

COMPUTER VISION-MEDIATED ASSESSMENT OF SURGICAL SKILLS AND EXPERTISE FOR ENDOSCOPIC KIDNEY STONE REMOVAL SURGERY

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INTRODUCTION AND OBJECTIVE:

The assessment of surgical skills is essential for clinical training and safety purposes. Though previous skills assessment tools have demonstrated success in evaluating surgical performance, there are no validated objective, real-time tools evaluating competency during retrograde intrarenal surgery (RIRS). We sought to apply our validated kidney stone segmentation software to evaluate automated metrics of RIRS skill level between novices and experts.

METHODS:

Forty-two separate videos of RIRS performed by four surgeons were prospectively recorded. Surgeons were categorized as 'expert' (n=2, i.e. fellowship trained endourologists performing >100 RIRS per year) or 'novice' (n=2, i.e. junior residents performing <100 RIRS per year) and assessed while performing two identified tasks: a) stone localization, and b) laser ablation. Each surgeon was randomly assigned to one of these tasks for each case. Stone localization was standardized for all cases with the systematic evaluation of the entire collecting system. For the second task, only the first 20 seconds of stone ablation (dusting, 0.3J and 60Hz) were analyzed. All videos were visually validated for quality and 30 frames per second (fps) were extracted. These frames were analyzed by our previously validated automated stone segmentation models. We performed a pixel based analysis, evaluating the percentage of each frame automatically identified as stone and compared differences between the novices and experts throughout each task.

RESULTS:

Of the 42 videos, 28 were evaluated for the localization task (14 expert, 14 novice) and 14 for the laser ablation task (7 expert, 7 novice). The number of frames without any identified stone was higher in the novice group for both the localization (novice: 25%, expert: 5%, $p<0.01$) and stone ablation (novice: 16%, expert: 8%, $p<0.01$) tasks. Stones occupied more of each frame for novices compared to experts in both the localization (18% vs. 11%, $p<0.01$) and stone ablation tasks (20% vs. 16%, $p<0.01$), suggesting closer stone visualization during RIRS by novice surgeons.

CONCLUSIONS:

Metrics automatically derived using computer vision show feasibility in discrimination of novice and expert surgeons performing RIRS for kidney stones.