

Surgeon Ergonomics During Total Knee Arthroplasty

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INTRODUCTION:

Total knee arthroplasty (TKA) surgery is physically demanding, repeatedly straining the surgeon's spine and shoulders. Pain during TKA was reported by 96.5% of surgeons while workplace injuries were reported by 66% of surgeons. The purpose of the current study was to measure detailed surgeon ergonomics during each step of the TKA procedure to enable ergonomic improvements in table and instrument design.

METHODS:

Four surgeons performed TKA on synthetic lower limbs with ligaments and bones engineered to represent the mechanical response of the knee during surgery. Surgeries were conducted with manual instrumentation on both right and left knees while standing on the side of the operative knee (8 total surgeries). Surgeons were outfitted with reflective markers and stood on force platforms to enable calculation of detailed kinematics and joint reaction forces in the spine and shoulders. The amount of time spent in challenging positions, defined as shoulder abduction $> 45^\circ$, lumbar spine flexion $> 20^\circ$, and cervical spine flexion $> 10^\circ$, was calculated during each surgical step and over the entire procedure.

RESULTS:

Surgeons spent $85.8 \pm 11.2\%$ of the procedure with excessive cervical spine flexion, $3.6 \pm 5.2\%$ of the procedure with the lumbar spine flexed, and $13.1 \pm 5.2\%$ and $10.4 \pm 2.9\%$ with the right and left shoulder abducted, respectively. The highest levels of shoulder abduction occurred while drilling the femoral canal, pinning the femur resection guide, and resecting the distal femur. Cervical spine flexion was common across all steps of the procedure, but lumbar flexion was less common.

DISCUSSION AND CONCLUSION:

Previous studies demonstrated that proper table height is critical for improving operating room ergonomics. In our study, surgeons self-selected table height based on preference. While this reduces shoulder abduction, it also increased cervical spine flexion. Future work will involve targeted ergonomic interventions through table design that reduces surgeon time spent in challenging positions.