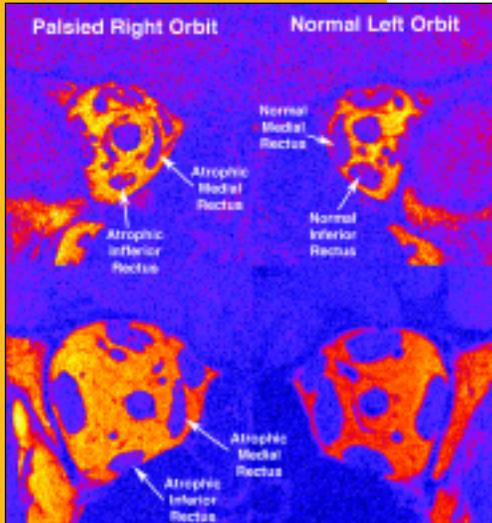


## High-Resolution Orbital MRI Improves Diagnostic Abilities by Showing Cranial Nerves



High resolution, surface coil MRI of the orbits of a patient with previously progressive right oculomotor palsy shows striking atrophy of the right medial and inferior rectus muscles.

A Jules Stein Eye Institute ophthalmologist has demonstrated the ability to see cranial nerves that conventional MRI cannot detect, using high-resolution magnetic resonance imaging (MRI) techniques for the eye he developed in the early 1990s. The high-resolution orbital MRI developed by Joseph L. Demer, M.D., Ph.D., Leonard Apt Chair in Pediatric Ophthalmology and chief of the JSEI Comprehensive Ophthalmology Division,

provides 10 to 15 times greater resolution than conventional MRI, and allows direct observation of the function of eye muscles. These advances have enabled Dr. Demer to correctly diagnose cases that have previously baffled clinicians, or were misdiagnosed.

“By refining the standard MRI technique, we can get enough resolution to trace the nerves out of the brain toward the eye socket,” Dr. Demer explains. “Instead of making indirect conclusions about these nerves, we can now look directly at them and have objective evidence about how they are structured and how they are functioning.”

Dr. Demer notes that in examining neuro-ophthalmological problems, including concerns about double vision, clinicians need to know whether there is any lesion or disease of the nerves that control muscles that move the eyes. Such a finding could indicate the presence of an infection, a tumor, or another life-threatening condition, or could otherwise explain why a patient is experiencing double vision.

### Conventional MRI

Given the limitations of conventional MRI, ophthalmologists have been forced to reach indirect conclusions about whether certain nerves are working properly based on office examinations of the movement and alignment of the eyes. With the high-resolution MRI developed by Dr. Demer, however, the cranial nerves can be observed through clear pictures. Research by Dr. Demer and others has demonstrated the ability to see muscles react and contract while receiving commands from nerves, as well as showing how certain diseases affect the appearance of the nerves. Dr. Demer has also found that high-resolution orbital MRI can detect tumors in the eye that are slightly larger than the head of a match – lesions that are undetectable with conventional MRI. “Nerves and lesions that would be invisible on a standard MRI are seen in detail with our high-resolution technique,” he says. “Using a surface-coil technique and other minor refinements, we can follow the nerves within the eye socket.”

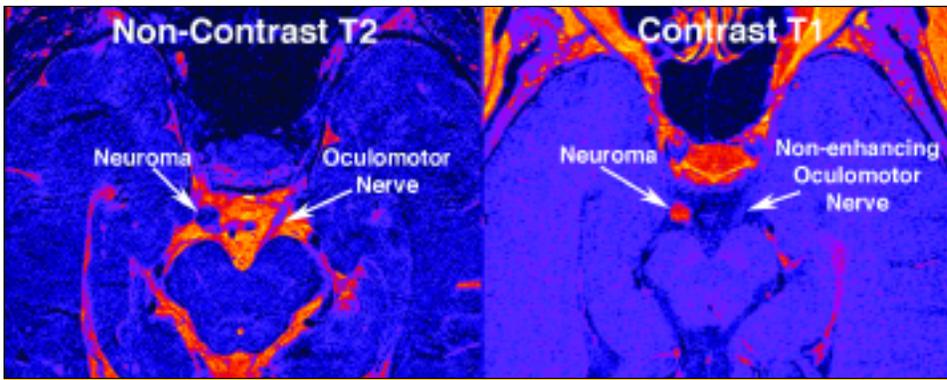
This ability has enabled Dr. Demer to reach conclusions about patients whose double-vision problems have previously defied diagnosis, or whose small tumors have previously gone undetected. In December 2002, Dr. Demer and colleagues published results of a 12-year, prospective study of extraocular muscle imaging in complex strabismus cases (*Journal of AAPOS*, Dec. 2002), which found that the new technique can enable diagnoses that would otherwise not be possible. “We have examples of patients who have gone five to six years with wrong diagnoses and several MRI scans that showed everything to be

