# Innovative Technologies in Pars Plana Vitrectomy

## Minimally Invasive Vitrectomy System

Simona-Delia Talu

Ophthalmology/Department of Surgical Sciences and Medical Imaging, Faculty of Medicine, "Iuliu Hatieganu" University of Medicine and Pharmacy 8, V. Babes str., 400012, Cluj-Napoca, Romania

talusimona@gmail.com

***Abstract*- Minimally Invasive Vitrectomy System is a concept that was developed during the past years with the goal to make pars plana vitrectomy a safer and a less traumatizing procedure. The development of small gauge vitrectomy systems has led to the decrease of tissue damage and the shortening of the operating time. Although MIVS is increasingly popular, its use varies substantially according to the personal experience of each vitreo-retinal surgeon. The transition from the 20 gauge to the small gauge vitrectomy (23G, 25G) is directly related to the global approach to vitrectomy regarding incision making, intraoperative fluidics, cutting technology, illumination and accessory instruments. The development of new instruments capable to overcome the size and lumen handicaps became necessary. The use of small gauge instruments has various consequences on the vitrectomy itself: the modification of fluidics during surgery, the decrease of illumination, the need of fewer accessory and multi-function instruments.**

**For the past 12 months, we used 25+ vitrectomy system sustained by the Constellation platform, in 296 cases that required vitreo-retinal surgery. The clinical conditions were the following ones: rhegmatogenous retinal detachments (120 cases - 40.54%), vitreous haemorrhages (100 cases - 33.78%), tractional retinal detachments (35 cases - 11.82%), epimacular membranes (15 cases - 5.06%), nucleus/lens luxated into the vitreous cavity (11 cases - 3.71%), intraocular foreign bodies (6 cases - 2.02%), macular holes (5 cases - 1.68%), endophthalmitis (4 cases - 1.35%).**

**In this paper, the personal experience of using MIVS in variate cases that required vitreo-retinal surgery is illustrated.**

***Keywords- Pars Plana Vitrectomy; Minimally Invasive Vitrectomy System (MIVS)***

## I. INTRODUCTION

One basic principle in surgery is to use less invasive approaches with the goal to obtain at least similar, if not better, clinical outcomes [1]. The fundamental objective of a vitrectomy is to relieve all the tractions between the vitreous and the retina with minimum disturbance to the underlying retina.

The "inventor" of the modern pars plana vitrectomy is Robert Machemer who was ophthalmologist and engineer. In 1972 he performed the first closed vitrectomy for a vitreous haemorrhage in a diabetic patient, using a 14 gauge instrument (2.1 mm) that combined all the necessary functions: irrigation, cutting, suction and endoillumination. This instrument was soon replaced by a 19 gauge vitrector.

The next step was performed by O'Malley and Heintz who separated the cutting and aspiration from the endoillumination and the infusion. This event marked the beginning of the bimanual surgery which is more precise and uses smaller caliber instruments.

At the beginning of the 1980s, the 20G vitrectomy system was commonly used. Since then, progress aimed to improve the efficacy and safety of pars plana vitrectomy by the development of endophotocoagulation systems, wide field visualization systems, pumps for intraocular pressure control, substances for retinal manipulation (perfluorocarbon liquids) and for the retinal tamponade (expansive gases, silicone oil) [1].

Starting 2004, small gauge vitrectomy (23G and 25G) became widely available. Although MIVS is increasingly popular, its use varies substantially according to the personal experience of each vitreo-retinal surgeon. Some surgeons use MIVS in all the vitrectomy cases, whereas others choose it only in selected circumstances and others don't use it at all [2, 3].

Minimally Invasive Vitrectomy System (MIVS) is a concept that was developed during the last years with the goal to make pars plana vitrectomy a safer and a less traumatizing procedure. The development of small gauge vitrectomy systems has led to the decrease of tissue damage and the shortening of the operating time. The elimination of the need for sutures reduced the suture-related inflammation and of the convalescence period [1, 4].

The transition from 20G to small gauge vitrectomy (23G, 25G) is directly related to the global approach to vitrectomy regarding incision making, intraoperative fluidics, cutting technology, illumination, and accessory instruments. The development of new instruments capable to overcome the size and lumen handicaps became necessary [1, 5, 6].

