

HEADS-UP 3-D VISUALIZATION IN COMPLEX VITREORETINAL SURGERY

The latest dimension in surgical viewing works well in many scenarios, including complex cases.

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The first use of heads-up 3-D technology was reported by Claus Eckardt, MD.¹ Since that time, interest in the use of heads-up 3-D visualization has grown, and the technology has improved.



The basic setup of the 3-D heads up display system has been described previously.² In brief, two cameras affixed to an operating microscope send signals to a central processor, which transmits an image onto a wide-screen high-definition monitor. Surgeons wear polarized glasses to appreciate the three-dimensionality of the image on a 2-D surface.



Often-cited benefits of using a 3-D heads-up display include improved ergonomics, increased depth of field, wider field of view, the possibility to overlay other data such as images from optical coherence tomography and fluorescein angiography during surgery, and the ability to digitally amplify images.^{2,3-6}



In this article we explain how heads-up 3D visualization, specifically with the Ngenuity 3D Visualization System (Alcon), can be used to perform complex surgical procedures.

USE IN COMPLEX CASES

In our experience, any case that can be performed with a conventional microscope can be performed with heads-up visualization, while at the same time capitalizing on the benefits of 3-D surgery. Most of the authors use the Ngenuity 3D Visualization System exclusively for all vitrectomies.

The cases described below were all performed using the Ngenuity platform. They illustrate how 3-D heads-up surgery can be used in the toughest cases to achieve the best outcomes for patients.

CASE EXAMPLES

Case No. 1: PVR and Scleral IOL Fixation

A 79-year-old woman presented with light perception vision, a subluxated posterior chamber intraocular lens (IOL), and a recurrent total retinal detachment (RD) with proliferative vitreoretinopathy (PVR) in the left eye (OS) 2 months after undergoing pars plana vitrectomy (PPV), scleral buckle,



AT A GLANCE

- Any case that can be done using a conventional microscope can also be done with the heads-up display.
- Heads-up 3-D visualization works well for complex vitreoretinal procedures, routine cases, and mixed anterior and posterior segment surgeries.
- Heads-up 3-D surgery can be used in the toughest cases to achieve the desired surgical goals.

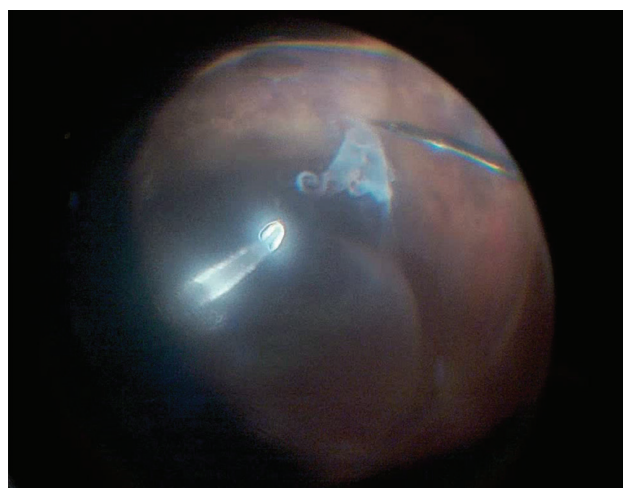


Figure 1. Case No.1: Heads-up bimanual dissection of PVR using forceps and a lighted pick.

and endolaser for repair of her primary rhegmatogenous RD. Her IOL became unstable during the primary RD repair, and postoperatively it was noted to be sublaxated. She underwent 25-gauge PPV with membrane peeling, relaxing retinectomy, injection of perfluorooctane (PFO), endolaser, and injection of silicone oil to repair the RD (Figure 1).

During the same surgery, the IOL was fixated to the sclera using a sutureless intrascleral fixation technique.⁷ Peripheral membrane peeling was achieved using a bimanual technique with a lighted pick and forceps, and these maneuvers were easily completed with the help of heads-up visualization. At the most recent follow-up visit, 3 months after her second surgery, the patient's retina was attached and she had hand motions vision.

