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Comparison of Two Different Ophthalmic Operating Microscopes on Speed, Consistency and Time Savings in the Operating Room: A Mini Review

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Abstract

Purpose: To evaluate the operating times and surgical efficiencies of to two different operating microscopes Leica Stativ S3B, Leica Microsystems, Wetzlar, Germany of OPMI Lumera T with Callisto software (Carl Zeiss Meditec, Inc., Dublin, CA) for uncomplicated cataract surgery at a single center. Both systems contain apochromatic optics, Schott-style glass and focused beams aligned with the microscope oculars. Lumera provides a xenon illumination source while Leica utilizes halogen as its illumination source. Xenon illumination sources generally provide greater brightness of illumination.

Clinical method and review: This was a prospective review of surgical charts by two experienced high-volume surgeons looking at total surgical times recorded in the chart. Previously identified traumatic and complicated cataract cases were excluded. Two focused beam microscopes were assessed.

Discussion: Fifty cases for each microscope were reported. Mean surgery time with the Leica microscope was 14.18 minutes (standard deviation 8.672) and 11.15 minutes (standard deviation of 2.421) with the OPMI Lumera T Zeiss microscope. ANOVA analysis revealed that the difference in surgery time between the two groups was significant at a level of p=0.16.

Conclusion: The newer model microscope with xenon lighting consistently produced significantly shorter operating room times with a time savings of 3.03 minutes per case with cataracts of similar density and complexity. Additionally, more variability within the surgical times was noted in the Leica groups compared with the Zeiss group (standard deviation 8672 *versus* 2.421, respectively). Enhanced illumination produced sharper imaging, easier visualization of structures that appears to provide an efficiency advantage in the operating room when performing routine cataract surgery.

Translational relevance: As baby boomers age, more and more strain is being put on the healthcare system including declining reimbursements. Surgical and clinical efficiencies are essential to meet growing healthcare needs in the safest, most efficient methods possible.

Keywords: Cataract surgery; Illumination; Surgical efficiency; Surgical microscope

Introduction

The surgical microscope is an integral tool for the ophthalmic surgeons. It illuminates and magnifies important structures in the eye. Improved visualization can lead to better detail recognition and stability of the red reflex. Technologic differences between microscopes can impact these factors leading to improved and more consistent outcomes as well as improved surgical times. The main differences between ophthalmic operating microscopes are stability of the red reflex, source of illumination and technologic accessories.

The red reflex produced by reflection of coaxial light from the fundus back to the surgeon and is critical for visualization of critical, often transparent, targeted structures within the eye. An inadequate red reflex may impair the surgeon's ability to operate effectively or require repositioning of the patient or the microscope to create more ideal circumstances. Stability of the red reflex is required to decrease interruptions in work and to optimize working conditions for intraocular surgery [1].

Literature Review

Sources of illumination in ophthalmic operating microscopes have evolved over time. Early operating microscopes using tungsten bulbs, halogen or fiberoptic with and without filters and were powerful enough to cause retinal burns, especially when used over an extended period [1]. Newer generation operating microscopes utilize halogen or xenon sources with different spectra for brighter lighting and reduced side effects. Xenon lights produce color spectrum that most closely mimics natural light compared to halogen or LED [1]. Xenon is known to have a better color rendering index (CRI), contrast and edge visualization with less overall light production, some surgeons still prefer the appearance of halogen lighting and some microscopes may use a xenon light with halogen filter [1].

Previous studies comparing ophthalmic surgical microscopes have examined red reflex intensity and stability as well as depth of focus, while this work focused on the difference in surgical efficiency and surgical complication rate in routine phacoemulsification with two different microscopes, one older model and one newer [2].

Two surgical ophthalmic microscopes were compared. The first, a Leica Stativ S3B, Leica Microsystems, Wetzlar, Germany is an

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older model microscope with halogen lighting, apochromatic optics, Schott-style glass and focused beams aligned with microscope oculars. It provides coaxial double-beam stereo illumination with Otto Flex II to assist with stabilizing the red reflex. The newer model OPMI Lumera T (Carl Zeiss Medi-tec, Inc, Dublin, CA) also utilizes apochromatic optics, Schott-style glass, stereo co-axial focused beams aligned with microscope oculars with xenon lighting. The accompanying Callisto software enables incision and rhexis assistance as well as integrating measurements from IOL Master, toric lens alignment and an integrated assistant microscope that works without loss of light for main surgeon and zooms independently [3]. Although both microscopes deliver quality outcomes and surgical experiences, the goal was to understand if technologic advances in microscope lighting and software translated into improved surgical efficiencies.

Clinical method and design

This was a retrospective review of surgical charts by two experienced high-volume surgeons in one surgical center looking at total surgical times in routine phacoemulsification cases from incision time to completion recorded in the chart. Both surgeons had previous experience with both the study Leica and earlier model Zeiss ophthalmic microscopes. The Leica model was in use for approximately 9 months and the Zeiss Lumera results were assessed immediately under arrival with no excluded "learning curve" time. Usual cataract technique was followed for each surgeon which consisted of suprascapular technique for one surgeon and divide and conquer for the other. Eyes previously identified as being traumatized or cases that were anticipated to be complicated were excluded from the study. Two focused beam microscopes were assessed.

Results and Discussion

Fifty cases for each microscope were reported with roughly half the cases done by each surgeon (48% MT, 52% RT). Mean surgery time with the Leica microscope was 14.18 minutes (standard deviation 8.672) and 11.15 minutes (standard deviation 2.421) with the OPMI Lumera T Zeiss microscope. ANOVA analysis revealed that the difference in surgical time between the two groups was significant at a level of $p=0.16$. Only 3 toric cases were reported, 2 with the Lumera and 1 with Leica, so separate analyses were not completed.

Ophthalmologists were the first in the medical field to utilize microscopes in surgery [4]. Microscopes have evolved from the first high intensity tungsten filament illuminators to more sophisticated surgical tools critical to assisting surgeons in consistent visualization of fine details, and assist in rhexis, toric lens and limbal relaxing incision placement. Improved illumination and visualization can enhance surgical performance and potentially outcomes. The main differences between older and newer model microscopes are red reflex intensity and stability, luminance, technologic add-ons and of course, expense. As microscope technology continues to advance and surgical reimbursements continue to decline, it is important to measure the practical outcomes of these improvements, or lack thereof, in clinical practice.

Calculating operating room costs can depend of many factors including geography and specialty. Cost per minute in an average operating theatre in an average acute care hospital in California has been estimated to be $36-$37 dollars per minute [5]. Ophthalmology is known to be the most expensive operating room because of its capital and technology intensive nature, estimated to cost exponential more at 284,10 Euros (375.33/minutes USD) [6].

Our study was limited by a small number of cases performed by only two surgeons in a single center. Individual surgeons can have different preferences and experiences and a more reliable data set could be achieved by including additional physicians of varying skill levels as well as additional centers. Further, incorporating more and different types of cataracts including previously traumatized eyes and those identified as potentially complicated prior to surgery might also affect the data collected and the analysis. There were no complications in either study arm and too few toric lenses in each group to allow for separate analyses.

Conclusion

This is the first study we know of its kind to look at the practical aspects of surgical efficiency with different ophthalmic operating microscopes in routine cataract surgery. Improving safety and efficiency of surgical procedures becomes ever more important as more and more cataract procedures are being done each year as baby boomers age and healthcare resources are being stretched thinner. Investing in a modern technologically advanced microscope may help to provide more efficient operating room sessions, provide more consistent procedure, allow more care to be provided and possibly reduce potential complications.

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