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Research Abstracts

Using Motion Capture to Analyze Surgeon Upper Extremity Kinematics

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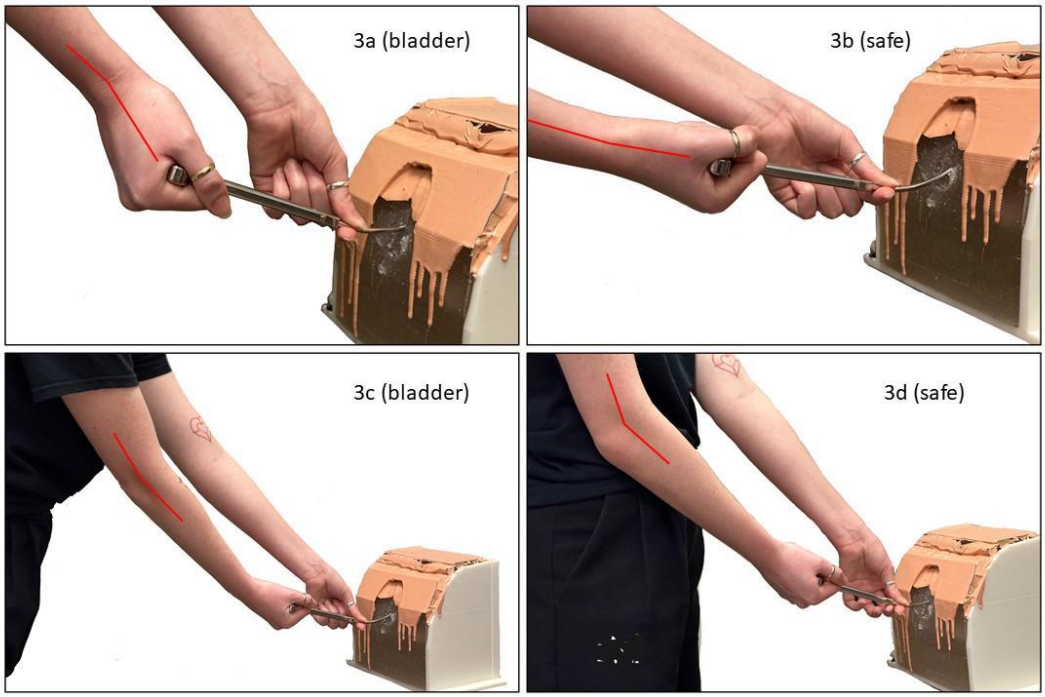
Introduction: Surgeon kinematics play a significant role in prevention of patient injury. We tested this on a midurethral sling (MUS) simulation platform previously presented at ACS Surgeons and Engineers. We hypothesized that surgeon elbow extension and ulnar wrist deviation are associated with bladder injury.

Methods: We used motion capture technology to measure surgeons' flexion/extension, abduction/adduction, and internal/external rotation angular time series for shoulder, elbow, and wrist joints. Starting and ending angles, minimum and maximum angles, and range of motion (ROM) were extracted from each time series. We created anatomical multibody models and applied linear mixed modeling to compare kinematics between trials with versus without bladder penetration and attending versus resident surgeons. 32 trials would provide 90% power to detect a difference.

Results: Out of 85 passes, 62 were posterior to the suprapubic bone and 20 penetrated the bladder. Trials with versus without bladder penetration were associated with more initial wrist dorsiflexion (-27.32 vs -9.03 degrees, p=.01), less final elbow flexion (39.49 vs 60.81, p=.03), and greater ROM in both the wrist (27.48 vs 14.01, p=0.02), and elbow (20.45 vs 12.87, p=0.04). (Figure) Wrist deviation and arm pronation were not associated with bladder penetration. Compared to attendings, residents had more ROM in elbow flexion (14.61 vs 8.35 degrees, p<0.01), but less ROM in wrist dorsiflexion (13.31 vs 20.33, p=0.02) and arm pronation (4.75 vs 38.46, p<0.01).

Conclusions: Bladder penetration during MUS is associated with surgeon wrist dorsiflexion and elbow flexion but not internal wrist deviation and arm supination. Attending surgeons exerted control with the wrist and forearm, surgical trainees with the elbow. Our findings have direct implications for surgical simulation incorporating surgeon upper extremity kinematics.


3a (bladder)
3b (safe)
3c (bladder)
3d (safe)