The presentation of the technical considerations on MIVS is followed by the illustration of the personal experience in using 25+ vitrectomy in various clinical conditions.



DOI: 10.5963/LSMR0303007

## II. TECHNICAL CONSIDERATIONS ON MIVS

The use of small gauge instruments has various effects on the vitrectomy technique: the modification of fluidics during surgery, the decrease of illumination, the need of fewer accessory instruments and the availability of fewer multi-function instruments [1, 2, 7].

### *A. Fluidics during Surgery*

The use of smaller cutter decreases the flow rate, making the surgeries longer. The flow rate through the cutter depends on the following factors: the diameter of the cutter's opening, the duty cycle, the vacuum, the viscosity of the material to be aspirated, the movement of the blade, the internal diameter of the cutter's lumen [1, 8].

The vitreous removal is adjusted by the transorifice pressure at the opening of the cutter. If the transorifice pressure is too low, the removal of the vitreous will be too long and if the transorifice pressure is too high, traction will be generated at the vitreo-retinal interface [1, 5, 6].

The rate of vitreous removal is influenced by the following factors: the infusion pressure, the aspiration pressure, the duty cycle of the vitrector and probe geometry [1, 2, 9].

The intraoperative fluidics in MIVS respects the Poisseuille's equation: $Q = \frac{\Delta P \pi R^4}{8 \mu L}$ in which Q=flow, $\Delta P$ = pressure gradient along the tube, R=radius of the tube, μ = viscosity of the fluid in the tube, L = length of the tube [10].

The efficiency of the system (rate of vitreous removal) is translated by the flow (Q). Therefore, in order to increase the efficiency of the MIVS, several options are available: to increase the infusion pressure; to work with higher aspiration pressure; to modify the duty cycle of the vitrector. The increase of the infusion pressure induces the decrease of the blood flow through the central retinal artery and the choriocapillaris. However, higher aspiration pressures are necessary with small gauge vitrectomy instruments in order to achieve reasonable rates of vitreous removal. For instance, in 20-gauge vitrectomy, the maximum suction level is set arround 150 mm Hg, in 23-gauge vitrectomy it is set arround 400 mm Hg and in 25-gauge vitrectomy, at 600 mm Hg. The maximum level of the aspiration pressure is set on the machine console and controlled by the foot pedal [12, 13]. The duty cycle of the vitrector represents the ratio between the length of time during which the vitrector is open and closed. The duty cycle of the vitrector can be modified such as the port is open for a longer time, which generates higher flow rates that compensate for the decreased flow associated with the small ports of the 23-gauge and 25-gauge vitreotomes [1, 2, 5, 6].

The main advantages of the MIVS reside in the features of the vitrectors with smaller port sides and are represented by: the ability to"nibble" the vitreous with very little traction and the possibility to work very close to the retina with no risk to incarcerate it in the vitreotome. On the other hand, the small port opening limits the ability of the vitreotome to aspirate and hold the vitreous. For instance, the inducing of posterior vitreous detachment with suction alone to lift the vitreous off the optic disc is difficult with small gauge vitrectomy probes. The probe geometry can increase the efficiency of the vitrectomy, but it is controlled by the manufacturer, not by the surgeon [1, 2, 8, 9].

### *B. Mechanical and Endoillumination Considerations*

The small gauge vitrectomy probes flex more when they are used to rotate the eye in order to remove the peripheral vitreous. This problem is exacerbated by the oblique scleral incisions that are created with the goal to obtain water-tight closure of the sclerotomies. When removing the central vitreous or dissecting the epiretinal membranes in the posterior pole, the instruments must have a perpendicular orientation on the eye wall. This requires the torsion of the probes, which is limited by their flexibility. Therefore, manufacturers are trying to redesign the 25 vitrectomy instruments by improving their stiffness [1, 2, 5, 6].

Another inconvenience of small gauge vitrectomy is the decrease of illumination during surgery. To overcome this drawback, high intensity xenon and metal halide light sources that deliver brighter illumination were developed [1, 2].

