Influence of Surgical Expertise on Visual Gaze Patterns while Viewing Robotic Adrenalectomy

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Introduction

- Eye metrics have been used to analyze visual behaviors and assess differences in surgical skill across expertise levels [1–4]
- Experts rely heavily on top-down strategies, using experience and contextual knowledge to prioritize critical areas of interest [4,5]
- **Objective: Investigate the influence of surgical expertise on visual attention while watching a video of a robotic adrenalectomy**
- **Hypothesis:** Experienced surgeons would routinely scan the surgical field for critical structures in the periphery, while less experienced surgical trainees would primarily focus their gaze on the surgical instrument

Methods

- Fifteen surgeons (8 residents, 7 attendings) viewed a 10-min edited video of the critical steps of a robotic right adrenalectomy without any case context using a screen–based eye tracker (Tobii Fusion Pro) (**Figure 1**)
- Demographic data, prior surgical volume, and the participants' responses to the question, "What case did you watch?" were recorded

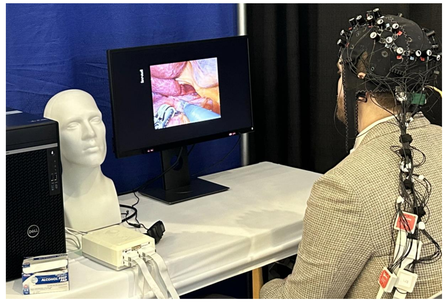


***Figure 1*:.** Experimental setup using a screen-based eye tracker

Data Analysis

- **Areas of interest (AOIs)** were identified from the video and included critical steps when surgical instruments were in contact with tissue (**Figure 2**)
- AOIs were dynamically mapped to determine gaze metrics

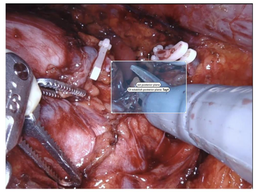


***Figure 2*:.** Visualization of AOI for establishing posterior plane, bounded around the instrument tip

- Cohorts were generated by expertise (attendings vs. residents)
- Mann-Whitney U and Friedman tests were used for statistical analysis

Results

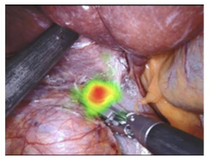
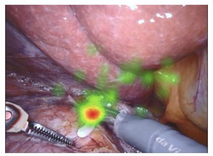
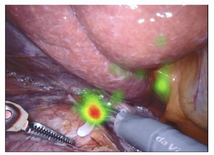
	Residents	Attendings
Clipping of the accessory adrenal vein		
Cutting of the accessory adrenal vein		

***Figure 3*:** Heat map of gaze (red indicates increased fixation) by procedural step and level of expertise

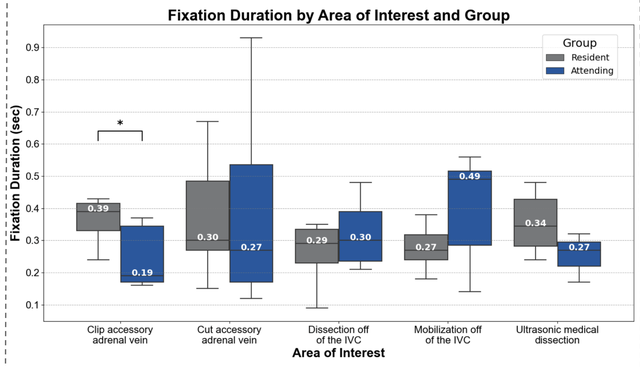


***Figure 4*:** Boxplot of fixation duration by AOI for residents and attendings. The plotted events had the highest Friedman test ranks, highlighting procedural steps with the greatest fixation differences across participants

- Fixation duration on the AOI was significantly longer for residents (p=0.021) during clipping of the accessory adrenal vein (**Figure 3, 4**)
- **Attendings** exhibited a broader gaze, dividing attention between the instrument and surrounding anatomy, while **residents** primarily followed the tool

	Residents	Attendings
Opening of peritoneum		

***Figure 5*:** Heat map of gaze for the opening of the peritoneum. Although less of a difference by group, attendings had higher concentration of gaze on instrument

- **Significant differences in fixation duration (p=0.022) and fixation count (p<0.001) across AOIs indicate that fixation varied by procedural step** (**Figure 3, 5**)
- The longest fixations on the AOIs occurred during cutting and clipping of the accessory adrenal vein, mobilization of the IVC, and dissection off of the IVC
- Case identification accuracy differed significantly between groups: Among the attendings, 5 out of 7 (71.4%) correctly identified the case, compared to only 2 out of 8 residents (25%)

Conclusion

- Visual attention varied across procedural steps, influenced by AOI and surgical expertise
- Attendings showed broader fixation during more straightforward steps, such as clipping a dissected adrenal vein, while residents focused more narrowly on the instrument
- Experienced attendings have a greater contextual visual understanding of the procedure
- These findings enhance our understanding of the differences between less and more experienced surgeons and could be used to facilitate the training process

References

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