

Veterans Affairs Palo Alto Hospital

High-Definition Endoscopy

By Grant Ellis

At a Glance

Physicians at the Endoscopy Unit at the Veterans Affairs Hospital in Palo Alto, California, wanted a way to capture the real-time SD images on their endoscope screens so they could be reviewed and shared with other members of a medical team for treatment planning and teaching. They also wanted to improve diagnosis of early-cancer lesions by capturing and reviewing HD endoscopy movies, a capability that their endoscopes did not include.

Apple Solution

Mac video technology enables the Unit to capture, review, edit, and disseminate SD and HD endoscopy using off-the-shelf hardware and software. Physicians review captured endoscopies to identify subtle indications of early cancers. Using Final Cut Pro, endoscopies for instruction, self-learning, presentations at conferences (using Keynote on MacBook Pro and 24-inch iMac computers), and dissemination to other professionals as DVDs.



Professor Roy Soetikno and Gastroenterology Fellow Dr. Tonya Kaltenbach during an endoscopy at the Palo Alto Veteran's Hospital Endoscopy Unit.

This year in the United States, an estimated 134,000 new cases of colon cancer will be diagnosed. More than 55,000 patients will succumb to the disease, which is the second most common cause of cancer death.

Colon cancer is preventable. The first line of defense against this disease is the detection and removal of precancerous or early cancerous lesions—before the lesions grow deep into the intestinal wall or spread to other organs. Thousands of screening colonoscopies are performed every day.

The trouble is, colonoscopy isn't easy. Cancers, and particularly early superficial cancers, can be extremely hard to identify. And endoscopists don't get a second look. They have to base diagnostic judgments on a single real-time session with the endoscope. When the examination is complete, the moving images are gone and unrepeatable. They aren't available for reference, consultation, or teaching.

The good news is that Dr. Roy Soetikno, head of the Gastrointestinal Section and Endoscopy Unit at the Veterans Affairs Palo Alto Hospital and an acknowledged visionary in the field, has developed a simple way for physicians to revisit colonoscopies using Apple technology. He uses the Mac computer to record, play back, and edit endoscopies. His teaching videos, assembled and edited with Final Cut Pro, are winning awards and raising the quality of diagnosis and treatment in this challenging field.

Capture and Playback

The Endoscopy Unit at the VA Palo Alto Hospital, which includes five attending doctors, nine trainees, and 10 nurses (plus visiting medical and surgical residents), is known for pioneering leading-edge techniques. Soetikno wanted a way to capture the motion video display he saw on endoscope screens. He turned to the Mac.

"Endoscopy is about video, so we took advantage of the Mac's unique video capabilities," says Soetikno, who is also an associate professor of medicine at nearby Stanford University. "We started by creating a mini-studio on a cart that we can move between endoscopy rooms. The mini-studio had a Power Mac, 23-inch HD Apple Cinema displays, and a UPS battery. With our battery, we were able to take it to the ICU or the Radiology Department without turning the system off." The mini-studio cart, which has since been replaced by an upgraded version, revolutionized endoscopy in the Endoscopy Unit.

"One reason we built this cart is that during a procedure we may have a fleeting recollection of something we saw seconds ago," says Soetikno. "We think, 'Did I miss something there? What was that?' We can stop the procedure, rewind, and take another look. Without the Mac we could never bring those moving images back. Using the Mac we can also develop complex treatment strategy that is safe and effective.

"As a result of focusing on the difficult-to-see early cancers and replaying them, we've imprinted their signatures on our brains. When we say we've spotted one of them, other people may look at the screen and wonder what we're talking about. They can't see them, but we can. That's another advantage we get from video replay on the Mac."

Seeing the Subtleties

Image quality has also been a problem for endoscopists. Most of them work with standard-definition video displays that make it difficult to pick up subtle differences in tissue—the surface of a polyp, or the signature of an early cancer in the colon wall.

"With standard definition video images, we just don't see the details of some of these lesions," says Dr. Roy Soetikno. "We need higher resolution and better contrast to find diseases at an earlier stage."

The major endoscope manufacturers (Olympus, Pentax, and Fujinon) have addressed this problem by upgrading to high-definition displays. The unit recently took delivery of its HD endoscopes, the Olympus EVLS Exera II and the Fujinon Super-CCD, and the unit's staff is clearly impressed by the quality of the images.

"We performed a colonoscopy on an 80-year-old man this morning," says Dr. Tonya Kaltenbach, a fellow in gastroenterology who is training under Soetikno. "He had a large polyp. The size of the polyp made us more concerned about a cancer. HD imaging enabled us to scrutinize the pattern of the polyp, which is very informative, and determine that it was not cancerous. We were able to make a treatment decision on the spot and remove the lesion safely and completely through the endoscope.



High-def image of a normal lined wall of the small intestine.



High-def image of a normal lined wall of the small intestine after application of blue (indigo carmine) dye spray.