The cannula sleeve imposed to redesign the accessory instruments: scissors, forceps, picks. They must have shorter and obliquely angulated tips which make them less efficient in dissecting and cutting epiretinal membranes. This limitation is compensated by the technical abilities of the vitreotomes that can replace the accessory instruments in most membrane dissections [1, 2].

The small gauge also limits the use of multifunction instruments, such as aspirating laser probes, forceps/scissors with endoillumination [2].

### *C. Relationship between Cutting Speed-Vacuum-Flow Rate*

According to Poisseuille's equation, the pressure gradient across the cutter and tubing ( $\Delta P$ ) is proportional to the flow (Q). Higher vacuums generate greater flows. High cutting speeds are associated with lower flow rates. Decreased flow rates



DOI: 10.5963/LSMR0303007

lower the intraocular turbulence and decrease the movement of the mobile retina. The flow rate and the cutting frequency determine the vitreo-retinal traction. The fastest cutting rate is best for all tasks in all cases, as it maximizes safety of all gauges vitreous cutters [1, 2].

The Ultravit High Speed Vitrectomy Probe has dual pneumatic drives. With the help of pulsed air, the surgeon is able to regulate the bias of the duty cycle independently of the cut rate. One of three modes can be selected: core mode, shave mode and 50/50. The open bias duty cycle is highly efficient at 5000 cpm. The port-biased closed duty cycle with lower cut rate will induce lower flow rate. As the cut rate increases, the flow increases. For core vitrectomy, open bias cutter at 5000 cpm is used. When working in the proximity of the detached retina, the surgeon selects the shave mode, with a closed duty cycle [1].

As consequence, the advantages of the MIVS are: the limitation of the port based flow rate, the pulse flow, the reduction of the cutter induced motion of the detached retina.

### *D. Three Dimensional Technology (3D)*

Three dimensional technology is offered by the new generation MIVS with the aim to make vitrectomy a safer and a more efficient procedure. The term “3D” comes from: “dual, dynamic, drive”. This allows the simultaneous linear control of vacuum and cut in order to obtain the flow rate [1]. Dual refers to the simultaneous control of the vacuum and cut rate. Dynamic means that the flow rate changes as the foot pedal is depressed. Drive signifies that the flow parameters are visualized via the foot pedal. The concept of dual linear control signifies that at any point in time the surgeon has two different preprogrammed settings for the vacuum and the cut rate. As the surgeon depresses the foot pedal, he changes the settings on the machine from the preset starting point for vacuum and cut to the preset end point of these two parameters. The safety of the vitrectomy is highest when the highest cut rate is used (5000 cpm) [1].

Although the 3D technology was available with the 20G vitrectomy, its advantages are best validated with small gauge vitrectomy. The cutters are designed such as the opening is very close to the tip, which allows the surgeon to work very close to the retina with no danger to injure it. The fact that the flow resistance is port based makes the surgery very safe in a wide range of cases [1].

The cutters are pneumatically and not electrically driven. As consequence, they have variable duty cycles that allow greater safety without compromising speed. For example, even if the cut rate is 2500 cpm, the variable duty cycle is able to keep the port opening time a sufficient duration so that the speed of vitrectomy does not reduce proportionally [1, 2, 8, 9].

### *E. MIVS: 23G, 25G*

The advantages of the MIVS are: less damage to the ocular tissues, less circulating fluid in the globe, less inflammation and discomfort for the patient, shorter operative time and no need for sutures. A new design for the cutter became necessary. In order to get safely close to the retina, the port opening was localized very close to the tip. Due to the port – based flow resistance, vitrectomy is very safe. The system is pneumatically driven. A new platform, specially designed for MIVS, was imagined [1, 2].

### *F. Instrumentation*

The use of MIVS requires the adaptation of instrumentation. This concerns the trocar insertion system, the valved cannulae and the infusion cannula [1, 11].

#### *1) Trocar Insertion System:*

The blade is bevelled and compact. The trocar has a bevelled tip, it is shaped like a funnel and the newest designs are valved [1, 2].

Fig. 1 illustrates the trocar insertion system for 25 gauge vitrectomy.