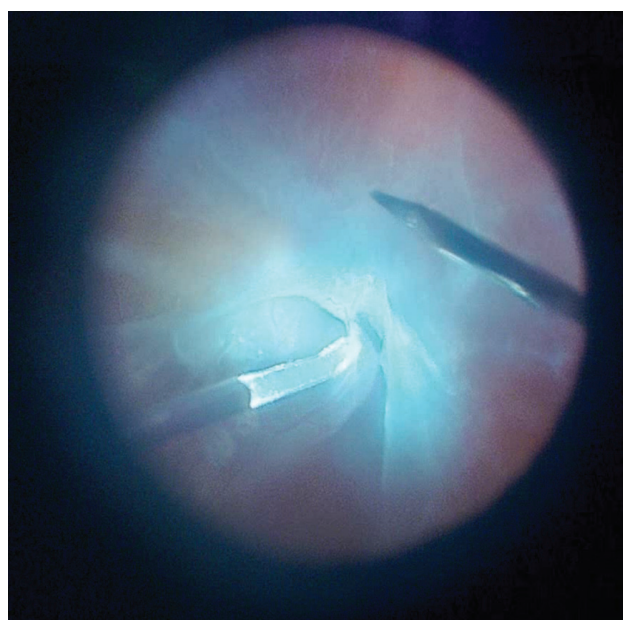


Figure 3. Case No. 3: Heads-up bimanual dissection for severe diabetic TRD using forceps and a lighted pick.

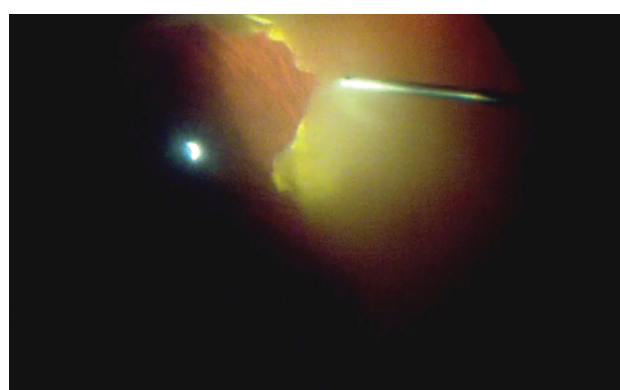


Figure 2. Case No. 2: Heads-up 27-gauge vitrectomy for dense vitreous hemorrhage in Terson syndrome.

Case No. 2: 27-gauge Vitrectomy for Terson Syndrome

A 56-year-old man developed subarachnoid hemorrhage from a ruptured aneurysm 3 months before presentation. He underwent extensive neurosurgical interventions and was stabilized, but he later realized that his vision was blurry. His visual acuity was 20/63 through a small window and light perception otherwise. Examination revealed dense dehemoglobinized blood filling the eye. He underwent 27-gauge vitrectomy to clear the hemorrhage, and the surgeon had no visualization issues while making way through the dense opacities using heads-up 3-D technology (Figure 2). At the 6-month postoperative timepoint, the patient's vision had improved to 20/20.

Case No. 3: Severe Diabetic TRD

A 56-year-old man with type 2 diabetes mellitus presented with counting fingers vision and a diabetic tractional retinal detachment (TRD) involving his macula OS. He received an intravitreal injection of an anti-VEGF agent 4 days before he was taken to surgery for repair of his TRD (Figure 3). The 3-D heads-up display allowed improved visualization of dissection planes by enhancing the depth of field, and much of the dissection could be achieved using the vitreous cutter. After complete vitrectomy with membrane peeling, endolaser, and silicone oil injection, the patient's retina reattached. The silicone oil was removed 3 months later. At his most recent follow-up visit, the patient's vision had improved to 20/400, and the retina remained attached.

