

New microcatheter provides light at the end of the tunnel for glaucoma surgery

**Roibeard O'hEineachain
in Lisbon**

A NEW microcatheter may revolutionise the surgical treatment of glaucoma by enabling the sustained dilatation of the Schlemm's canal throughout its complete circumference, according to Robert Stegmann MD, Pretoria, South Africa, who will be describing his new technique at this year's Congress of the ESCRS.

"Instead of just inflating 120 degrees of the canal, which we were able to do with the Grieshaber cannula in the older viscocanalostomy technique, we can now use the new flexible microcatheter to inject viscoelastic in an extremely accurate amount very atraumatically throughout the entire 360 degrees of the canal," said Dr Stegmann in an interview with *EuroTimes*.

The new device may be used to insufflate the Schlemm's canal with viscoelastic as part of an enhanced viscocanalostomy technique and/or as a guide for placing a drawstring suture to stretch Schlemm's canal, he added.

The catheter may enable surgeons to achieve more predictable results than has been possible with standard viscocanalostomy, he noted. The new techniques under investigation appear to increase the flow of aqueous into Schlemm's canal and out through the collector channels. The suture technique may also greatly reduce the likelihood of closure of the exposed ends of the canal (the ostia) through scar formation, Dr Stegmann explained.

The new microcatheter is produced by iScience, a company based in California. It has a diameter of 200 microns and an atraumatic soft tip. A helium-neon light source shone through an optical fibre illuminates the catheter tip, which also contains a polyamide lumen for the injection of high viscosity sodium hyaluronate.

"The surgeon can see the pulsed red laser flash at the catheter's tip and will know where the catheter is at all times. This is important because you don't want to go laterally into the supra-choroidal space or medially into the anterior chamber

where you could damage the iris," Dr Stegmann noted.

In addition, a new high-resolution ultrasound system, also produced by iScience, provides accurate localisation of Schlemm's canal and can also provide confirmation of the success of the procedure.

Technique similar to conventional viscocanalostomy

In his current technique, Dr Stegmann commences as he would with a conventional viscocanalostomy procedure. He first dissects a parabolic flap in the sclera to a depth of 250 to 300 microns then dissects a further 300 to 400 microns down to a level that is just superficial to the choroid to create a scleral lake. He then dissects forward to reveal the canal of Schlemm and create a Descemet's window.

He then gently insufflates the surgically created ostia with a viscoelastic, which serves as a lubricant to allow the safe insertion of the microcatheter. As he passes the microcatheter through the canal of Schlemm he uses a micrometer syringe to

deliver 0.02 ml of viscoelastic per 1/8 turn on the micrometer screw.

Once he has passed the microcatheter 360 degrees through Schlemm's canal and it emerges at the operative site he attaches two 10/0 prolene sutures to the catheter which he then draws back through the canal. After withdrawing the catheter, he ties off the ends of the sutures with a special slipknot to create 20 grams of tension.

"The sutures act like an internal belt to pull the trabecular meshwork away from the outer wall and increase the diameter of the canal of Schlemm and prevent scarring by pulling the ostia and the rest of the canal wide open."

Fortuitous side effect suggests new therapeutic modality

Dr Stegmann noted that he first started using the new microcatheter as a means of enhancing the standard viscocanalostomy procedure. That is, he dilated Schlemm's canal with viscoelastic with the aim of keeping the canal distended after the viscoelastic was absorbed.

However, he added the suture to his technique when high-resolution ultrasound images showed a fortuitous and beneficial side effect in a few cases, which he saw could be affected in all his patients through a modification in his technique.

"In certain cases we saw traction on the trabecular meshwork in some areas because of iris structures adhering there and we also saw that the flow of aqueous had been increased in those particular areas. It seemed that pulling at the roots of the ciliary body opened up little pores in the trabecular meshwork to allow more aqueous to flow out," he explained.

"I thought we could produce the same effect to a greater degree by putting a suture 360 degrees around the canal of Schlemm. Then by applying some tension we could pull the trabecular meshwork away from the outer wall of the canal of



Robert Stegmann

Schlemm, where all the little collector channels are, and so increase aqueous outflow," he added.