Fig. 1 Trocar insertion system for 25G vitrectomy



DOI: 10.5963/LSMR0303007

2) *Valved Cannulae:*

One of the most recent developments is the introduction of the valved cannulae. They are easily removed from the trocar, with no need of additional forceps. They need no plugs during their removal. They have a vented extension that can be inserted to allow air exit during air/silicone oil exchange. By the use of the valved cannulae, the stability of the eye increases, there is less risk of wound leakage, turbulence and of retina/vitreous incarceration at the sclerotomy sites. Furthermore, the work under air is much easier, as the valved cannulae provide a true intraocular pressure control, which was impossible with 20G vitrectomy during the exchange of instruments [1, 2].

In Fig. 2 a valved cannula is shown.

Fig. 2 Valved cannula

*3) Infusion Cannula:*

The infusion cannula possesses a threaded portion set in the trocar to avoid the cannula coming out during surgery [2].

In Fig. 3, the setting of 3 ports 25 gauge vitrectomy is presented: one for the infusion line and the other two for the active instruments.

Fig. 3 Setting of 3-ports 25 gauge vitrectomy

*4) 25G Forceps and Scissors:*

The 25G forceps and scissors are weaker and by consequence, more difficult to manipulate. Because of their greater malleability, it is more difficult to position the eye during surgery [1, 2, 5, 6].

*G. Hypotony*

The lack of placing sutures at the end of surgery raises the problem of hypotony in the postoperative period. Preventing hypotony is crucial for the safety of MIVS, as the low intraocular pressure can draw bacteria from the ocular surface inside the eye, through a siphoning effect. The procedures to prevent hypotony are: total fluid-air exchange, closure of the infusion line / decrease of the infusion pressure while the removal of the cannulae. If there is any suspicion of leakage at the level of the sclerotomy, the best way to handle it is to place a suture [2].

*H. Future Research*

Future research in vitreo-retinal surgery technologies involves the development of even smaller gauge vitrectomy systems (27G) and higher cutting rates (7500 cpm) [1, 2, 12].



DOI: 10.5963/LSMR0303007

## III. PERSONAL EXPERIENCE WITH 25+ VITRECTOMY SYSTEM

### *A. Overview*

For the past 12 months, we used 25+ vitrectomy system sustained by the Constellation platform, in all the cases that required vitreo-retinal surgery (296 cases): rhegmatogenous retinal detachments (120 cases - 40.54%), vitreous haemorrhages (100 cases - 33.78%), tractional retinal detachments (35 cases - 11.82%), epimacular membranes (15 cases - 5.06%), nucleus/lens luxated into the vitreous cavity (11 cases - 3.71%), intraocular foreign bodies (6 cases - 2.02%), macular holes (5 cases - 1.68%), endophthalmitis (4 cases - 1.35%).

Table 1 summarizes these cases.

TABLE I CLINICAL CONDITIONS IN WHICH 25+ VITRECTOMY SYSTEM WAS USED

| Clinical condition | Number of cases | % |
|---|---|---|
| Rhegmatogenous retinal detachment | 120 | 40.54 |
| Vitreous haemorrhage | 100 | 33.78 |
| Tractional retinal detachment | 35 | 11.82 |
| Epimacular membranes | 15 | 5.06 |
| Nucleus/lens luxated into the vitreous cavity | 11 | 3.71 |
| Intraocular foreign bodies | 6 | 2.02 |
| Macular holes | 5 | 1.68 |
| Endophthalmitis | 4 | 1.35 |
| **Total** | **296** | **100** |

All the above mentioned situations are severe, as they have the potential to lead to visual loss if not treated adequately. Some of these conditions are acute and represent immediate indications for surgery: endophthalmitis, intraocular foreign bodies. In others, even if acute by nature, pars plana vitrectomy can be delayed for a few days: rhegmatogenous retinal detachments, vitreous haemorrhages, tractional retinal detachments threatening the fovea, nucleus/lens luxated into the vitreous cavity. Finally, there are chronic conditions in which vitreous surgery can be scheduled: macular holes, epimacular membranes, tractional retinal detachments away from the fovea.

### *B. 25+Vitrectomy for Rhegmatogenous Retinal Detachment*

In reghmatogenous retinal detachments (RRD), pars plana vitrectomy should be performed as soon as possible, especially in the macula off cases. The most frequent indication of pars plana vitrectomy on our series was represented by the RRD: 120 cases (40.54%). The advantages of small gauge vitrectomy are best validated in this condition.

