

Micro-incision Vitrectomy Surgery: A paradigm shift in modern vitreoretinal surgery

Monte Carlo
7th EURETINA Congress, May 2007



Micro-incision Vitrectomy Surgery:

A paradigm shift in modern vitreoretinal surgery



**Stanley
Chang**



**Athanasios
Nicolakopoulos**



**Jean-François
Korobelnik**



**Marc
de Smet**



**Jose
Garcia-Arumi**



**Stanislao
Rizzo**



**Carl
Groenewald**

In recent years, new 23-gauge and 25-gauge micro-incision vitrectomy instrumentation has become available to vitreoretinal surgeons, allowing them to reduce the size of scleral incisions to a fraction of what was possible with standard vitrectomy and in this way provide more rapid postoperative rehabilitation and a reduced risk of complications. Continuing innovations in micro-incision instrumentation and technique are also raising the possibility of applying micro-incision approach to virtually all indications where standard vitrectomy is presently used. At a *EuroTimes* Satellite Education Symposium held during the 7th EURETINA Congress in Monte-Carlo and chaired by Stanley Chang MD, Columbia University, New York, NY, US, a panel of leading vitreoretinal surgeons discussed the current status and future prospects of micro-incision surgery.

“The main question we're going to answer in this symposium is, is smaller better? With gas prices going up we are going for more fuel efficient cars. Are we going to do the same with vitreoretinal surgery?” asked Dr Chang as he introduced the symposium.

Shifting to micro-incision vitrectomy surgery

Dr Chang commenced the session with a review of the history of vitreous surgery instrumentation. He noted that the

original vitrectomy instrument was the vitreous infusion suction cutter (VISC), invented by Robert Machemer MD the “father of modern vitreous surgery” in 1970. The multifunctional probe provided endoillumination and removal of vitreous through one instrument inserted through the pars plana, although it required a 3.3mm sclerotomy. In the mid-1970s Carl Wang MD developed the Ocutome® 800 a set of 20-gauge instruments that became the first complete divided system for posterior vitrectomy.

In the 1980s Visitec introduced the first 23-gauge cutter for vitreous biopsy and in 1993 Dr Chang presented his own 23-gauge system for vitrectomy. However, the 23-gauge system was not adopted by industry at that time and it was not until the introduction of transconjunctival sutureless entry that such micro-incisional techniques became popular, first through the work of Eugene De Juan MD in 2001 with his 25-gauge system and then Claus Eckhardt MD with his 23-gauge system in 2005.

Advantages of micro-incision vitrectomy include greater postoperative comfort and reduced ocular hyperaemia. In addition, most procedures do not require sutures, so there is faster postoperative recovery. As a result, patients require less topical medication after surgery and therefore have less risk of steroid-induced ocular hypertension.



“If you think about it, it's pretty analogous to the transition from ECCE to clear cornea phaco,” Dr Chang said.

The disadvantages of micro-incision vitrectomy in the early days were that the 25-gauge vitreous cutter was less efficient, that there was also only a limited array of instruments available, and those that were available were overly flexible and fragile. However, over the past five years refinements in the technology have addressed these problems, he noted.

For example, the introduction of a xenon light source to the Alcon vitrectomy system has greatly enhanced endoillumination during micro-incision procedures. The xenon light has a bulb-life of approximately 300 hours, and the 23-gauge and 25-gauge fibre optics and light pipes have been modified to enable viewing of almost the entire field of the posterior pole. There is also a Torpedo light for a chandelier effect.

In addition, the new disposable DSP ILM forceps of the Alcon system provide a precision grasping effect, further enhancing the safety and efficiency of micro-incision vitrectomy surgery.

“I found that the main indication for 25-gauge vitrectomy was for glaucoma filtering blebs, where I think 25-gauge is essential to allow for a sutureless incision that will preserve the bleb”

Stanley Chang MD

Some of the problems that remain with the micro-incision approach are the increased risk of hypotony and endophthalmitis. Micro-incision instrumentation also costs more, but since most procedures may be performed without sutures it can make up for the cost by reducing the duration of surgery.

Dr Chang noted that he first started using 25-gauge surgery primarily for straightforward cases such as macular pucker, macular hole, vitreous macular traction syndrome, mild vitreous opacities, and in some cases of retinal detachment. He also used it for vitreous biopsy in cases of suspected endophthalmitis, in combined cataract and vitrectomy procedures, and for vitrectomy in glaucomatous eyes with filtering blebs.

