced patella experienced less flexion (Fig. 3), less medial rotation and less tilt than the contralateral patella (Fig. 4). The patella flexion results were consistent with previously reported literature data for both TKA (Fig. 5) and non-implanted patella (Fig. 6). Also, the resurfaced patellae contacted the femur more proximally than healthy patellae. Subjects with a TKA experienced higher frequencies than the normal and contralateral knees.

DISCUSSION: This study correlated 3D patellofemoral kinematics with sound under in vivo conditions for four activities. Variable audible signals were detected for TKA and non-implanted knees. Sound and frequency identification, under in vivo conditions, for TKA may lead to a better understanding of wear and failure modes with respect to the patellofemoral mechanics, more specifically, the patellar insert.

REFERENCES:

ACKNOWLEDGEMENTS: Financial support was provided by Zimmer, Inc.