One of the major goals of the vitrectomy for RRD is to be as complete as possible. Reaching this objective is difficult with 20G vitrectomy system, because getting very close to the retina with a 20G cutter is associated with the risk of producing iatrogenic retinal tears. The higher safety of 25+ vitrectomy allows working in the proximity of a mobile, detached retina, with minimal risk of retinal injury.

The vitreous “shaving” can be more complete, the risk of creating iatrogenic retinal breaks is minimal.

Another factor conditioning the postoperative reapplication of the retina is the relief of any traction around the retinal breaks, which requires working very close to the retina [13, 14, 15, 16, 17].

Figures 4 - 7 illustrate the major steps of a vitrectomy performed with 25+ gauge system in an eye with RRD.

In Fig. 4 the removal of the central vitreous is presented.

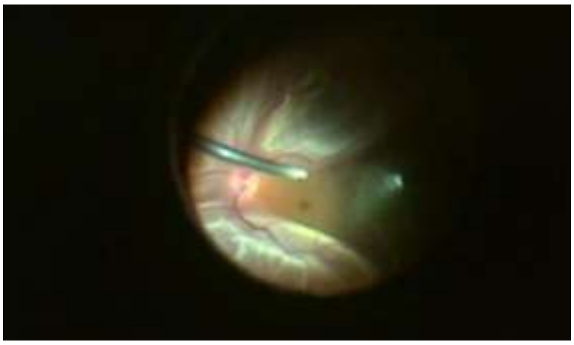

Fig. 4 Removal of the central vitreous with 25+ vitrectomy system in a case of RRD

Fig. 5 shows how the high safety profile of the 25+ cutter allows working very close to the mobile, detached retina and to remove all the vitreous from its surface. During this step, low vacuum and high cut rates are used in order to minimize the risk



DOI: 10.5963/LSMR0303007

of creating iatrogenic retinal breaks.

Fig. 5 25+ vitrectomy in the proximity of the mobile, detached retina

In an eye with RRD, the complete removal of the vitreous up to its base (periphery) is crucial for the reattachment of the retina. Fig. 6 illustrates the process of “shaving” the vitreous base with 25+ vitrectomy.

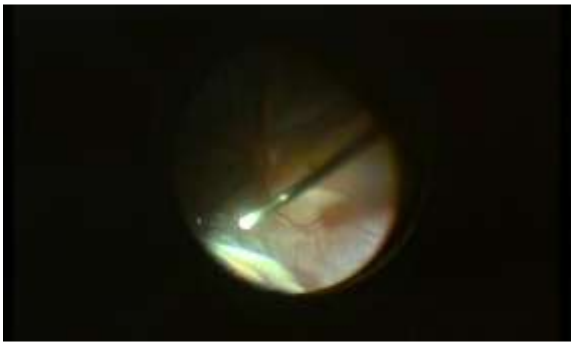

Fig. 6 “Shaving” of the vitreous base in a case of RRD

Eliminating any traction around the retinal break is very important for retinal reattachment. The safety offered by the 25+ vitrectomy system allows the achievement of this goal, as shown in Fig. 7.

Fig. 7 Removal of any vitreo-retinal adherences around the retinal break with 25+ vitrectomy system

The reattachment of the retina during surgery can be obtained by draining the subretinal fluid through the break and simultaneously injecting air. This step is shown in Fig. 8.

