

NGENUITY 3D Visualization System

Provocative Technology Advances Vitreoretinal Surgery

The system has great potential and it addresses some unmet needs.

BY ALAN FRANKLIN, MD, PhD



My partners and I purchased the NGENUITY 3D Visualization System (Alcon) almost immediately after we completed a demonstration on it—and I have been using it full time ever since. The benefits of digitally assisted vitreoretinal surgery outweighed any potential doubts we had about being early adopters.

For instance, our traditional systems show us an analog view through the microscope, only magnified. With the NGENUITY 3D Visualization System, however, the camera is not just magnifying our view—it is digitizing it. By providing a real-time manipulation of the digital image, NGENUITY significantly improves the surgical image.

WHY I AM USING THE TECHNOLOGY

Traditional retina surgery involves looking through microscope oculars, but the NGENUITY 3D Visualization System includes a high-resolution camera attached to the microscope that projects onto a 4K 3D monitor at the foot of the bed. This means we can look up at the monitor instead of hunching over the microscope. Ergonomically, we expect that this feature alone may minimize the C-spine issues that are common for ophthalmic surgeons.¹

Mathematically, when we consider the calculations that have been done, a 480P monitor—or something with similar resolution to our parents' television—shows a resulting moving image on the screen with only 20/200 clarity. General advances in imaging technology that include 4K monitors now permit image clarity on the screen that approaches 20/20.² Moreover,

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since that image is now being projected on a 55-inch 4K screen, the field of view is larger and stereopsis is enhanced. This provides the surgeon with exceptional detail of 3D macular anatomy with high magnification.²

In addition, with the NGENUITY 3D Visualization System, I have been able to use about 30% less lighting than I would with a normal microscope. I have also become less reliant on using dyes because of the improved image quality.

The NGENUITY 3D Visualization System also provides a unique ability to visualize through media opacities in the vitreous. With its red-free setting, this system allows us to see through vitreous hemorrhage; this has helped me to more efficiently remove both blood and preretinal membranes during vitrectomy procedures on diabetic patients.

The system allows everyone in the room or at a monitor with a live feed to see what the operating surgeon is visualizing in 3D in real time. This provides a new and unique opportunity for teaching both physicians in training and adjunctive staff. Video presentations in 3D communicate enhanced detail and visual information compared to our standard video, which is in 2D.

MINIMAL LEARNING CURVE

My learning curve with this system was very fast—within the first few posterior segment cases, I was as comfortable operating digitally heads up as I was using an analog microscope. My transition to looking up at the screen with scleral buckle or glaucoma valve surgeries was almost as seamless.

Now I am equally confident when performing any of these cases with the NGENUITY 3D Visualization System.

In short, I believe that the NGENUITY 3D Visualization System is the future of imaging during vitreoretinal surgery. ■

1. Dhimitri KC, McGwin G Jr, McNeal SF, et al. Symptoms of musculoskeletal disorders in ophthalmologists. *Am J Ophthalmol.* 2005;139:179-181.
2. Riemann CD. Machine vision and vitrectomy: three-dimensional high-definition video for surgical visualization in the retina OR. Poster presented at: American Academy of Ophthalmology Annual Meeting; October 17, 2010; Chicago, IL.

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Three-Dimensional Visualization Will Change Vitreoretinal Surgery

The platform digitizes images, helping to make surgery better for retina surgeons.



BY ALLEN C. HO, MD

Technology has been constantly improving our ability to perform surgery, but our operating room microscopes are based on 1950s technology, which are based on 300-year-old Galilean telescope optical principles. Improved surgical visualization has remained an unmet need for retina surgeons. Retina surgeons have accepted these limitations—we typically have clear corneas, vitreous, and tissues to look through to get to our surgical field in the posterior segment of the eye, which also meant we did not spend a lot of time trying to improve the optical system beyond the introduction of wide-angle imaging that allowed us to see further into the periphery.

Retina surgeons have different visual demands than those typically posed to anterior segment eye surgeons. Outside of ophthalmology, surgeons are embracing endoscopic viewing and using digital imaging.

Posterior segment surgeons can now join those ranks, thanks to the introduction of Alcon's NGENUITY 3D Visualization System, a high-definition, surgical visualization platform that converts an optical operating room microscope into a digital imaging system. And it is all viewed on a large, high-definition 4K monitor in the operating room.

