

## ACS 2026 Surgeons and Engineers: A Dialogue on Surgical Simulation

P-B-06

### Research In-Progress

#### Determining Skill from Behaviors Analyzed in Videos of Knee Arthroscopy

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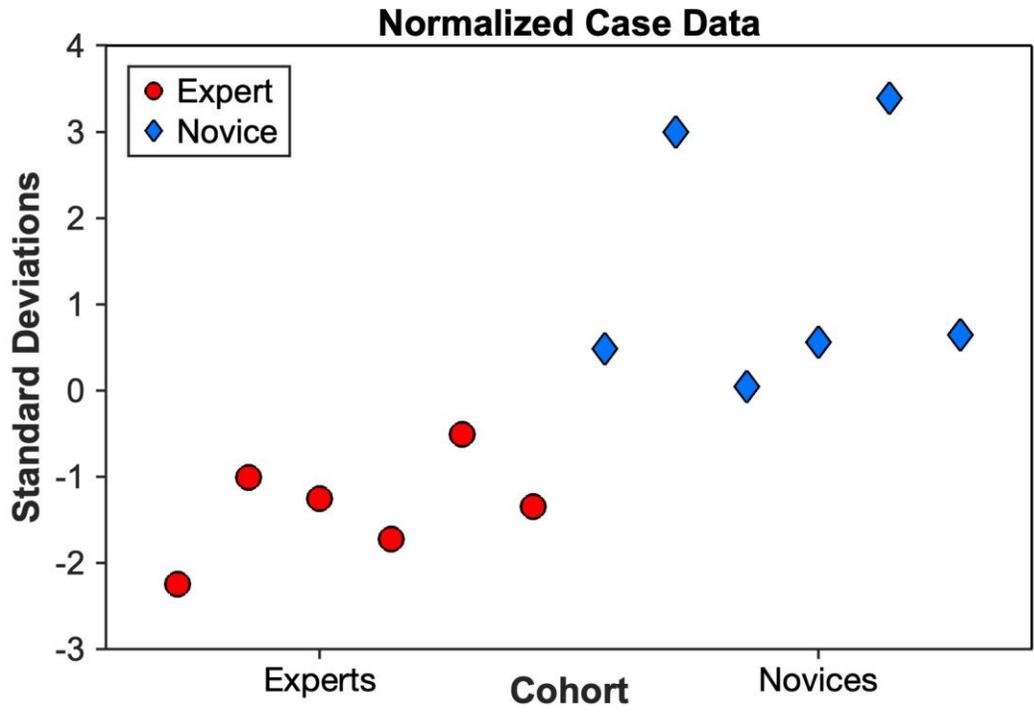
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**Introduction:** Each year, approximately 750,000 arthroscopic knee procedures are performed in the U.S.; a substantial number are performed by orthopedic residents. Immediate feedback for residents is beneficial following a procedure, but tools to enable this are lacking. This study analyzes videos from arthroscopic knee procedures performed by experts and novices to differentiate skill based on tool and camera behaviors observed during the diagnostic portion of the procedure.

**Methods:** Videos collected from four experts and nine novices over eleven months included the diagnostic portions of 92 knee arthroscopies. We evaluated two metrics involving the time spent: (1) creating the medial portal, beginning when the camera viewpoint stops moving and ending when a surgical tool becomes visible, and (2) navigating into medial and lateral compartments of the tibiofemoral joint, beginning when the camera viewpoint stops moving and the joint opens and ending when the posterior meniscus is visible. The analyst was blind to the experience of the surgeon. Data were normalized by z-score and plotted for comparison.

**Preliminary Results:** The experts completed these sub-procedures significantly faster than novices (Figure 1), suggesting these times may be useful in quantifying the surgeon's skill. Novices had significantly larger summed scores than the experts, Welch's  $t(6.86) = -4.28$ ,  $p = 0.0038$ , with a large effect size (Cohen's  $d = 2.4$ ).

**Next Steps:** Preliminary analysis indicates that experts create the medial portal and navigate into the compartments faster than novices, consistent with the original hypothesis. Further analysis and a second analyst will confirm generalizability. Next, arthroscope angulation (rotation of the off-axis view angle) will be analyzed as a potential indicator of surgical skill. The long-term goal of the research is to automate analysis to provide objective, quantitative, immediate feedback to residents and their staff supervisors.



**Figure 1: Plot of the normalized score versus experience level.**