“I found that the main indication for 25-gauge vitrectomy was for glaucoma filtering blebs, where I think 25-gauge is



Zoran Tomic

23-gauge sufficient for most combined procedures

Zoran Tomic MD, University Hospital, Uppsala, Sweden, told the symposium that he currently performs 90 per cent of his combined phacoemulsification and vitrectomy with 23-gauge instrumentation. He noted that combined procedures account for about 80 per cent of his cases, because they are generally older patients who are likely to develop cataracts anyway.

When performing combined procedures, Dr Tomic first inserts the vitrectomy infusion cannula and then performs the phacoemulsification. He then proceeds with the vitrectomy and upon completing that he implants the IOL. He explained that he implants the IOL last to avoid difficulties with the lens edges and capsular opacities.

Dr Tomic noted that his results with 23-gauge have been so effective that 20-gauge procedures have become virtually obsolete at his centre.

“A fellow of mine has only ever done sutureless 23-gauge vitrectomy. He has never done 20-gauge. I think 23-gauge is a step forward like phaco was for cataract surgery, when surgeons started doing phaco they stopped doing extracapsular cataract extraction,” he added.

essential to allow for a sutureless incision that will preserve the bleb,” he added.

Dr Chang suggested that the best cases to transition to micro-incision technology are combined phaco/IOL and vitrectomy cases, first using the 25-gauge incisions and instruments for infusion and light and 20-gauge cutters and forceps for the vitrectomy itself. The surgeon can then gradually switch to a completely 25-gauge approach, or alternatively to a combination of 25-gauge and 23-gauge instruments.

“I've found that patient satisfaction is higher with sutureless micro-incision vitrectomy. In almost every case when you ask them about pain or postoperative discomfort



Micro-incision Vitrectomy Surgery:

A paradigm shift in modern vitreoretinal surgery

they have none. Case selection is important so that you can use the technology in a way that will optimise patient outcomes,” he said.

Maximising patient outcomes with 25-gauge micro-incision vitrectomy surgery

New enhancements of the Alcon micro-incision vitrectomy system, together with its capability for multi-gauge surgery, can enable surgeons to maximise outcome in a wide range of indications, said Athanasios Nikolakopoulos MD, Thessaloniki, Greece.

He pointed out, for example, that the superior illumination of the new 25-gauge Torpedo light has proved to be particularly advantageous in retinal detachment surgery. The light can be guided by an assistant, which leaves the surgeon's hands free to perform scleral de-pressure and clear the periphery in ways which were not possible before.

“This way you minimise surgical trauma and maximise results. Also you can have combined bimanual surgery which provides comfort for the patient and surgeon”

Athanasios Nikolakopoulos MD

“With this light you can remove all the vitreous from the tear and all the traction, because your assistant is guiding the light to where you are working. This way you can suck the fluid from beneath the retina and if you can do your own scleral depression you can easily do laser because you are pushing the periphery towards your laser,” Dr Nikolakopoulos explained.

The improved illumination also makes it possible to remove traction close to the retina and greatly facilitates the injection of silicone oil. Another advantage of the Alcon system is that it provides the capability to combine 20-, 23- and 25-gauge in the same procedure using just one vitrectomy machine.

“This is an advantage because sometimes you need to combine different gauge instrumentation in the same eye. This way you minimise surgical trauma and maximise results. Also you can have combined bimanual surgery which provides comfort for the patient and surgeon,” he added.

The 25-gauge high pressurised infusion probe of the Alcon system further facilitates combined-gauge surgery. It makes it possible to use the 25-gauge for infusion without deflating the eye, while using 19-gauge instruments for complex manoeuvres such as removing lens fragments from the vitreous, Dr Nikolakopoulos said.

The disposable 25-gauge forceps also add to the ease-of use of the system because the surgeon can use two at once for removing dropped lenses and foreign bodies without being too concerned about damaging them because they are fairly inexpensive. In addition, the injection of antibiotics into the eyes with endophthalmitis becomes much easier because both the vitrectomy and the injection can be performed on a 25-gauge basis through the same incision.

Dr Nikolakopoulos noted that he has performed 510 procedures with 25-gauge instrumentation, either exclusively or combined with different gauge instruments. Among those procedures were 114 retinal detachments, an indication for which he now performs vitrectomy surgery entirely with 25-gauge instruments.

He said that the indications for which he achieves the best results with 25-gauge procedures include combined diabetic traction and retina detachment, combined cataract and vitreoretinal surgery, aphakic retinal detachment and endophthalmitis. He noted that among all his cases he had only seen four cases of post-vitrectomy retinal detachments and only a fourth as many retinal tears as he had with larger gauge instruments.