I have been using this system throughout its various stages of development as a beta-site surgeon, beginning in 2008. Initially limited by resolution and latency issues, it is now ready for prime time, and we are acquiring the NGENUITY 3D Visualization System for our operating room. When I see the digital visualization and digital platform, I believe it is going to

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be more than visualization. It is going to impact the way we manipulate tissue, the way we laser, the way we can see something by just maybe tilting our head. In my opinion, this will be one of the best things that has happened to retinal surgery, because visualization has lagged behind all the other improvements in technology.

FEATURE BENEFIT

There is great potential here to link visualization with our surgical instrumentation. I believe this is just the first step to completely changing the way we perform vitreoretinal surgery. For example, we need exquisite depth of field to peel membranes from the surface of the macula, when macular tissue is less than 0.5 mm thick. The NGENUITY 3D Visualization System uses optics from the optical microscope, but provides

for 3D viewing, which in turn provides us with a comparable depth of field and the resolution needed to perform this type of fine macular work. Our retina fellows at Wills Eye Hospital found the system intuitive.

WHY SURGEONS WILL EMBRACE THIS TECHNOLOGY

The obvious and first reaction was: “Wow, the definition, the depth, the focus, the detail is very high.” In my experience, it immediately brings the whole surgical team on the same page. There is a real teaching benefit here, because we can point to something on the screen and everyone in the operating room can see the same thing with the same perspective. Quite frankly, it makes performing surgery fun—when we are not bound by the oculars of the microscope, it allows for more interaction between all the members of the surgical team.

Improved ergonomics for the surgeon is another expected benefit—surgeons do not realize how fatigued we get as the day progresses when we are looking through a microscope for hours at a time.^{1,2} But the NGENUITY 3D Visualization System

has me looking forward at a monitor, which kept me more “fresh” throughout the day. At Wills Eye Hospital, our senior fellows operate every day, all day, sometimes into the night. I believe they are going to enjoy a much better kind of physical experience over time because of these anticipated improvements in ergonomics.

For me, an unexpected benefit was the image resolution and the immersive experience that you can get with the monitor. The bottom line: if we can see better, we can do better surgery. This technology can take us there. ■

1. Dhimitri KC, McGwin G Jr, McNeal SF, et al. Symptoms of musculoskeletal disorders in ophthalmologists. *Am J Ophthalmol.* 2005;139:179-181.

2. Desai URT, Abdulhak MM, Bhatti R. Occupational Back and Neck Problems in Vitreoretinal Surgeons. Paper presented at: American Society of Retina Specialists Annual Meeting; August 2004; San Diego, CA.

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A Paradigm Shift for Retina Surgeons

By digitizing images and using 3D functionality, retina surgery will be forever changed.



BY JOHN KITCHENS, MD

The NGENUITY 3D Visualization System (Alcon) essentially eliminates our need to look through microscope oculars to visualize the retina and vitreous during surgery. It uses a 3D HDR camera, 55-inch, OLED 4K display, and 3D glasses to help

visualize what we are doing inside the eye.

Bypassing the traditional oculars results in many unique changes to how we perform vitreoretinal surgery. First, the surgeon is less dependent on the position of the oculars. In other words, the surgeon no longer has to fit his or her posture to that of the microscope/oculars position. Ergonomically, our posture changes fundamentally because of this difference. This posture change should allow the surgeon to develop a more relaxed and comfortable position.

The second paradigm shift with the NGENUITY 3D Visualization System is how it redefines surgical video and imaging capture. It completely changes how we acquire surgical videos. Surgical video capture is no longer a 3rd wheel in the operating room. Instead, what you see in surgery is what you get recorded. That not-so-subtle difference has radically improved the quality of surgical videos we are now able to capture. For some of us, sharing our interesting cases and techniques fuels our passion for vitreoretinal surgery. I believe the fact that our videos can now be 3D improves our ability to educate staff, fellows, and referring doctors as well

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as other retina specialists at educational meetings in the United States and abroad. In my opinion, the NGENUITY 3D Visualization System produces unparalleled surgical video quality.

PARADIGM CHANGES WITH THE MICROSCOPE

The NGENUITY 3D Visualization System features a digital inverter, which alleviates the need to ask the operating room nurses to invert. The system also features multiple different color and light intensity profiles that may enhance surgeon visualization. For example, I now see the peripheral vitreous much better using one of these specific capture profiles. And because the high-dynamic range camera is so sensitive, I have been able to operate at much lower light levels than I could previously.³

I have found I can turn my light level down to 5%, yet still be able to perform membrane peeling and macular work with these low-light intensities. I have also seen advantages during an air fluid exchange, because I see less glare as a result of the reduced lighting levels. A final advantage is the camera's ability to adapt to varying scene conditions. Through a combination auto-gain and available auto-exposure, the system is able to adjust the camera's light sensitivity automatically. Along with the high dynamic range capability, the camera system provides a view that is free of overexposed areas even when switching from macular to wide-angle work, or when varying the distance the light pipe is in the eye.

