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Impact of Cataract Surgeon Experience on Surgical Phase Deviations: An Audio-Visual Data Analysis

Purpose: Audio-visual (AV) data has become a promising learning tool in ophthalmology. Through analysis of these datasets, we can gain new insights into surgical skills training. This project aims to analyze AV data to uncover differences in deviations from the standard phase sequence in cataract surgery based on surgeon experience level.
Methods: "Cataract-101: video dataset of 101 cataract surgery" is an AV dataset published by the Institute of Information Technologies (ITEC). We stratified this dataset using Python 3.0 into parameters such as phase duration, repetition, and sequence. The standard phase sequence is the standardized amount of time to complete each phase of cataract surgery. Using a Mann-Whitney U test, we assessed differences in the number of deviations from the standard phase sequence based on surgeon experience level. Low-experience (LE) vs. high-experience (HE) surgeons were characterized by the publishers of the dataset.
Results: Phases 2 (viscous agent injection), 7 (capsule polishing), and 10 (tonifying & antibiotics) of cataract surgery had >50 deviations from the standard phase sequence for both LE and HE surgeons. HE surgeons had more deviations in all 3 of these phases. Phases 3 (rhexis), 5 (phacoemulsification), 6 (irrigation & aspiration), and 8 (lens implant setting up) had significantly ($p < 0.001$) more deviations in LE compared to HE surgeons. Phases 3, 5, and 6 only had deviations by LE surgeons.
Discussion: Establishing differences in deviations from the standard phase sequence by LE and HE surgeons can guide training efforts for LE surgeons. The increase in deviations by LE surgeons could be due to the natural learning curve associated with surgical skills, ability to solve problems in real time, and less overall efficiency. Higher deviations by HE surgeons in phases where deviations were common in both groups could reflect that HE surgeons can make informed decisions about how and when to deviate from standard practice.