“You can do combined surgeries if you have a machine that can use 20-gauge, 23- and 25-gauge instruments. So it's not really which one you want to chose, it's the ability to be able to go from one to another without compromising the results,” he added.

Clinical results of vitrectomy with 25-gauge surgery

A review of the literature concerning clinical results with 25-gauge minimally invasive vitrectomy shows that the rate of complications is becoming reduced as surgeons gain experience using the highly flexible instrumentation, said Jean-François Korobelnik MD, Groupe Hospitalier Pellegrin, Université Bordeaux, Bordeaux, France.

For example, there were eight cases (3.8 per cent) of postoperative choroidal detachment in one series of 140 eyes (Lakhanpal, *Ophthalmology*, May 2005), but the complication is now reported much more rarely. However, some complications such as retinal detachment and



hypotony persist, he said.

Retinal detachment occurred in one eye of a series of 45 eyes (Ibarra et al, *AJO* May 2005) that underwent 25-gauge vitrectomy. Low IOP occurred in nine per cent of one series 150 eyes (Shimada et al, *Jpn J Ophthalmol*, September, 2005) and hypotony in 17 per cent of another series of 71 eyes (Yanyali et al, *Eur J Ophthalmol*, Jan 2006). In the latter series there was also elevated IOP in seven per cent of cases.

In another recent series (Oshima et al, *Ann Acad Med Singapore*, Mar 2006) there was transient hypotony in 13 per cent of 150 eyes, despite precautionary suture placement in eight per cent of eyes.

On the other hand, most series show relatively few severe complications. Reports in the literature include one case of endophthalmitis in a series of 125 vitrectomies, and four eyes with leaking sclerotomies, more often in eyes that had been previously vitrectomised and in 10 per cent of cases which had silicone oil removal (Amato et al, *Ophthalmic Surg Lasers, Imaging* 2007).

Moreover, where topography has been used in pre- and postoperative assessment shows that (Yanyali et al, *AJO*, November 2005) in 32 eyes that underwent 25-gauge vitrectomy there were no topographic changes of the cornea at first day, first week, and first month after the operation,

Oblique sclerotomies

One recent change in technique that has already been shown to improve outcomes is the use of oblique sclerotomies. In a retrospective series which compared the outcome of 25-gauge transconjunctival vitrectomy in 337 eyes with oblique sclerotomies with that of 542 eyes with standard incisions, the leakage rate was only one per cent in the oblique incision group compared to nine per cent in the standard incision group.

“When you remove the cannula there will sometimes be some vitreous coming out of the eye, and if you don't look for it you will not see it. If you see it, remove it with a sponge and seal the incision with a small massage of the conjunctiva,” he added.

Dr Korobelnik noted that the rate of complications with 25-gauge surgery is no greater than with 20-gauge and that since the adoption of oblique angled sclerotomies the rate of severe hypotony and choroidal detachment has decreased. He predicted that the next steps for improving outcomes in 25-gauge vitrectomy surgery will be the development of techniques and instrumentation for combined sutureless phacoemulsification and vitrectomy procedures and the use of topical anaesthesia.

“Try micro-incision vitrectomy surgery, you will like it. And I think it's really ideal for macular surgery, although it has a learning curve related to the flexibility of 25-gauge instruments,” he added.

Micro-incision vitrectomy: A new option in 23-gauge

Returning to the podium, Dr Chang noted that new 23-gauge technology which has recently become available can provide a performance similar to and in some respects better than 20-gauge surgery, while maintaining the safety advantages of 25-gauge surgery.

The original 23-gauge system developed by Claus Eckhardt MD required two separate steps for incision creation and micro-cannula insertion. Alcon has recently developed a new 23-gauge vitrectomy system that provides simplified one-step incision and entry. It has a trocar-cannula design similar to the Alcon 25-gauge system, with a sharp and solid trocar blade.



The port of the current Alcon 23-g probe is 50% closer to the distal end than the 20-g port. The new "closer port to tip" will soon be available for the 25-g probe



The Alcon 23-g vitrectomy cutter



Micro-incision Vitrectomy Surgery:

A paradigm shift in modern vitreoretinal surgery



Detail of the new Alcon 23-g trocar blade with the premounted cannula

Alcon's new 23-gauge system also has machined disposable titanium cannulas which reduce friction against the metal instrument shafts. The smoother movement provides a higher level of control when working close to the retina surface, he noted. Moreover, the system's vitreous cutter includes many innovative features which enable more precise control and easier manipulation of the probe in vitrectomy procedures.