BETTER ERGONOMICS

This system also has allowed me to have a more relaxed and ergonomic posture. I am no longer "locked in" to a ridged posture with my neck extended.^{1,2} As quickly as the first day of use, I noticed considerably less neck fatigue. Instead of being hunched or sitting upright, I am actually able to lean back a bit more in my chair. My posture with the NGENUITY 3D Visualization System enhanced my ability to perform maneuvers, such as buckling with the microscope and maneuvering equipment in and out of cannulas.

A 3D DISPLAY

The 3D display is beautiful. I bring all of the other ophthalmologists in our surgery center into the operating room to see what we can do with this system and how we do it. Our staff is enthralled at times and now has a greater appreciation for the steps of each procedure. It has engaged them on a whole different level.

SURGICAL TRAINING

One of the most enjoyable aspects of my career has been training fellows. With our traditional microscope, the view of the fellow has always been dependent upon how good the camera was and whether the fellow has the image in focus.

With the NGENUITY 3D Visualization System, I am able to see exactly what the fellow is seeing—at the same depth, with the same focus, and with excellent clarity. Our fellows can truly

see what is going on inside the eye. I can point out things on the screen where they are looking in real time and explain what is going on.

The NGENUITY 3D Visualization System engages our staff much more because our nurses have the glasses on. They are seeing things in 3D, and have been totally mesmerized. Be prepared though—you will need to have enough glasses to go around, because all of the operating room staff will want to see "the action" (even anesthesia).

There are a few downsides to the system. Realize that with the NGENUITY 3D Visualization System, it may take four to five cases before surgeons are comfortable with the depth of the instruments inside the eye. To ease this transition, I would recommend the first few uses be with pseudophakic patients. Working outside the eye, particularly suturing on the cornea, is different under 3D viewing than with a traditional microscope.

The system needs its 55-inch monitor to be placed at either the foot of the patient's bed or, preferably, at knee level. This may require anesthesia equipment to be displaced a bit, or the patient's bed may need to be angled slightly.

The digital inverter currently requires an operating room staff member to invert the view when using a noncontact wide-angle system.

CONCLUSION

I am a surgical video aficionado and love training future vitreoretinal surgeons. I believe that the NGENUITY 3D Visualization System completely redefines these two passions. This system is just a glimpse of the future that this technology holds for our field. ■

1. Dhimitri KC, McGwin G Jr, McNeal SF, et al. Symptoms of musculoskeletal disorders in ophthalmologists. *Am J Ophthalmol*. 2005;139:179-181.
2. Desai URT, Abdulhak MM, Bhatti R. Occupational Back and Neck Problems in Vitreoretinal Surgeons. Paper presented at: American Society of Retina Specialists Annual Meeting; August 2004; San Diego, CA.
3. Eckardt C, Paulo EB. Heads-up surgery for vitreoretinal procedures: an experimental and clinical study. *Retina*. 2016;36(1):137-147.

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IMPORTANT PRODUCT INFORMATION

Caution: Federal (USA) law restricts this device to sale by, or on the order of, a physician.

Indication: The NGENUITY® 3D Visualization System consists of a 3D stereoscopic, high-definition digital video camera and workstation to provide magnified stereoscopic images of objects during micro-surgery. It acts as an adjunct to the surgical microscope during surgery displaying real-time images or images from recordings.

Warnings: The system is not suitable for use in the presence of flammable anesthetics mixture with air or oxygen. There are no known contraindications for use of this device.

Precautions: Do not touch any system component and the patient at the same time during a procedure to prevent electric shock. When operating in 3D, to ensure optimal image quality, use only approved passive-polarized glasses. Use of polarized prescription glasses will cause the 3D effect to be distorted. In case of emergency, keep the microscope oculars and mounting accessories in the cart top drawer. If there are any concerns regarding the continued safe use of the NGENUITY® 3D Visualization System, consider returning to using the microscope oculars.

ATTENTION: Refer to the User Manual for a complete list of appropriate uses, warnings and precautions.