Promising early results

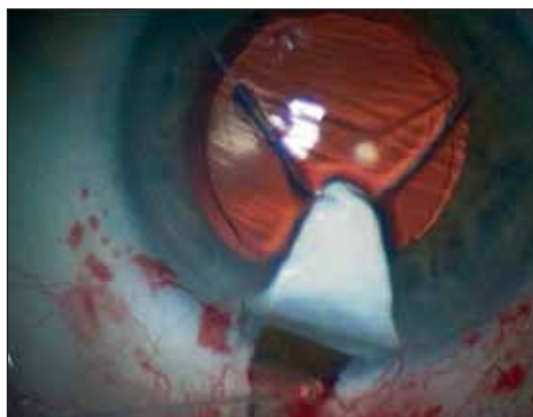
Dr Stegmann will be describing his preliminary results with the enhanced viscocanalostomy and circumferential suture techniques in about 100 patients, some with a year's follow-up, at the ESCRS congress.

He noted that his high success rate in his African glaucoma patients, among whom the mean preoperative IOP is 47-49 mmHg, suggests it should be even more effective in Caucasian glaucoma patients, among whom the mean IOP is 24-25 mmHg. Dr Stegmann said that he has had a success rate of about 79% in his African population, while his associates in America are reporting success rates of around 92% with the technique.

"In children we have been able to get down to 8.0 mmHg in a high percentage of cases which is about episcleral venous pressure in a child. In adults we're closer to 13-14 mmHg that pretty much parallels episcleral venous pressure in an adult. That means in Caucasians IOP would probably be between 10-12 mmHg and this seems to be the situation for those surgeons in Europe and America I've taught the procedure to."

He added that postoperative high-resolution ultrasound shows that the procedure expands the diameter of Schlemm's canal to 80 microns. In the normal eye its diameter is only 50 microns, he noted.

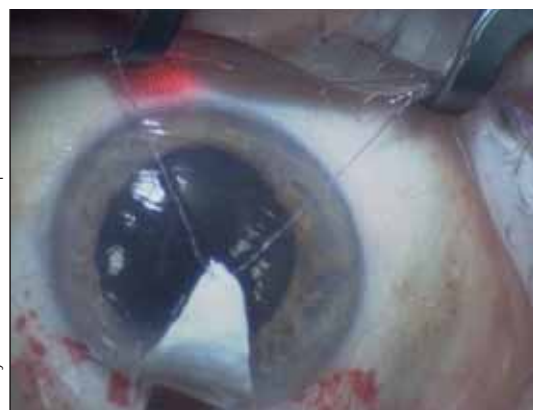
"I now favour the stitch over all other procedures I've done to date, because I've successfully done this in a very broad cross-section of



Catheter just prior to insertion. Note the illumination of the catheter tip from the helium-neon light source.



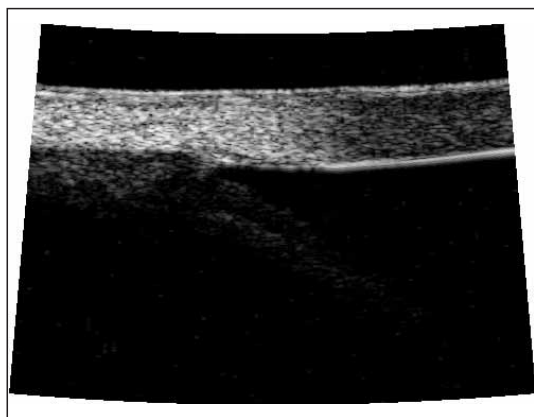
The catheter tip at 9 o'clock. The illuminated tip informs the surgeon of the catheter's location throughout the procedure.



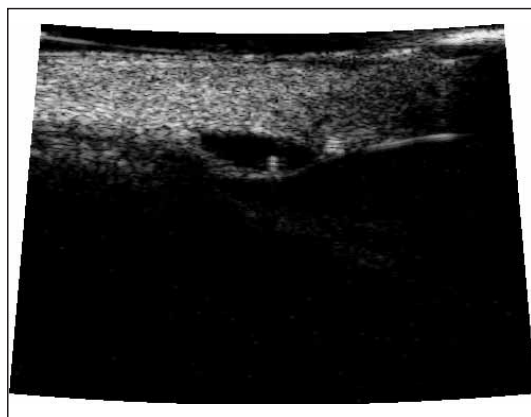
The catheter tip at 6 o'clock. The illuminated tip informs the surgeon of the catheter's location throughout the procedure.



The catheter being withdrawn after passing through the complete circumference of Schlemm's canal.



Per-operative high-resolution ultrasound 7 o'clock position just prior to procedure. Arrow shows undilated Schlemm's Canal



Same view immediately post-procedure showing dilated Schlemm's canal with 10/0 prolene tension suture in the canal.

glaucomas, including paediatric, congenital, open angle and closed angle glaucoma."

