Clinical microscopy's changing view

BY HANK HOGAN
CONTRIBUTING EDITOR

For clinical microscopy, the familiar view is changing, as images once seen through eyepieces are increasingly viewed on a screen. The result could be greater collaboration in the operating room, better surgical results and the ability to do pathology at a distance, thereby bringing rare expertise to remote locations.

However, don't count out traditional microscopes just yet. In some situations, they still offer higher resolution. They also are still the only way for a pathologist to make an official determination about a tissue sample.

Dr. Mark Packer, associate clinical professor at Oregon Health & Science University (OHSU) in Portland, noted that new technology brings benefits. "I do like the increased freedom that you have in the operating room as a surgeon by not having to be wedded to the oculars of the microscope."

Packer's work involves correcting the vision of patients undergoing cataract surgery. Consequently, those who needed glasses beforehand will emerge with their vision corrected so that they will not need glasses afterward. The procedure requires removing the cataract and inserting an intraocular lens, which must be precisely placed.

With the new technology, what ordinarily would be seen through a microscope is now up on a screen in three dimensions, enabling greater collaboration among surgical team members. That is because everyone – not just the surgeon – can see what is happening. For that same reason, the technique is useful for professional training and as a way to educate potential patients about a procedure.

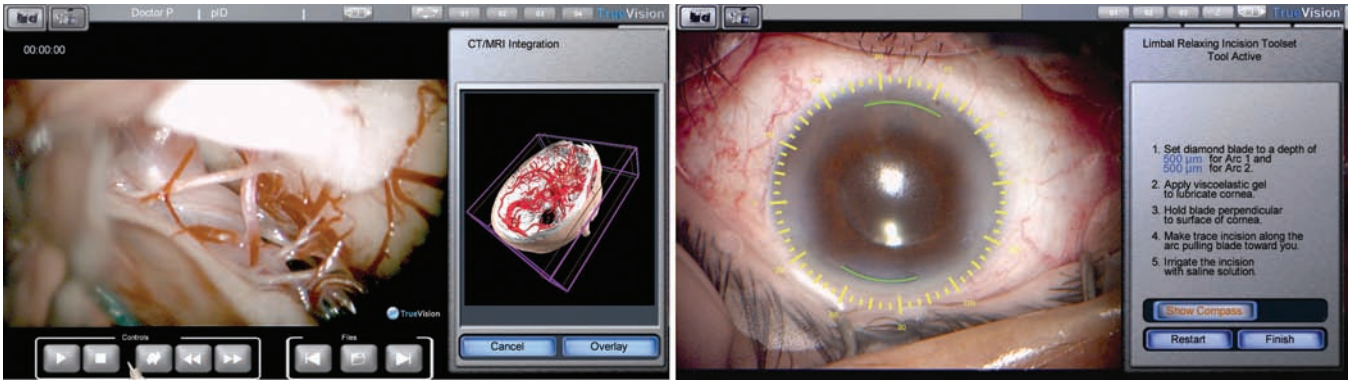
Packer and his team use a device from TrueVision Systems of Santa Barbara, Calif., a privately held technology company. Designed to fit on a standard microscope, the visualization system is intended for microsurgery and is being used primarily for ophthalmology and neurosurgery. However, it also could be used in spine, ear, nose and throat procedures. It captures the image from a microscope, digitizes it and displays it on a screen in a 1080p format, with viewers seeing it in 3-D through the use of polarizing glasses.

This visualization, which involves capturing and processing 2 gigabits of data a second, takes place with no noticeable lag, said Robert Reali, vice president of marketing and operations at TrueVision. "It's real time enough that surgeons can look at the screen and operate."

Some advantages of this approach, he said, include the ability to record procedures in high-definition video, which can be useful for teaching and training. Another is the ability to overlay a surgical plan or other data with what is on the screen. Thus, a surgeon can image an eye, for example, while the patient sits upright. The captured data acts as a guide when the surgeon operates on a prone patient. Data captured by such nonvisible techniques as MRI or CT also can be in the mix.