"What most impresses me about this system compared with other systems is the 23-gauge vitrectomy probe. It is an outstanding probe, with a cut rate of 2500 cuts per minute, compared to 1500 cuts per minute with the 25-gauge probe. The probe is stiffer and less flexible and the port is closer to the tip. I've found the cutting performance to be better than that of the 20-gauge," Dr Chang said.

He noted that the greater proximity of the probe's port to its tip makes it easier to shave tissue close to the surface of the retina and the smaller tip enables access into smaller spaces than is possible with 20-gauge. Furthermore, the high speed cutting reduces the traction on the retina as it is being cut and can reduce the need for scissors in the eye.

In addition, the 23-gauge light probe is designed to be stiffer and provide greater illumination. It couples a 20-gauge fibre with a 23-gauge light fibre in the handle. The 23-gauge endo-laser probe is also stiffer than the 25-gauge instrument.

Other additions include the disposable scissors and forceps. The ILM forceps are the same platform as the 25-gauge variety but with a stiffer shaft. There are also 23-gauge and 25-gauge needles to complement the system. The system also has quick-lock tips that fit on reusable handles such as the Sutherland or revolution handles.

Future developments will include multi-gauge viscous fluid injection, re-usable handheld instruments, a wide angle endoilluminator, 23-/20-gauge sclerotomy adapters, and a retinal pick. Also in the pipeline is an enhanced entry system with stainless steel thin-walled metal cannulas, a locking retention groove for infusion, and plugs that lock into the cannulas.

"With a new assortment of enhanced micro-instruments, I believe that I will be using this to replace my current 20-gauge technology. I still prefer the smaller gauge wherever possible because I believe smaller incisions are inherently safer," Dr Chang added.

23G MIVS: Surgical indications

In addition to affording an efficacy equivalent to 20-gauge surgery, 23-gauge surgery also shares most of 25-gauge surgery's safety advantages. The one-step 23-G system's improved illumination together with its highly efficient vitreous cutter further facilitates and enhances the safety of vitreoretinal surgery, said Marc de Smet, MDCM, PhD, FRCSC, Vitreoretinal surgery division ZNA Middelheim, Belgium.

The advantages of 25-gauge vitrectomy are that hypotony is relatively infrequent, which makes suturing unnecessary, it also has rapid healing, and patient satisfaction is very high. Its drawbacks are that it is more time-consuming and the flexibility of the instruments makes it a little more difficult to treat pathology sited far in the retinal periphery or vitreous cavity.

"I like the 25-gauge mainly for macular procedures, for vitreous biopsy, and I like it for situations that are not too complex, particularly because now we have access to 23-gauge systems"

Marc de Smet, MDCM, PhD, FRCSC

"I like the 25-gauge mainly for macular procedures, for vitreous biopsy, and I like it for situations that are not too complex, particularly because now we have access to 23-gauge systems, Prof de Smet said.

The advantages of the 23-gauge vitrectomy include its more rigid instrumentation and its flow dynamics, which are essentially the same as those of a 20-gauge system. In addition, most 23-gauge procedures do not require sutures and, in the case of the Alcon vitrectomy system, the 23-gauge vitreous cutter is similar in efficacy to the 20-gauge cutter and in many respects better.

The drawbacks with 23-gauge surgery include a slightly elevated risk of hypotony. However, Prof de Smet said that since he has started using the Alcon 23-gauge system his



rate of postoperative hypotony has decreased to less than 10 per cent, and in only one per cent of cases have further interventions such as gas injection been necessary.

“When you start using this technique you will probably encounter some cases of hypotony, at a slightly higher frequency than with 25-gauge, and there is a certain learning curve because wound design is more important here. You have to be very careful as to how you place your trocars, they have to be placed using a bevelled incision,” he said.

“When you start using this technique you will probably encounter some cases of hypotony, at a slightly higher frequency than with 25-gauge, and there is a certain learning curve because wound design is more important here”

Marc de Smet, MDCM, PhD, FRCSC

He also cautioned against being too attached to the concept of sutureless incisions, particularly in cases where silicone oil is used.

“Certainly if you have to do a lot of vitreous base dissection you will encounter circumstances where, despite a nice massage there will be a leak and the placement of sutures easily alleviates this problem. In fact if you are going to use silicone oil I would certainly suggest you suture the incision, because otherwise you may find that some of your patients accumulate subconjunctival silicone oil and your oil-fill will be less than adequate,” he said.

Prof de Smet noted that he currently recommends the 23-gauge approach for virtually all procedures. Surgery with 23-gauge instrumentation is very effective for removing lenticular fragments and performing fluid/gas and oil/fluid exchange.

