

# ACS 2022 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

## Research In-Progress

### Are Metrics That Quantify Suturing Skills Different for Performance by Pronation Versus Supination?

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**Introduction:** Suturing is a basic and critical aspect of surgery. Surgeons intuitively know the importance of wrist-roll in suturing. Specifically, surgeons must decide whether to use supination (forehand) or pronation (backhand) to suture as a function of their spatial configuration with respect to the anatomical site requiring suturing. To study the importance of wrist-roll, we explored a multimodal assessment of suturing skills by extracting several metrics from sensor data. This study examines the relationship between dominant rotational movement during suturing (pronation vs. supination) and metrics used to quantify suturing skills (duration, tool-tip motion smoothness, needle motion, and force).

**Methods:** The suturing platform has markings printed in a radial pattern indicating twelve suture areas to be completed in each trial. In this pilot experiment, we collected data from 4 subjects (two attending surgeons [deemed experts] and two non-clinicians [deemed novices]). All subjects completed trials under different conditions, including superficial and deep suturing, resulting in 174 total sutures. For all the sutures, skill metrics were computed. Further, each suture was classified in terms of dominant movement, i.e., supination or pronation.

**Preliminary Results:** Mann-Whitney U statistical significance tests were used to compare various metrics for experts' supination to experts' pronation, as well as for novices. In this intragroup comparison, more metrics demonstrated significant differences between pronation and supination for experts than novices. Additionally, we compared expert performance with novices, resulting in significant statistical differences in most metrics. (See Table 1)

**Next Steps:** In general, the metrics used in this study demonstrated the potential to differentiate between experts and novices in various suturing scenarios. Moreover, this research showed the potential for further analysis from a larger set of data from attendings, residents, and medical students. These data could ultimately enable the presentation of objective and meaningful feedback for assessing and improving suturing skills, specifically with regard to the wrist-roll technique.

Table 1. P-Values When Comparing Suturing Quantification Metrics for Pronation vs. Supination

Metrics/Sutures	Expert supination vs. Novice supination	Expert pronation vs. Novice pronation	Expert supination vs. Expert pronation	Novice supination vs. Novice pronation
Duration	0.000	0.001	0.011	0.217
Tool-Tip Motion Smoothness (LDLJ From EM Sensor 1)	0.000	0.001	0.001	0.547
Tool-Tip Motion Smoothness (From EM Sensor 2)	0.000	0.001	0.001	0.612
Needle Swept Area	0.206	0.389	0.001	0.090
Needle Sway Length	0.183	0.608	0.004	0.142
Peak Downward Force	0.000	0.001	0.655	0.035
Tangential Force Peak to Peak	0.000	0.000	0.662	0.788
Orthogonal Force Peak to Peak	0.000	0.000	0.785	0.508