Case No. 4: Sick Cell TRD

A 29-year-old man with hemoglobin SC sickle cell disease was referred for multiple recurrent rhegmatogenous and tractional RDs. His visual acuity was counting fingers, and his examination revealed a macula-involving temporal RD with overlying fibrosis under silicone oil in an aphakic eye. The patient underwent 23-gauge silicone oil removal, membrane peeling, focal relaxing retinectomy, endolaser under PFO, and silicone oil injection (Figure 4). Visualization with the heads-up 3-D system was clear and allowed delicate membrane peeling and complex maneuvers using forceps

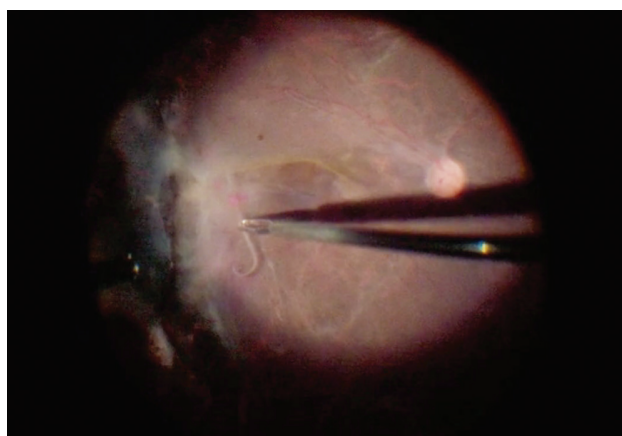


Figure 4. Case No. 4: Heads-up 3-D membrane peeling of tractional membranes in sickle cell retinopathy using forceps and vertical scissors.

and scissors. The silicone oil was subsequently removed. The patient's retina remains attached, and vision in the operated eye has improved to 20/125.

Case No. 5: Retroprosthetic Membrane

A 55-year-old monocular woman with a keratoprosthesis in her seeing eye presented with counting fingers vision and a retroprosthetic membrane on her keratoprosthesis. She had previously undergone multiple surgeries for recurrent RDs with PVR. Using a 23-gauge vitrectomy platform, a microvitrectoretinal blade was used to incise the membrane, which was then peeled away with forceps (Figure 5). Performing this advanced anterior segment work using vitreoretinal instrumentation was not a problem on the heads-up display. The patient's visual acuity remained stable at counting fingers postoperatively, but she experienced subjective improvement.

Case No. 6: Intraocular Foreign Bodies With PVR

A 20-year-old man was struck in the eye by a falling piece of wood, resulting in a ruptured globe for which he underwent primary repair. Approximately 1 week after the primary surgery he returned to the OR for vitrectomy, lensectomy, and removal of multiple pieces of intraocular wood. His eye subsequently became hypotonous and

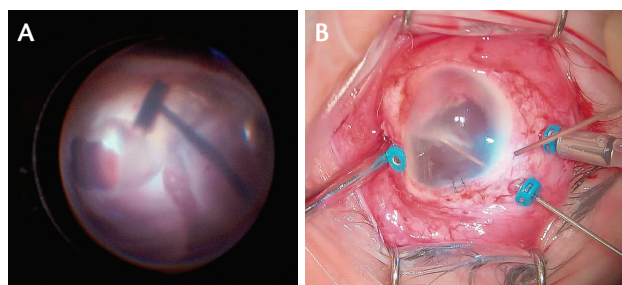


Figure 6. Case No. 6: Heads-up removal of intraocular wood (A) and repair of RD with PVR (B).

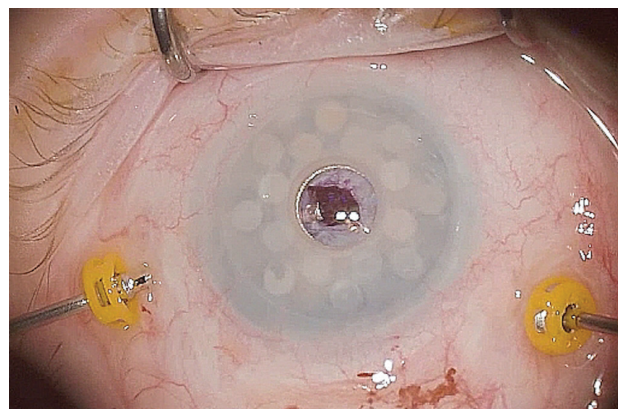


Figure 5. Case No. 5: Heads-up dissection of dense retroprosthetic membranes using a microvitrectoretinal blade and forceps.