He added that he has had experience with 2 step 23-gauge systems such as the DORC 23-gauge vitrectomy system. He said that while the DORC system is very good, the two-step manoeuvre can sometimes make insertion of the trocar difficult, particularly when holding the drawn-back conjunctiva with plates or callipers

In contrast, the insertion Alcon 23 G trocar/cannula is a one-step procedure, similar to that of Alcon's 25-gauge system. Its ports also stay in place better and its low profile

is helpful during procedures that require the surgeon to move around a lot in the eye and where it is necessary to indent.

He also concurred with Dr Chang in predicting that the indications for 23-gauge surgery will broaden to include probably all of the current indications for 20-gauge surgery as more 23-gauge instruments become available.

“23-gauge has replaced nearly all of my 20-gauge. The current limitation has to do with instrumentation. Some improvement in design is needed, but that's on its way. I still tend to use 25 G surgery for micro-procedures because I think a smaller hole is better, it heals faster,” he added.

23G MIVS: Clinical results

To provide additional perspective on the safety and efficacy of 23-gauge sutureless surgery, Jose Garcia-Arumi MD, Instituto de Microcirugía Ocular, Barcelona, Spain, presented the results of a prospective study in which he used the approach in 128 eyes of 112 patients.

The main indications for surgery in his study were idiopathic epiretinal membrane, idiopathic macular hole and central retinal vein occlusion. Other indications included diabetic macular edema with traction, diabetic vitreous haemorrhage, traumatic macular hole, paediatric vitreoretinal disease and retinal detachment. In 34 of the cases vitrectomy was combined with phacoemulsification.

In the first few cases in his series of patients, Dr Garcia-Arumi used the Eckhardt two-step system which involved first making a bevelled sclerotomy with a 45° angled microblade, and then making a 30° incision, followed by insertion of the microcannula. The first microcannula inserted would be for infusion.

In the later cases he used the Alcon one-step system, placing the trocar with the microcannula through a 30° incision. In cases which had undergone previous vitrectomies, he plugged the second sclerotomy prior to the third in order to maintain the IOP.

During surgery he increased the IOP to 35 mmHg with vacuum up to 400 mmHg. In most cases he used a single Xenon light source. If an accessory light was necessary he used a 25-gauge torpedo light. When removing the microcannulas, he maintained the IOP at 20 mmHg. After plugging the cannulas he removed them with an Adson forceps, and then applied pressure over the sclerotomy to close the wound and prevent conjunctival haemorrhage. In paediatric cases he sutured the sclerotomies.



Micro-incision Vitrectomy Surgery:

A paradigm shift in modern vitreoretinal surgery

Good outcomes, acceptable complications

After a mean follow-up of 10 months (range 8 to 13 months) vision had improved from a mean pre-operative value of 20/100 to 20/50 ($p < 0.001$), with significant improvements for each subgroup.

Dr Garcia-Arumi said that he found the main advantages of 23-gauge surgery to be the minimal trauma it causes to the conjunctiva and sclera, the reduced postoperative astigmatism and patient discomfort, and a shorter operating time.

“In our hands macular hole and epiretinal membranes takes only 20 to 30 minutes. Vitreous removal is also much quicker with 23-gauge and the stiffness of the probe means that there is a shorter learning curve than with 25-gauge”

Jose Garcia-Arumi MD

“In our hands macular hole and epiretinal membranes takes only 20 to 30 minutes. Vitreous removal is also much quicker with 23-gauge and the stiffness of the probe means that there is a shorter learning curve than with 25-gauge,” he added.

On the other hand, Dr Garcia-Arumi said that he found posterior vitreous dissection more difficult with the 23-gauge system than with 20-gauge and that he needed to convert to 20-gauge in one case of retinal detachment and one case of proliferative diabetic retinopathy. In addition, it was necessary to open the conjunctiva in two cases and in four cases microcannulas became disinserted, all with the two-step technique. Suturing of the sclerotomy was necessary in six cases.

Postoperative complications included three cases with IOP less than 5.0 mmHg (2.3 per cent), two of which required suture of sclerotomies, and five cases of IOP greater than 25 mmHg, all of which were controlled with topical timolol.

“Generally, postoperative IOP was quite stable and showed just a slight increase in the postoperative period,” he said.

Other complications included vitreous haemorrhage with spontaneous resolution in two cases, 11 and 13 days after surgery, and cataracts in 41 cases (32 per cent). There was also one case of retinal detachment which occurred two

weeks after removal of epiretinal membranes. The case was managed with 23-gauge surgery using an endolaser probe and injection of SF6.