Jules Stein Eye Institute  
UCLA

40

1966 - 2006

Excellence in Vision  
Education  
Patient Care  
Research



High resolution MRI of the brainstem of the same patient shows a neuroma of the right oculomotor nerve in the interpeduncular region that enhances strikingly with gadolinium contrast. This tumor was missed on three conventional MRI scans before referral to JSEI.

normal, and we went in and on the first scan found a tumor that explained everything,” he says. “In other cases, we have been able to demonstrate that an injury to the eye socket has directly damaged a nerve that has paralyzed a muscle, and we accurately forecast whether the patient will recover without treatment — potentially sparing unnecessary surgery.” Dr. Demer’s group also used high-resolution orbital MRI to discover tissues within the eye socket, previously unknown, that led to a fundamentally new understanding of eye muscle operation. The discovery earned Dr. Demer the Friedenwald Award in 2003, the highest scientific honor bestowed by the Association for Research in Vision and Ophthalmology.

### Research Leads to Refinements

Since 1991, Dr. Demer has received funding from the National Eye Institute to develop MRI techniques for the eye muscles. He has advanced the technology through targeted application of MRI to the eye and its socket. His group has used surface coil devices — special hardware akin to radio antennae, with greater sensitivity to receiving the radio signals from specific areas of tissue that are then used to construct an image. Methods developed

by Dr. Demer’s team prevent the eye from moving during the scan — a problem that often leads to blurred MRI pictures.

Just as important as the refinement of MRI to get better-quality pictures has been Dr. Demer’s research in interpreting the images. “We’re seeing things that haven’t been described in the textbooks before because they couldn’t be detected,” he explains. Dr. Demer has focused on three clinical applications: the diagnosis of strabismus; determination of neuro-ophthalmological conditions, including whether abnormalities in eye movements are indications of serious neurological disease; and reconstruction of injured eye sockets after severe injury or after an eye has been removed because it harbors a melanoma.

Dr. Demer recently received a five-year National Eye Institute grant renewal to make further refinements in high-resolution orbital MRI. Although far superior to conventional MRI, the approach still requires a longer scanning time than a computed assisted tomography (CAT) scan, and is unable to detect certain tissues that are either too small or lack sufficient contrast with adjacent tissues. “You can always improve

the pictures,” Dr. Demer says. “But every year we are getting better at this, and we will continue to refine it.”

### Sharing Expertise

Although the hardware needed for high-resolution orbital MRI is widely available, the intensive professional education and training required to successfully employ the technology has limited its use outside UCLA. Dr. Demer is working to change that. Clinical fellows have come from all over the United States and abroad to train with Dr. Demer and bring the new approach back to their institutions. Dr. Demer has taught at centers in the eastern United States, Australia and England, and offers courses at professional meetings. “Right now it’s a matter of passing on the expertise, as well as educating ophthalmologists to appreciate what kind of information they could be getting so that they order the tests and insist that they be done,” he says.

Dr. Demer routinely receives referrals from across the country and as far away as South Africa to evaluate complicated cases. He offers referring ophthalmologists the option of a consultation in which Dr. Demer conducts a clinical examination and runs the high-resolution orbital MRI scanner, then interprets the results. He recommends referrals and consultations for complex forms of strabismus, orbital tumors, and trauma or inflammatory conditions that can result from sinus-surgery complications. “For any condition in which the ophthalmologist needs to know what’s going on inside the eye socket,” Dr. Demer explains, “this technique can quite often provide decisive information without pain or risk to the patient.”