The company is in clinical studies for products with some additional capabilities. One plan calls for the introduction of a new product in April 2010 that is designed to help correct astigmatism during cataract

Above: Eye surgeons look at a screen, instead of through microscope oculars, during a procedure. The image on the screen appears doubled because it is in 3-D. The glasses worn by the surgeons enable them to see the two polarized images as a single 3-D one. Courtesy of Oregon Eye Surgery Center.



Here, information from a digitized clinical microscopy image is integrated with CT/MRI data (left) or with instructions from a surgical tool (right). This additional information allows surgeons to get all the information they need without having to look away from the screen. Courtesy of TrueVision Systems.

surgery. The new products should help both the surgeon and patient, Reali said. "These tools are designed to be much more accurate, with the potential to lead to better patient satisfaction."

In a different light

At a cost in the $100,000 range, these real-time 3-D visualization systems are not cheap. Given the increasing complexity of the cuts needed in surgery, however, they could prove very useful, said OHSU's Packer. The fact that the image is in three dimensions is also a plus.

There are other issues besides the cost, however. Packer said one of these is the image that can be seen on the screen compared with what can be seen through the eyepiece. "The resolution of the digital image is not quite the image you get through the operating microscope, especially the latest generation of operating microscopes."

On the other hand, the image on the screen has a greater depth of field. The resolution of the digital image is good enough for most circumstances, he said.

Parker uses a Lumera microscope from Carl Zeiss Meditec, which has its US headquarters in Dublin, Calif. According to James Carter, the company's vice president of ophthalmic surgical sales, the microscopes have fairly long working objectives, a necessity given that they do not touch the eye but, instead, rest ~200 mm above it. The optical head also must be fairly large because it allows for viewing by both the surgeon and assistant surgeon.

The company continues to improve its products, but not all of these areas involve the microscope directly, Carter said. For instance, lighting for clinical microscopes historically has been by halogen lamps, but Carl Zeiss introduced xenon lamps some time ago. Such illumination has a different color temperature than halogen, rendering images differently.

Carter noted that xenon is preferred by about four out of five surgeons, largely because it appears more like natural lighting. "Doctors are commenting they have less fatigue, and they can see the details a little bit more sharply."

Based on this outcome, it is difficult to see standard LEDs coming into favor. The reception may be different, however, for those that offer natural-appearing lighting.

Sliding into a digital future

Another example where what is seen through an eyepiece is being replaced by something on a screen comes from pathology. There the traditional practice is being challenged by whole-slide imaging, or virtual microscopy. In it, a high-resolution scan of an entire slide is done using digital imaging, with the data later viewed on a screen.

The technique already is being used in education, said Lorne Davies, group manager for clinical digital imaging at Olympus America of Center Valley, Pa. In such a setting, it makes more sense to have 200 digital images than 200 slides, which can be broken and can be viewed by only one student at a time.

For education, the digitization speed is relatively unimportant, and the fact that today's technology takes a few minutes for a typical scan at 40× is not a problem, he said. However, he added, that number must be less than a minute for the technology to be useful in a high-volume pathology laboratory or in drug screening.

Davies predicted that the technology for faster scans would arrive at some point. Better optics with higher numerical apertures that allow wider fields of view, along with better sensors, are just some of the innovations that will make this possible.

A bigger issue, he said, is how to integrate the new technology into the standard pathology work flow, which includes the acquisition of tissue, the making of a slide, the inspection by a pathologist, the creation of a report and the delivery of that report to the requesting physician. Virtual slide technology disrupts that sequence by inserting itself between the slide production and inspection step.

Another problem involves the amount of data that can be generated. A single slide may produce tens of gigabytes of data, leading to challenges in the storage and movement of the image. Advances in computer technology, however, should help with this issue.

In considering virtual slides, Davies listed a series of benefits, including remote viewing and the ability to avoid the problem of lost or damaged slides. But even with those and expected technical improvements, he does not see virtual microscopy eliminating the traditional variety. "It's going to revolutionize routine microscopy in some respects, but it's not going to replace every standard light microscope."

hank@hankhogan.com