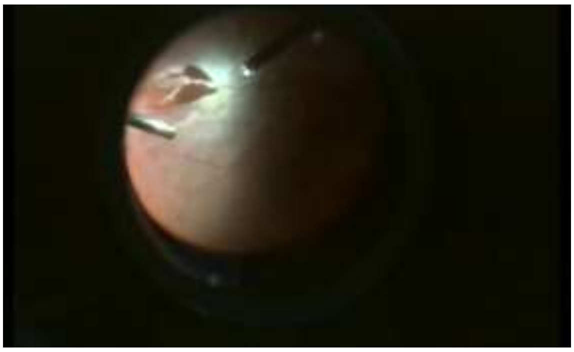

Fig. 8 Drainage of the subretinal fluid through the retinal break



DOI: 10.5963/LSMR0303007

*C. 25+Vitrectomy For Vitreous Haemorrhage*

The presence of blood inside the vitreous cavity can have various causes: complication of a retinal disease (neovascular proliferation, retinal break, age related macular degeneration, vascular abnormalities), trauma. The degree of emergency of pars plana vitrectomy in a vitreous haemorrhage is dictated by its cause: immediate if retinal break/detachment is present, delayed in the other conditions. Vitreous haemorrhage was among the commonest indications for vitrectomy on our series, representing 33.78% of all cases. The primary goal of vitrectomy is optical, to clear the vitreous and restore the patient’s vision. In the same extent, vitrectomy allows identifying and treating the underlying retinal condition that generated the vitreous haemorrhage, thus preventing its recurrence. In most of our cases, the cause of the vitreous haemorrhage was the diabetic retinopathy: 78 cases (78%). In 18 situations (18%), after cleaning the vitreous, branch retinal vein occlusion was identified and in the remaining 4 cases (4%), neovascular age-related macular degeneration was diagnosed. In the diabetic retinopathy and branch retinal vein occlusion cases, the vitrectomy was followed by the endolaser photocoagulation of the retina, in order to prevent any haemorrhagic recurrence.

*D. D. 25+ Vitrectomy for Tractional Retinal Detachment*

The majority of the tractional retinal detachments (TRD) on our series were subsequent to proliferative diabetic retinopathy: 30 out of the 35 cases (85.71%). The remaining 5 cases (14.28%) followed the retinal fibro-vascular proliferation complicating the branch retinal vein occlusions. No matter the cause, the retinal traction develops chronically, leading to the detachment of the retina.In all the 35 cases, there was no need for accessory instruments (forceps, scissors), as the dissection of the fibro-vascular tissue was achieved with the vitrector alone. In the 20-gauge vitrectomy, the dissections of these membranes were impossible without accessory instruments (forceps and scissors) [5, 6]. This involves a more aggressive approach of the retina and the frequent exchange of instruments during surgery. In contrast to the 20-gauge vitrector, the opening of the 25+ cutter is located very close to the tip, making it possible to cut directly the tissue from the surface of the retina. The high cutting rates (5000 cpm) permit to work very close to the retina with no risk to injure it [18]. With the 20-gauge cutter it is not possible to remove directly the membranes from the surface of the retina, because the work in the proximity of it would be too dangerous [19]. However, during the membrane dissections, retinal breaks were created in 5 cases (14.28%): 3 of them were produced indirectly, by the traction of the retina in the attempt to lift the membrane and 2 of them were generated by the direct cut of the retina with the vitrector. There was no anatomical and functional consequence of the retinal breaks. In all of the 35 cases, after the membrane dissection, the retinal photocoagulation was completed and the eye was left with silicone oil for 2 – 3 months. The silicone oil has several advantages: it allows the visualization and surveillance of the retina from the first day after surgery and it decreases the risk of postoperative haemorrhages and infections.

*E. 25+ Vitrectomy for Epimacular Membranes*

The membranes develop progressively on the surface of the macular region. Macular surgery is an indication for MIVS for most vitreo-retinal surgeons, as it involves minimal gestures. The challenge comes from the 25 gauge forceps that are more flexible than the 20G ones and require a learning curve period [19, 20]. Fig. 9 presents the removal of an epiretinal membrane from the surface of the macula.

