

THREE CONCEPTS TO BUZZ ABOUT

A summary of selected presentations on innovative products and procedures shared during this year's meetings.

Introducing ... the Squeezer

By Karen Roman, Editor-in-Chief

At a session titled *RetinaTech: Where Surgery Meets Technology* during this year's Euretina meeting in Copenhagen, Denmark, Claus Eckardt, MD, took the podium to discuss a new device for the intraoperative injection of dyes and perfluorocarbon liquid (PFCL).

Dr. Eckardt began his talk by pointing out that the vast majority of surgical instruments are held using what he called the *pencil grip*, which in his opinion guarantees the best control of an instrument. He noted that even intraocular injections are often carried out using the pencil grip, which requires the surgeon to use his or her other hand to push down the plunger. Alternatively, he said, syringes can be held between the first two fingers to allow the thumb of the same hand to push down the plunger, although the length of the insulin syringe usually makes it difficult to stabilize the injecting hand against the patient's head.

Unfortunately, Dr. Eckardt continued, when staining agents are injected during vitreoretinal surgery, surgeons have to use this unsteady *syringe grip* because their other hand is normally busy with the light pipe, backflush needle, or another instrument. Furthermore, he said, the syringe grip can be risky when used in patients with small pupils because the grip makes it hard to guide the needle close to the retina.

THE DYE SQUEEZER

To address these and other issues, Dr. Eckardt developed a tool that he calls *the squeezer* to allow retina surgeons to perform injections with one hand using the preferred pencil grip. The squeezer consists of a silicone tube within a plastic frame. "Loading the squeezer with dye takes a few seconds, and it can be prepared by a nurse," he said. Once the device is loaded, injection is performed by simply squeezing the silicone tube between the thumb and forefinger. At this point in his talk, he showed a video demonstrating how the squeezer allows perfect control over the timing, speed, and amount of dye injected. "Because it is given in such a controlled fashion, you actually use much less dye," Dr. Eckardt noted. With the dye squeezer, surgeons can get close to the retina and suspected remnants of vitreous. The tool can be used with cannulas of all sizes: 23, 25, and 27 gauges.



THE PFCL SQUEEZER

According to Dr. Eckardt, another good indication for a squeezer is for the injection of PFCL. Because the volume of PFCL typically injected is much more than that of dyes, a squeezer with a longer tube had to be designed. Whereas the dye squeezer has a 1 cc capacity, the PFCL squeezer can hold up to 5 cc. Dr. Eckardt explained that the filling procedure is the same as that for the dye squeezer, and it can also be performed by a nurse. The surgeon receives the PFCL squeezer from the nurse just as he or she would most other vitreoretinal instruments. This is instead of holding the PFCL syringe with a pencil grip and potentially encountering difficulties inserting the cannula into the trocar or creating bubbles by not going close enough to the retina. Using the squeezer, he said, it is easy to guide the cannula into the trocar and to get close enough to the retina to inject a single bubble.

Each squeeze of the PFCL squeezer releases approximately 1 cc, Dr. Eckardt noted. In an emmetropic eye, for example,

one would need to squeeze three to four times to fill the eye to equator. He has compared the time needed to inject 4 cc using a typical syringe with that of using the squeezer, and he stated that the syringe was only a few seconds faster than the squeezer.

SAFE AND DISPOSABLE

Regarding whether the squeezer is safe, Dr. Eckardt said that it absolutely is—much safer than a syringe, in fact. When the squeezer is squeezed, the fluid can leave the tube only in the direction of the cannula. When pressure is released, the bottom of the tube is instantly refilled from above, so vitreous fluid can never enter the squeezer.

Both the dye squeezer and the PFCL squeezer are being produced as disposable devices by Vitreq.

Image-Assisted and Image-Guided Surgery



By Richard Watson, MD

During a session called *Surgery Outside the Box* at the fourth annual meeting of the Vit-Buckle Society in Miami Beach, Fla., Yannek Leiderman, MD, PhD, delivered a talk titled “Image-Assisted Vitreoretinal Surgery,” in which he discussed both image-assisted and image-guided surgery.

Dr. Leiderman said he believes that these technologies are the future of vitreoretinal surgery.

IMAGE-ASSISTED SURGERY

Image-assisted vitreoretinal surgery is the integration of ophthalmic imaging into the OR to facilitate surgical decision-making. Dr. Leiderman focused on intraoperative optical coherence tomography (iOCT) as an example, and he discussed ways in which iOCT can alter intraoperative decisions. Dr. Leiderman showed a video of a tractional retinal detachment (TRD) repair in which an extensive tractional membrane hampered the surgeon’s view. iOCT images, however, clearly showed the retina underneath the membrane, with the pegs of attachment and tissue separation planes easily discernible. Forces applied to the membrane during surgery were seen to tent the underlying retina.