“We have obtained functional results with 23-gauge similar to what we have with 20-gauge and with equivalent vitrectomy time to 20-gauge, using higher vacuum, double that which we use with 20-gauge. The probe dissector was much better for proliferative diabetic retinopathy cases. And with this port located near to the tip, it's very easy to perform vitreous dissection safely and without the need of scissors,” he said.

He added that he would continue to recommend 20-gauge vitrectomy surgery for retinal detachment cases with proliferative vitreoretinopathy and for severe tractional retinal detachments secondary to proliferative diabetic retinopathy. He also recommended 20-gauge surgery for cases that require extensive intraocular manoeuvres such as the removal of intraocular foreign bodies.

Addressing the art of wound construction

Stanislao Rizzo MD, Eye Surgery Clinic, Santa Chiara Hospital, Pisa, Italy told the symposium that continuing improvements in micro-incision vitrectomy technique and instrumentation have led to better healing wounds, providing greater safety and patient comfort.

He noted that surgeons originally performed 25-gauge sclerotomies with a straight incision perpendicular to the sclera, but they sometimes found that incisions were not completely water- or airtight. The leaking incisions caused hypotony and short tamponating time, and also increased the risk of endophthalmitis.

Surgeons later obtained better results by adapting Eckhardt's oblique incision technique for 23-gauge surgery to a 25-gauge approach. A comparison of UBM findings with the two techniques shows that with straight incisions there is diastasis of wound lips, but with oblique sclerotomies the wound lips are in good apposition.

More recently, Dr Rizzo has developed an oblique incision which is made parallel instead of perpendicular to the scleral fibres. It therefore avoids cutting the scleral fibres, which in turn allows the wound to close more efficiently.

“As the scleral fibres are arranged in concentric circles, the standard oblique incision cuts through them and the sealing of the wound will be delayed. With an incision performed parallel to the scleral fibres the incision is much narrower after the cannula removal because the fibres are split apart instead of cut,” he explained.



Dr Rizzo performs the incision by inserting the blade parallel to the scleral fibres 3.0mm from the limbus in the direction of the posterior pole. The blade extends 4.0mm into the vitreous chamber and is then straightened in order to exert the pressure necessary to insert the cannula, he explained.

“As the scleral fibres are arranged in concentric circles, the standard oblique incision cuts through them and the sealing of the wound will be delayed. With an incision performed parallel to the scleral fibres the incision is much narrower...”

Stanislao Rizzo MD

In a study in which he compared the wound healing of parallel and perpendicular oblique 25-gauge sclerotomies, the incisions were barely detectable by UBM examination at day one in nearly 90 per cent of those with parallel incisions. By comparison a minimal gap was evident in all of those with perpendicular incisions (Rizzo et al, Graefes Arch Clin Exp Ophthalmol, February, 2007).

“The perpendicular wound is clearly evident but the parallel sclerotomy is barely visible, and therefore sealed. We can conclude that an incision running in the direction of the scleral fibres is more resistant to stretching and tearing and spares the majority of the fibres,” he added.

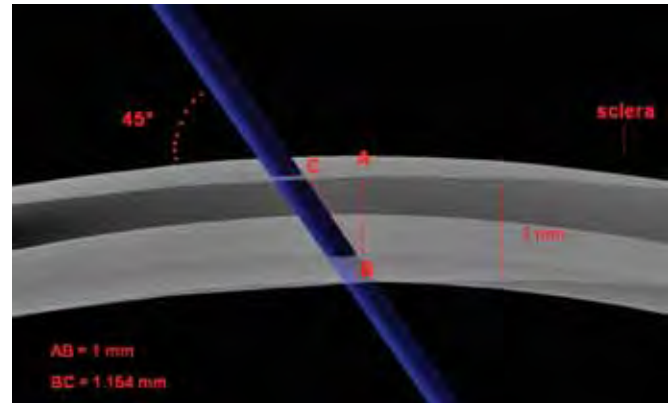
The Zorro lightning 23-gauge incision

Modifications in incisional technique and instrumentation can also produce a more optimal suture-free wound when using a 23-gauge approach, Dr Rizzo said.