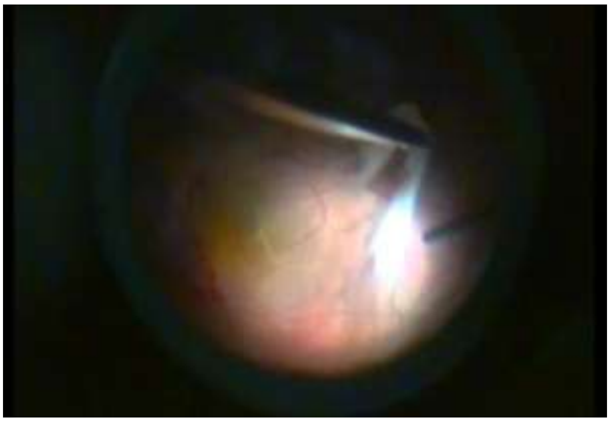

Fig. 9 Removal of an epiretinal membrane with the forceps

*F. 25+ Vitrectomy for Nucleus/Lens Luxated into the Vitreous*

The lens can get into the vitreous cavity either after a trauma, or as a complication of cataract surgery. Its removal can be immediate (if the cataract surgeon has the necessary equipment and skills to approach the vitreous cavity) or delayed for a few days. Some surgeons suggest that waiting for a few days hydrates the lens, making its removal easier. If the nucleus/lens accidentally dislocated in the vitreous cavity is transparent and soft (this usually happens rarely, in young patients), it can be removed with the 25+ vitrector. However, in most instances, the hardness of the dislocated lens material requires a hybrid approach. This means that the surgery is started with the 25G system and after completing the vitrectomy, one sclerotomy is



DOI: 10.5963/LSMR0303007

enlarged to 20G in order to give access to the fragmatome that uses ultrasound energy to remove the lens [21]. At present, there is no 25 G fragmatome available. Of the 11 nucleus/lenses luxated in the vitreous cavity, 9 had to be removed with the fragmatome, whereas in 2 cases the young age of the patient and the softness of the lens allowed the extraction with the help of the 25G vitreotome alone, as shown in Fig. 10. In this circumstance, in order to improve the efficiency of the surgery, high vacuum and low cut rate were used, but only when at the tip of the vitrector there is a lens fragment. When working in the vitreous and in the proximity of the retina, the vacuum is decreased and the cut rate is increased from the foot pedal.

Fig. 10 Removal of a lens fragment from the vitreous cavity with 25+ vitrectomy system

### *G. 25+ Vitrectomy for Intraocular Foreign Bodies*

The presencce of a foreign body inside the eye is an emergency in which the pars plana vitrectomy is the indication of choice. All the 6 intraocular foreign bodies (IOFB) in our series were removed from the vitreous cavity with a hybrid approach. After completing the vitrectomy with the 25+ system, one sclerotomy was enlarged to 20G to allow the access of the intraocular magnet and the extraction of the IOFB.

Fig. 11 presents this hybrid approach in which the sclerotomy in the supero-temporal quadrant was enlarged to give access for the intraocular magnet.

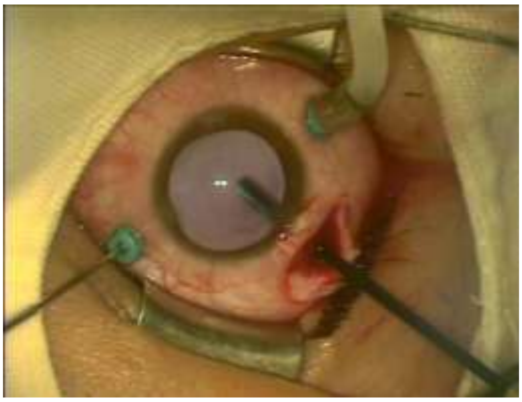

Fig. 11 Hybrid approach to remove an IOFB: introduction of the intraocular magnet through the supero-temporal sclerotomy

Fig. 12 illustrates the intraocular approach of the IOFB with the magnet, after the dissection of the IOFB from any adherences with the vitreous and the retina. In the background, the retinal impact site of the IOFB is seen. Laser photocoagulation of the retina was performed around it to prevent secondary retinal detachment.

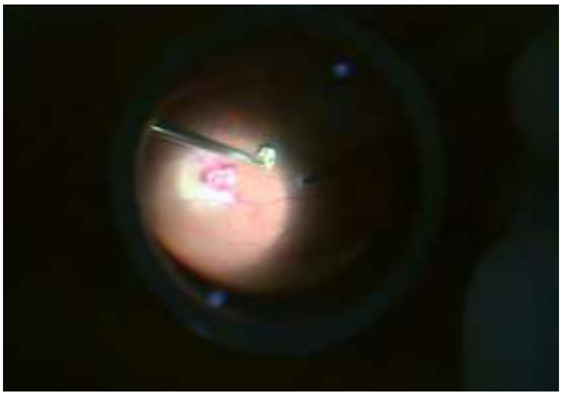

Fig. 12 Approach of the IOFB with the intraocular magnet



DOI: 10.5963/LSMR0303007

The IOFB is extracted from the eye through the supero-temporal sclerotomy, as shown in Fig. 13.