Although similar videos have documented this complication, there is little in the way of published data. Dr. Leiderman explained that iOCT may one day allow quantitative feedback about how much stress is exerted on the retina during such maneuvers. He added that his lab is working to quantify this stress and to determine the limits and associated consequences for the retina. After desired stress limits are determined, real-time extrapolation of retinal stress from iOCT images could greatly

enhance surgical decision-making in the OR, he said. Dr. Leiderman stressed that prospective analyses with patient outcome data will be required before the clinical utility of iOCT is validated.

IMAGE-GUIDED SURGERY

Dr. Leiderman also discussed image-guided vitreoretinal surgery, which involves automated modulation of surgical instrumentation via an image-based feedback control system. This requires use of software that can automatically make changes to the operating instruments (eg, cutter speed or vacuum level) based on what the software detects in images from the operating microscope.

Continuing with the previous example of a TRD repair, Dr. Leiderman said that the development of image-guided surgery could lead to a system that automatically stops the cutter or turns off the vacuum when a preset retinal stress limit is reached. He cited as another example rhegmatogenous retinal detachment repair, during which cutting of detached bullous retina with the vitrector may occur. Dr. Leiderman explained that an image-guided system could automatically stop the vacuum if the retina quickly jumped too close to the cutter, and that this automated stop could occur faster than the limits of human reaction. Such a system would be analogous to collision-avoidance systems in automobiles, he said. A footpedal-controlled instrument (in this analogy, an automobile), paired with either radar or optical-based detection, could apply the brakes faster than humanly possible when software anticipates a collision.

Dr. Leiderman reported that he is working to develop such a system for vitreoretinal surgery; he called it collision avoidance for vitrectomy. Ideally, this system could prevent iatrogenic retinal breaks from vitrector use. Continuing with the automobile analogy, Dr. Leiderman jokingly suggested that this system might also include a “seat belt” that tightens before an impending mishap, pulling fellows away from the operating microscope.

Image-guided surgery may offer valuable assistance to even the most skilled and attentive surgeons. Dr. Leiderman provided the following comparison: Airline pilots rarely make errors, but automatic systems have a proven track record of decreasing these rare errors. In the OR, image-guided systems that integrate intraoperative imaging with instrumentation control may one day work well to allow skilled surgeons to further improve patient outcomes.

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Could Current Retina Instruments Be Improved Using 3-D Printers?

By Karen Roman, Editor-in-Chief

In another talk given during the *RetinaTech: Where Surgery Meets Technology* session at this year's Euretina meeting, David R. Chow, MD, described the potential role of 3-D printers in retina surgery.

"In the history of retina surgery, we have been using forceps with a standard design," commented Dr. Chow, noting that these forceps do not take into account variation in the size and shape of human hands or grips. To demonstrate his point, he presented a slide showing the hands of four well-known retina specialists. These included men and women and left-handed and right-handed doctors. All were different sizes.

Dr. Chow said that 3-D printing is expected to be an \$8.5 billion industry by 2020. "It's the definition of a disruptive technology because it allows greater customization in product offerings, so less inventory may be necessary," he said. Because replacement parts can be made locally, 3-D printing technology will enable small, innovative startup companies to gain prominence, he added. The medical world is just now starting to catch on to the phenomenon.

THE RETINA SURGERY CONNECTION

Dr. Chow acknowledged that the instruments used in today's vitreoretinal procedures are quite good, but he questioned whether they could be better. He explained that he had an idea for creating customized retinal forceps using 3-D printing, and that this concept is being developed in conjunction with Katalyst Surgical. He and his collaborators started with molds of different sizes and different materials until they found something that seemed to work. He then imprinted his grip in the material at the depth and impression he wanted, and these specifications were scanned using a 3-D scanner to create a software file. The next step was to superimpose his grip onto substrate forceps, and then his grip was printed onto the forceps using selective laser sintering.

To test the process, Dr. Chow said, he and Katalyst Surgical recruited prominent surgeons from around the world. Their grip impressions were taken, and the technology produced prototypes with the surgeons' personalized grips. Dr. Chow marveled at how the surgeons differed in their preferences for their customized grips.

One might wonder, once a customized grip is created, how one would rotate one's tips. Dr. Chow assured the audience that new prototypes will address this issue so that surgeons will be able to rotate the tips with their customized grip. "We are also collecting metrics," he said. "We now have about 80 surgeons' grips, and I'm going to be presenting that material to show you the difference in grips that we would have when given the choice." ■