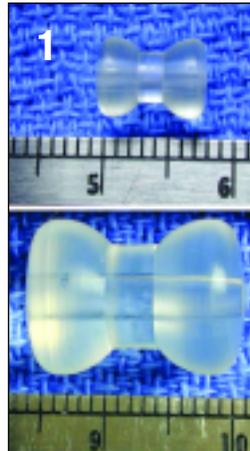
## A New Lacrimal Stent Promises Early Results

**L**acrimal surgery (dacryocystorhinostomy, DCR) has continued to evolve. The Orbital and Ophthalmic Plastic Surgery Service at the Jules Stein Eye Institute has favored the endonasal approach for more than 10 years. The endonasal approach avoids a cutaneous incision with the associated risks of scarring and muscle weakness, and also allows a more precise anatomically customized surgery.

The latest technology, including endoscopes, custom instrumentation for removal of bone and soft tissue, and specialized silicone stents, has improved the ability to remove the bone and soft tissue in order to create an opening between the lacrimal sac and the nose. Today, this can be accomplished under monitored local anesthesia with minimal blood loss and rapid recovery, and no cutaneous incision. However, the surgery still has a failure rate in the range of 5 percent to 10 percent, because the newly created opening can be closed by scar tissue.

Robert Alan Goldberg, M.D., chief of the Institute's Orbital and Ophthalmic Plastic Surgery Division, has developed a new type of lacrimal stent made of hydrogel — a specialized plastic that absorbs water. The stent is currently an experimental device, and surgeries are performed under the auspices of the institutional review board at UCLA.\*

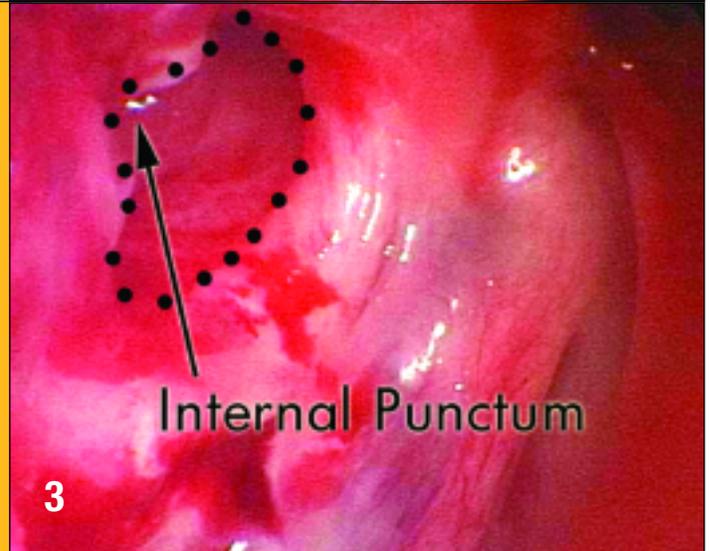
Dr. Goldberg explains, "When it comes out of the package, before it touches water, the stent is small enough to easily fit into the surgical opening. Once the stent is positioned in the newly created DCR ostium, it begins to absorb water and expand." Over the first 24 hours, the stent expands to seven times its orig-



**Figure 1.** Hydrogel lacrimal stent in dry form, out of the package (top), and following hydration for 48 hours (bottom)



**Figure 2.** Stent in position at the end of surgery



**Figure 3.** Healed DCR surgery immediately after stent removal, showing wide-open surgical ostium (dotted lines) with the internal punctum draining into the nose

inal size, and it also becomes much softer (Fig. 1). The enlarged, soft stent gently presses the mucosal edges together, acting like a surgical staple (Fig. 2). The soft, smooth, wet surface of the stent is very biocompatible and seems to promote rapid mucosal epithelialization of the newly created lacrimal opening.

After two to four weeks, the lacrimal mucosa has healed in the desired position. An ostium has been created from the lacrimal sac to the nose, providing a pathway for drainage of tears, and protecting against infection. At this point, the stent is removed by visualizing it in the nose and sliding it out, utilizing office endoscopy.