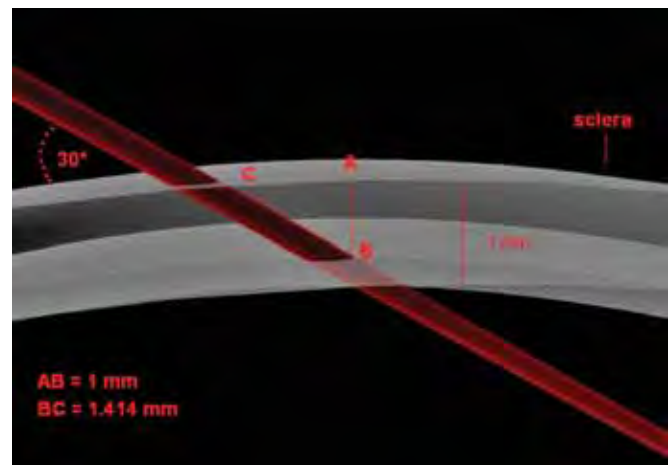
He noted that with the older two-step 23-gauge approach the difficulty in recognising the first stiletto cut can sometimes result in double-incisions, and the cannula can also be more difficult to insert. However, Alcon's new one-step trocar/cannula system has been designed like the Alcon 25-gauge system, so that the blade and the cannula can be inserted altogether in one manoeuvre.

Nonetheless, hypotony and leakage can still occur with the new 23-gauge one-step system. Dr Rizzo has therefore developed an incisional approach he calls the Zorro Lightning incision. It involves creating an oblique incision, reducing the angle from 45° to 30° and then leaving the instruments un-

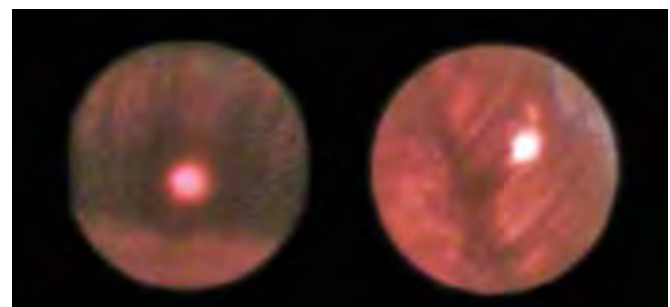
straightened (*see figures below*). He noted that his experimental findings with this kind of incision indicate that they are less prone to leakage than standard oblique incisions.



To achieve an airtight incision with 23-gauge one step system we have to modify the incision angle: with an Incision Angle of 45° we achieve a tunnel of 1.154mm



By reducing the incision angle by 15° the length of the tunnel increases by 30 per cent as the tunnel is 1.414mm, therefore it is more airtight



Endoscopic view: Oblique Incision has an area of approximately 1.130 mm², while Lightning Incision is much narrower as has an area of approximately 0.950 mm²



Micro-incision Vitrectomy Surgery:

A paradigm shift in modern vitreoretinal surgery

Drop-free trocars

Wound healing following vitrectomy can be further improved by the use of “drop-free” trocars which prevent the outflow of vitreous, Dr Rizzo said. Such a technology can also reduce the fluid consumption and outflow, reduce the turbulence in the vitreous chamber, and maintain a constant IOP. Other benefits could include the achievement of a complete vacuum, flow rate, and pressure control and the avoidance of vitreous and retina incarceration.

“As soon as the cannula is positioned the difference in pressure outside the eye causes a bit of vitreous to come out. If we position a diaphragm at half of the lumen the vitreous flow doesn't occur because the gel is stopped inside the cannula,” he explained.

Drop-free top-end valve trocars are available from DORC and Medlab. However, with these models a suction cup effect may occur, which can cause the incarceration of the sclerotomy after cannula withdrawal. Dr Rizzo has therefore designed a new bottom-end valve for the 23-G trocar cannula system. The slip-on valve locks the fluid and the vitreous within the vitreous chamber and not the cannula, reducing outflow by 90 per cent.

“Using modified incisions and bottom-end valve cannulas we can achieve a more stable vitreous chamber environment,” he added.

Comparing 23G to 25G vitrectomy surgery

In the final presentation of the symposium, Carl Groenewald MD, St Paul's Eye Unit, Liverpool, UK, provided a technical overview of the differences between Alcon's current 23G and 25G vitrectomy systems.

He noted that both systems have non-coring trocars with modified MVR blades. However, the maximum width of the wound created by the 25-gauge trocar is 0.61mm while that of the 23-gauge trocar is 0.74mm. The tip of the 23-gauge blade is also a little bit longer to enable oblique insertion.

The trocar blades of both 25-gauge and 23-gauge system are very sharp and penetrate the sclera with little force, Dr Groenewald noted. For this reason, he does not need to pre-place his 23-gauge ports and plug them prior to combined cataract and vitrectomy procedures and he generally does not have to suture the wound, he said.

As regards the two system's respective infusion cannulas, that of the 25-gauge system is a metallic tube with an inner diameter 0.42 mm, whereas that of the 23-gauge is a steel

tube with an inner diameter 0.56 mm, which contributes to the 23-gauge system's superior flow dynamics.

