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Digital 3D HD Imaging Gains Traction in the Ophthalmic OR

Sunday, February 21, 2010

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Analysis of: TrueVision Systems Releases First Ever 3D Visualization and Guidance Platform for Microsurgery | www.microscopy-news.com

Source: www.glggroup.com

Summary:

There are tremendous applications for 3D HD surgery in ophthalmology, from education to archiving to enhancing surgical outcomes. As this technology moves forward through incision marking and toric intraocular lens placement with the Ophthalmic Tool Set, the capabilities of 3D surgery will surpass what we have in the standard microscope.

Analysis:

3D HD technical advances are helping surgeons to capture and display realtime surgery and play it back to audiences for educational purposes.

Recently, stereo video from the TrueVision System was debuted at AAO as part of an educational course where attendees donned stereo glasses to view horizontal and vertical phaco chop techniques for phacoemulsification (cataract surgery) in 3D HD.[1] There have been successful follow up presentations at multiple meetings, including the recent Hawaiian Eye 2010 on Kauai where I demonstrated Refractive Lens Exchange to a standing room only crowd.

In teaching cataract surgery chopping techniques, many of the motions are in the vertical plane, and the biggest challenge is learning how deeply to position the chopper and phaco tip. Appreciation of the correct depth for optimal holding with the phaco needle and separating with the chopper can be pose significant difficulty. However, the 3D platform and its increased depth of field permit students to see precisely how deep the instruments are placed.

Similarly, one of the challenges of adopting biaxial phacoemulsification, with separation of infusion and aspiration, has been learning the most effective placement of the phaco tip and irrigating chopper relative to each other in the vertical plane. If the stream of irrigation fluid washes material away from the phaco tip, it prolongs the procedure and may set the stage for mischief if a piece of nucleus is forgotten in the angle or the sulcus. In addition, keeping the stream high up in the chamber in cases of Intraoperative Floppy Iris Syndrome prevents iris billowing and prolapse. The 3D HD imagery facilitates understanding of the critical vertical dimension in these techniques.

Educational applications of 3D microsurgery are not limited to demonstrating these videos at professional meetings. 3D images can be played back or viewed directly during surgery as education for patients and their families. This type of visual display seems to demystify the surgery, show patients what the surgeon is doing in the eye and foster a sense of knowledge about the procedure. It is tremendous for patients and family members to see a cataract procedure with this sort of “wow factor” and insight that 2D does not offer. The reactions and feedback have been consistently positive and help to reduce anxiety. In fact, one woman who

was watching her husband's cataract surgery actually commented that she could not wait to have hers done. Seeing the surgery live in 3D HD completely removed her anxiety.

The images projected on the visual display are also a wonderful teaching tool for the OR staff. It enables them to participate in the surgery and increases staff synergies.

In the standard OR set up, the surgeon is the only person who has a full stereoscopic view. A 3D display system creates a different visual experience because it gives personnel an opportunity to see exactly what the surgeon sees while operating. It has increased synergy in our OR where our scrub nurses can understand when you have an issue and can anticipate the next instrument needed. Surgeons can use peripheral vision to easily transfer instruments safely and efficiently. A more involved staff improves the work flow in the OR. Since humans are creatures of habit, some surgeons may be initially reluctant to switch to performing surgery via a 3D widescreen platform. The transition is facilitated by keeping the traditional oculars in place by using a stereo bridge so surgeons can revert back to them as they learn to rely on a projected image.

I found that the learning curve was simply a leap of faith—the decision to *not* look through the oculars and to rely instead on the projected, widescreen image. I related this psychological hurdle to my experiences in outdoor education and high ropes challenge courses: balancing or jumping from a pole 50 ft above the ground simply requires an internal decision to overcome fear. The actual physical environment in this situation is carefully and controlled and quite safe. Just so, the surgical procedure progresses smoothly once the commitment is made. In my office, it took only 5 or 6 procedures to perfect the illumination and positioning of the screen before that “circuit” in my mind changed, and I was no longer reaching for the scope with my eyes.

This brings up an important secondary, ergonomic benefit of reduced neck and back strain thanks to the projected image on a screen and no longer having to look down in a microscope for extended periods of time. Many surgeons have recognized that the upright display system provides relief for this occupational hazard. My traditional microscope set up was already optimized to reduce the strain on my neck. Conversely, I have found it necessary with the upright display slightly to alter my direction of gaze because of obstruction from the strut which supports the optical system of the microscope. I have to look a little to the left or right to perform surgery. With eventual modifications to the microscope and camera design it will be possible to achieve straight-on, unobstructed visualization.

A trade-off in 3D HD imaging is a reduction of resolution. Therefore, it is important to obtain the highest resolution visual object as an input to the digital camera. I noticed, for example, a significant improvement in imaging with the use of the Lumera microscope's Dual Stereo Coaxial Illumination (Carl Zeiss Meditec, Jena). Colleagues have also noticed the dramatic clarity, resolution, and color that can be achieved with this scope.

Like any new technology, surgeon feedback sparks new designs and software applications. The next steps in development for 3D surgical imagery include higher resolution images, a more compact display to maximize OR space, expanded indications into other subspecialties like retinal and neurosurgery, and an Ophthalmic Tool Set that will overlay metric data on the 3D screen to help guide wound placement, limbal relaxing incisions, and capsulorhexis size.

The state of the art today is that we are generally estimating the diameter of the capsulorhexis based on the pupil size. When we have an unusual case we may utilize forceps with an engraved ruler (e.g., the Seibel Rhexis Ruler, MicroSurgical Technologies, Redmond, WA). The TrueVision Ophthalmic Tool Set software provides a digital template for sizing and placement of the capsulorhexis based on an image capture preoperatively at the slit lamp. The Tool Set also offers a template to perform Limbal Relaxing Incisions. The guiding image marker for the incisions is superimposed on the eye, sized and rotated correctly for a

more precise astigmatic correction. Amazingly, the arcuate guides can be “locked on” to the surgical view of the eye so that they move with the eye and maintain the correct relationship to the cornea’s steep axis.

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Reference

1. Packer M. Skills Transfer Program: Microincision Cataract Surgery. American Academy of Ophthalmology & European Society of Ophthalmology 2008 Joint Meeting. Atlanta, 8-11 November 2008.

Relevant Subject(s):

Refractive Surgery

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