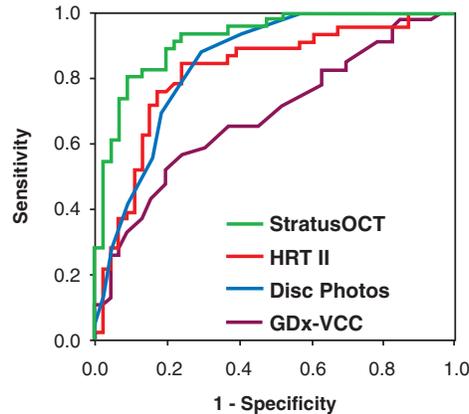
Dr. Goldberg finds the initial results very encouraging: large lacrimal ostia have been noted, with excellent healing of the mucosal edges, in all cases performed to date (Fig. 3). He notes, "If these excellent early results are verified experimentally with longer follow-up and with additional patients enrolled, then the hydrogel lacrimal stent may be a significant step forward in our goal of designing minimally invasive endonasal DCR surgical technique with a high success rate." ⊕■

\* Dr. Goldberg does not have any commercial interest in the products cited in this article.

# Optic Disc Imaging in Perimetrically Normal Eyes of Glaucoma Patients with Unilateral Field Loss

Ophthalmologists have become increasingly interested in diagnosing glaucoma before functional deficits manifest. Existing evidence that modern imaging techniques can detect glaucomatous damage before visual field loss occurs makes it relevant to compare them in pre-perimetric glaucoma. Perimetrically unaffected eyes of glaucoma patients have been found to be at high risk for developing visual field abnormalities. Recognition of morphological damage is important for an early diagnosis of the disease.

A clinical study performed at the Jules Stein Eye Institute by Federico Badala, M.D.; Kouros Nouri-Mahdavi, M.D.; Behrooz Koucheki, M.D.; Hector Fontana, M.D.; Anita Manassakorn, M.D., international fellows at the Institute; and Simon K. Law, M.D., Pharm.D., Assistant Professor of Ophthalmology; and Joseph Caprioli, M.D., Professor of Ophthalmology and Chief of the Glaucoma Division, compared the diagnostic precision of



optical coherence tomography (StratusOCT), confocal scanning laser ophthalmoscopy (HRT II), scanning laser polarimetry (GDx-VCC), and clinical evaluation of the optic disc in pre-perimetric glaucoma.

The research team studied data from 46 open-angle glaucoma patients with glaucomatous visual field loss with achromatic perimetry in one eye and a normal visual field in the fellow eye, and 46 normal controls. The perimetrically unaffected eyes of open-angle glaucoma patients with unilateral field loss well

represent preperimetric glaucoma. Open-angle glaucoma is predominantly a bilateral disease and the “pre-perimetric” eyes are at high risk for developing visual field defects. Furthermore, the rim area and the retinal nerve fiber layer (RNFL) have been found to be thinner in this subset of eyes than in a normal control group in previous studies.

Receiver operator characteristic (ROC) curves, sensitivities at fixed specificities and likelihood ratios were used to compare the performance of StratusOCT, HRT II, GDx-VCC, and clinical evaluation of optic disc stereophotographs to distinguish perimetrically unaffected eyes of glaucoma patients from normal eyes. The larger the area under the ROC curve, the better the diagnostic accuracy.

The present study suggests that StratusOCT can detect evidence of early glaucomatous damage sooner than other imaging techniques or clinical evaluation of the optic disc by experienced observers in eyes at high risk for developing visual field loss. This is the first report in which early structural glaucomatous damage is more frequently diagnosed with an imaging device than with expert clinical evaluation of optic disc stereophotographs. The inferior and superior average RNFL thicknesses were the parameters that best distinguished eyes with preperimetric glaucomatous damage from normal eyes. 

## JSEI Continuing Education Programs

May 19-20, 2006

Jules Stein Eye Institute

Clinical and Research Seminar and 40th Anniversary Celebration  
RBP Auditorium

37th Jules Stein Lecturer George B. Bartley, MD

3rd Bradley R. Straatsma Lecturer Uwe Pleyer, MD

3rd Thomas H. Pettit Lecturer Todd P. Margolis, MD, PhD

2006



Jules Stein Eye Institute UCLA

100 Stein Plaza

Box 957000

Los Angeles, CA 90095-7000

U.S.A.

First Class Mail

U.S. Postage

PAID

UCLA