The Vitreous cutters of both systems have pneumatic-driven diaphragm drives which provide radial reciprocal guillotine cutting. Both the 23-gauge and 25-gauge systems have the same lightweight probe, weighing four grams without tubing and 39 grams with tubing. As a result the cutters produce little vibration. The 23-gauge cutter has the advantage of cutting at 100-2500 cpm, compared to a cutting speed of only 100-1500 cpm with the 25-gauge cutter, Dr Groenewald pointed out.

“When I use the 23-gauge or the 25-gauge I use the light pipe to indent. With the new stiff probe I can easily use the 25-gauge probe to turn the vitreous base using my light pipe only”

Carl Groenewald MD

The 23-gauge and 25-gauge systems also differ significantly regarding the stiffness of their probes, he noted. While a 23-gauge probe is only a fourth as stiff as a 20-gauge probe, it is over twice as stiff as a 25-gauge probe. However, Alcon has improved the stiffness of the 23-gauge and 25-gauge probe by 57 per cent by changing their internal diameters. It is therefore now possible to perform



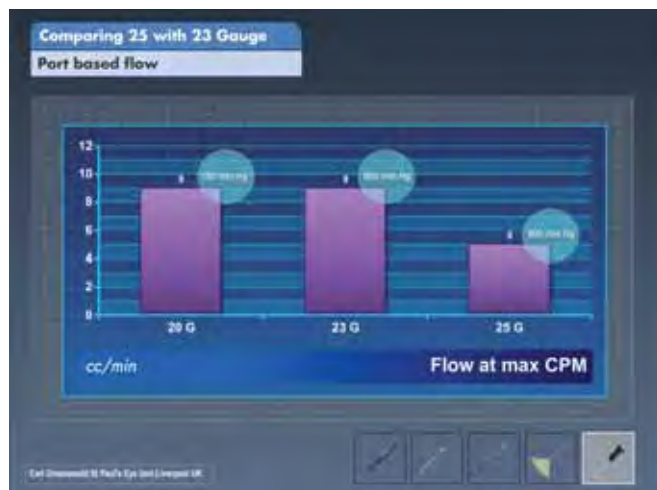
Differences in terms of stiffness among the Alcon 20-, 23- and 25-gauge vit-probes



deep indentation with a 25-gauge probe, which has always been possible with the 23-gauge probe.

“When I use the 23-gauge or the 25-gauge I use the light pipe to indent. With the new stiff probe I can easily use the 25-gauge probe to turn the vitreous base using my light pipe only,” he added.

One of the great advances of the 23-gauge instrumentation is the shorter distance from port to the tip of the probe, a feature that adds considerably to the precision with which surgeons can perform their vitrectomy surgery, he noted. In addition, the 23-gauge platform can achieve the same port based flow as the 20-gauge platform, just by increasing the vacuum. At maximum cut speed the port based flow is 18 cc/min for both the 20-gauge and 23-gauge systems, compared to only fivecc/min for the 25-gauge system.



Port-based flow: Comparison among the Alcon 20-, 23- and 25-gauge vit-probe

The introduction of the xenon light in the Alcon system has improved illumination several-fold for the 20-gauge, 23-gauge and 25-gauge systems, Dr Groenewald pointed out. While the older halogen light bulbs provided only 10, six and five lumens for the three gauges, respectively, the new xenon light provides 65, 37 and 30 lumens, respectively, he added.

Conclusion

In summarising the symposium's presentations, Dr Chang said that micro-incision vitrectomy surgery is most likely here to stay and will be increasingly incorporated into the surgical armamentarium of vitreoretinal specialists.

“I envision that 20-gauge surgery is gradually going to be replaced by 23-gauge and that 25-gauge will continue to be used for macular surgery and more simple cases. As the 25-gauge cutter and other instruments are further refined we will see it used in more and more cases and I look forward to these changes because smaller is better as long as we don't give up the functionality of the instruments we use,” he said.

Contacts

Stanley Chang

sc434@columbia.edu

Athanasios Nikolakopoulos

nikolako@vitreoretinal.gr

Jean-François Korobelnik

jean-francois.korobelnik@chu-bordeaux.fr

c.cicolini@makalu.fr

Jose Garcia-Arumi

17215jga@com.es

imo@imo.es

Marc de Smet

m.d.desmet@amc.uva.nl

Stanislao Rizzo

chiroftalmica@ao-pisa.toscana.it

stanos@tin.it

Carl Groenewald

carl.groenewald@virgin.net



Sponsored as an educational service by

Alcon[®]

GAU050