Apple Technology at the VA Palo Alto

- 5 Mac Pro desktop systems
- 2 24-inch Intel-based iMac computers
- 2 17-inch Intel-based iMac computers
- 2 15-inch MacBook Pro computers
- 4 23-inch HD Apple Cinema Display monitors
- 1 30-inch HD Apple Cinema Display monitor
- 7TB Xserve RAID server
- Final Cut Studio
- Final Cut Express
- QuickTime Pro
- Keynote

Endoscopy Technology at the VA PA

- 8 Olympus Evis Excera II
- 1 Fujinon 4400
- 8 National Display HD monitors

"The basis for upgrading to HD is very simple: how can you diagnose intestinal disease if you can't see it and don't know what it looks like?"

Dr. Tonya Kaltenbach,
Head of the Gastrointestinal Section and
Endoscopy Unit at the Veterans Affairs
Palo Alto Hospital

Sharing the Knowledge in HD



A screenshot of Final Cut Pro, used for editing an endoscopy video.

"The basis for upgrading to HD is very simple," Dr. Tonya Kaltenbach continues. "How can you diagnose intestinal disease if you can't see it and don't know what it looks like? That's the most important thing we get from HD imaging—an appreciation of endoscopic diagnosis, and of intestinal pathology at an early stage."

Although the new endoscopes provide an HD screen display for examinations, they only enable the capture of single-frame SD images. Soetikno, however, captures HD motion video on Mac systems the same way he does with SD video. The HD play-back, using full motion, slow motion, and still-frame video, is a powerful tool when meeting with surgeons about lesions that cannot be treated endoscopically.

"Early gastrointestinal cancers are hard to identify," says Kaltenbach. "There may only be a subtle change in the appearance of the tissue. Using Mac technology, we can review HD endoscopy images and videos to recognize lesions. When we share the video with surgeons and pathologists, they can appreciate what we see during the procedure. That's why capturing video of endoscopies is a critical step in patient care."

All four of the unit's endoscopy rooms are now equipped with Mac Pro systems and HD Apple Cinema Display monitors. iMac computers are installed on both mobile endoscopy units for use in the Intensive Care and Radiology departments. An Xserve RAID server stores the terabytes of data that the endoscopy team accumulates through its clinical practice. In addition to benefiting their endoscopy, this mountain of visual data has a clear purpose: the sharing of learning, which is Soetikno's personal passion.



This is a colon polyp—a precursor of colon cancer. Colon and rectal cancer is the number two cause of cancer death in the United States. A significant proportion of the Palo Alto Veteran's Hospital Endoscopy Unit's work is devoted to screening patients for the precursors of colon and rectal cancer using colonoscopy.



A shot of the colon polyp above with dye. This picture shows that the polyp is cancerous.

Spreading the Knowledge

Soetikno's team has much to share with fellow professionals: a library of instructive videos, enthusiasm for HD endoscopy, and a simple way to implement Macintosh capture and playback capability.

Soetikno and his team capture endoscopies at the highest available resolution, usually as QuickTime Pro movies, and assemble and edit them in Final Cut Pro. Their teaching videos are viewed by endoscopists and staff throughout the world and have won several awards from the American Society of Gastrointestinal Endoscopy. HD video will make them even more effective.

"As an endoscopist, the thing I found most frustrating was seeing these beautiful HD images live and in real time on the endoscope screen, then having to show them to surgeons and medical doctors in still-frame SD," says Kaltenbach. "Sometimes they say, 'I see,' but they can't possibly see, because the details are lost in SD. We're really excited about using Apple to capture these images in motion HD. It's such a gain for patient care."

The VA team also uses its videos for self-learning, and Soetikno uses them to instruct physicians in training. Kaltenbach has taken a course on Final Cut Pro and is now assembling and editing the videos.

"I came to work with Roy because of his vision and enthusiasm," says Kaltenbach. "He told me that if I didn't have a Mac, we really wouldn't work well together. I was not a Mac user, but I now use Macs for everything—movie-making in Final Cut Pro, iTunes, and my Palm. I use it to store all my movies and create talks with Keynote. I use Macs all day, every day."

iPod, iChat, and Remote Consultation

"We have the hardware, the software, and the knowledge about capturing and sharing knowledge in HD," says Soetikno. "That's our message. And that's why we're interested in working with Apple technology."

Soetikno foresees a better way of informing patients about endoscopy procedures: let them play videos on iMac or iPod, rather than reading about them. Physicians can consult with specialists by sending a few seconds of video and using iChat. The VA team's self-educational videos are downloadable through iTunes from the Massachusetts General Hospital and the Gastrointestinal Endoscopy journal, of which Soetikno is associate editor.

Roy Soetikno hopes his vision helps other professionals take their practice to another level. "People dream about this," says Soetikno. "They want to record endoscopy movies, and they just can't get there. I want to tell them that this is mature technology that any doctor can use. Get a Mac, a FireWire cable, and QuickTime Pro, and you're set."

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