developed an RD associated with PVR. On presentation to our institution, vision in his affected eye was hand motions, and his intraocular pressure (IOP) was too soft to be measured. About 3 months after his initial injury he underwent repeat vitrectomy with membrane peeling, retinectomy, silicone oil injection, removal of additional pieces of intraocular wood, and silicone oil retention sutures (Figure 6). Switching between complex anterior and posterior segment tasks was not a problem using the Ngenuity platform. At his most recent visit, the patient maintained hand motion vision with an IOP of 5 mm Hg, and the retina remained attached.

Case No. 7: Stage 5 Retinopathy of Prematurity

A boy born prematurely at 25 weeks postmenstrual age and weighing 800 g developed bilateral total RDs despite laser photocoagulation and lens-sparing vitrectomy surgery in each eye. He was referred to our practice and, at approximately 50 weeks postmenstrual age, he underwent lensectomy, vitrectomy, and membrane peeling, revealing a closed funnel RD. Two weeks later, he was taken to the

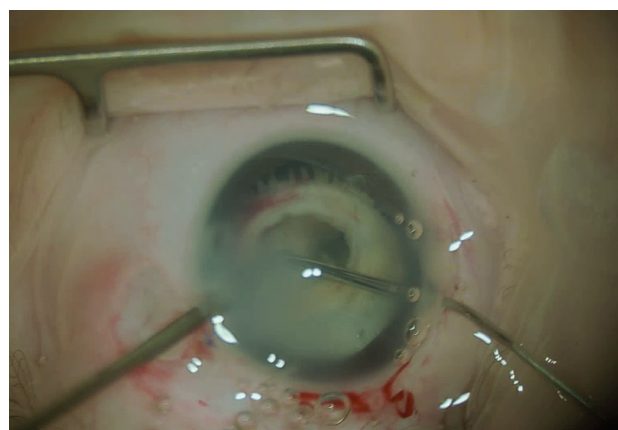


Figure 7. Case No. 7: Heads-up bimanual anterior dissection of a closed funnel RD in stage 5 retinopathy of prematurity under direct visualization.

From the BMC Archive

The Case for 3-D Retina Surgery

By Allen C. Ho, MD; David W. Friess, OD; Jason Hsu, MD; and Ehsan Rahimy, MD

Retina Today November/December 2015

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Seeing the World Through 3-D Glasses

By Yoshihiro Yonekawa, MD

Retina Today October 2016

Find it online at: bit.ly/Yonekawa1016

OR again for further staged membrane dissection using the Ngenuity platform for visualization (Figure 7). The enhanced depth of field allowed precise dissection, and, by the end of the case, the funnel detachment had opened. This anterior dissection was performed entirely under direct visualization without a wide-angle viewing system.

3-D ADVANTAGES

For performing complex vitreoretinal surgery, the Ngenuity 3D Visualization System offers several advantages over traditional surgery through the microscope oculars. The system's ability to digitally amplify the light signal permits surgeons to operate at lower light levels, thus theoretically reducing the risk of light toxicity during long, complex cases. Also, the increased depth of field and wider field of view may allow delicate maneuvers at the vitreoretinal interface to be performed more safely. Some of these complex surgeries can take longer than a typical case, and there is an ergonomic advantage to being able to sit back and operate with full spinal support. The entire operating room can also see exactly what the surgeon sees, which enhances the immersive educational experience for observers and allows surgical technicians to be more involved in the case to better anticipate your next move.

Given the versatility and potential advantages of using a 3-D heads-up display, this modality may become the standard approach used for the broad spectrum of cases encountered by vitreoretinal surgeons, including the most complex of cases. ■

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