Future refinements of the technique

Dr Stegmann told *EuroTimes* that the precise amount of viscoelastic to be injected is one of the things he hopes to determine as he obtains further results. He also said the quantity would most likely depend on the degree of collapse of Schlemm's canal, which can vary enormously in different patient populations.

"I'm now close to 100 cases and I'm not sure how much viscoelastic needs to be injected. In my population the canal of Schlemm has collapsed entirely and it's more difficult to pass that cannula 360 degree but when I do it in Europe in Caucasians the passage of the microcatheter it is very easy."

It may also be that, outside of its use as a lubricant during the procedure, the viscoelastic may not be crucial for a successful outcome, he said. The wide dilatation of Schlemm's canal alone may be enough to prevent fibrotic closure of the ostia, he added.

Another aspect of the procedure Dr Stegmann would like to make more precise is the means of applying tension to the sutures that are drawn

through the canal of Schlemm. It is possible that some device other than a suture might be developed which would provide greater ease, accuracy and precision, he said.

A multicentre study with the new microcatheter and suture technique is now in the planning stages. It will involve 16 surgeons from the US, five from Germany and two from the UK.

Another step towards restoring normal aqueous outflow

Clive Peckar FRCS FRCOphth, Warrington, UK, will also be describing his experience with the new microcatheter technique and the new high-resolution ultrasound equipment at the ESCRS Congress.

"I think that the most exciting thing about this is that we now have a tool that is just the start of a whole new approach to dealing with Schlemm's canal in glaucoma. We don't have the final answer but this a whole new way of approaching the management of glaucoma," Dr Peckar told *EuroTimes* in an interview.

Dr Peckar, who will be a participant in the multicentre study, said that he first began performing viscocanalostomy procedures eight years ago because of its lower rate of side effects compared with trabeculectomy.

Viscocanalostomy also provides a more natural, physiologic restoration of aqueous outflow, he said.

He explained that trabeculectomy along with most of the non-penetrating techniques are fistularising procedures. That is, they create new and unnatural outlets for the aqueous, directing the fluid to the conjunctiva where a filtering bleb is formed.

In contrast, viscocanalostomy provides a channel for aqueous through a Descemet's window into a scleral lake, from which the fluid drains out through Schlemm's canal as it does in the normal healthy eye.

"We believe viscocanalostomy is the only true operation that re-establishes drainage into Schlemm's canal," he added.

He pointed out that while the main complication of viscocanalostomy is failure of the technique in a small proportion of cases to provide adequate drainage, fistularising procedures have similar failure rates in Caucasian patients and much higher failure rates in African patients.

In addition, fistularising techniques are prone to other potentially devastating complications, particularly when anti-metabolites like mitomycin are used to make the bleb more long lasting. Mitomycin can make the bleb very thin, which can lead to endophthalmitis, he said.

Dr Peckar noted that an American study involving 239 eyes of 198 patients who underwent trabeculectomy with mitomycin (DeBry et al, *Arch Ophth*, March 2002) indicated that the five-year probability of developing endophthalmitis in such patients is 7.5%, while that of bleb complications in general is 23%.

"For these reasons we want

an operation which is bleb-independent with drainage that is totally internal, which is how it's supposed to be. Up to now the problem has always been that we can only dilate a small part of the canal and we've always believed that if we can dilate more of the canal and really stretch the trabecular meshwork we would get much better drainage into it and better drainage of fluid out of it."

He added that the new high-resolution ultrasound system not only enables surgeons to see the effect of their surgery on ocular structures, it can also prove whether or not the technique is really producing the effect they are aiming for.

"We now have an imaging technique that tells us both what we're doing during surgery and the effect of this surgery afterwards. And if you can correlate this with IOP afterwards you have got a 100% correlation between changing the configuration of Schlemm's canal and the effect it has on the IOP."

Dr Stegmann will discuss his new surgical techniques at the Lisbon ESCRS Congress during the Main Symposium on Glaucoma and Cataract Surgery (Monday, September 12, 11:00-13:00, Auditorium I), at the Young Ophthalmologists Programme (Saturday, September 10, 9:00-16:00, Auditorium I), and in an Instructional Course presentation (Saturday, September 10, 12:00-15:00, Auditorium IV).

Dr Peckar will be describing his experience with the new microcatheter and new high resolution ultrasound equipment at an Instructional Course presentation (Saturday, September 10, 12:00-15:00, Auditorium IV) and in free paper sessions (Tuesday, September 13, 14:30-18:00, Auditorium VIII, and Wednesday, September 14, 8:00-10:30, Auditorium VIII).