Fig. 13 Extraction from the eye of the IOFB through the supero-temporal sclerotomy

### *H. 25+ Vitrectomy for Macular Holes*

We used MIVS to treat 5 cases with stage IV macular holes. The goal of surgery is to remove the posterior hyaloid and perform the peeling of the internal limiting membrane. This is possible only with a forceps which is specially designed to achieve this goal [20]. We had no incident related to the internal limiting membrane peeling. In all the 5 cases the optical coherence tomography showed the closure of the hole and the improvement of symptoms: metamorphopsia, visual acuity.

### *I. 25+ Vitrectomy for Endophthalmitis*

Endophthalmitis (the presence of pus inside the eye) is an emergency condition that benefited the most from the advent of vitreo-retinal surgery techniques. Of the 4 cases in our series, in 3 situations, magnetic IOFBs were associated and in one patient the endophthalmitis was secondary to a penetrating injury without IOFB. Pars plana vitrectomy was performed in emergency with the 25+ system. In all situations, the technical difficulties were generated by the visualization problems: corneal edema, cataract, vitreous opacities and blood that can be misinterpreted as detached retina. Vitrectomy for endophthalmitis is a challenging indication because the media are hazy and the necrotic, detached retina can be confused with the layers of vitreous having blood streaks within [22]. All these oblige the surgeon to a slow and cautious approach. We overcame the above mentioned difficulties by the following manoeuvres: we scraped the corneal epithelium, cleaned the anterior chamber, enlarged the pupil and removed the lens if opacified. Vitrectomy was very careful: we progressed from the anterior to the posterior part of the vitreous cavity, going deep before going wide. In each case, at the end of vitrectomy, vancomycin and dexamethasone were injected in the vitreous cavity and systemic antibiotic and steroids were administered in order to control the inflammation. In all the 5 endophthalmitis cases vision was restored to more than 10/20.

## IV. CONCLUSIONS

Minimally Invasive Vitrectomy System proved its efficacy and safety on our series. Since its introduction in the clinical practice, this is the only system that we used for vitreo-retinal surgery. The technical advantages of the MIVS are best revealed in the cases of rhegmatogenous retinal detachment. The safety of the small gauge cutter allows the work in the proximity of the detached, mobile retina, with little risk to injure it. In the cases requiring the dissection of the fibrous tissue from the surface of the retina (tractional retinal detachments, epimacular membranes), the technical abilities of the 25+ cutter diminish the need for accessory instruments: forceps, scissors, picks. In all the cases of intraocular foreign bodies and in the majority of lens/nucleus dislocations in the vitreous cavity, a hybrid approach was used, consisting in the enlargement of one sclerotomy to 20 gauge. Globally, the use of MIVS has led to the decrease of tissue damage and the shortening of the operating time. The elimination of the need for sutures reduced the inflammation and the convalescence period. Future research in vitreo-retinal surgery technologies involves the development of even smaller gauge vitrectomy systems (27G) and higher cutting rates (7500 cpm)

## REFERENCES

[1] M. Nagpal, G. Paranjpe, P. Jain and R. Videkar, “Advances in small-gauge vitrectomy”, Taiwan Journal of Ophthalmology, vol.2, pp 6 – 12, Feb. 2012.

[2] J.T. Thompson, “Advantages and limitations of small gauge vitrectomy”, Survey of Ophthalmology, vol. 56, pp 162 – 172, March-April 2011.

[3] Y.H. Yoon, D.S. Kim, J.G. Kim, et al., “Sutureless vitrectomy surgery using a new 25-gauge transconjunctival system”, Ophthalmic Surg Lasers Imaging, vol. 37, pp 12—9, Jan. 2006.

[4] R.R. Lakhanpal, M.S.Humayan, E.De Juan Jr, et al., “Outcomes of 140 consecutive cases of 25-gauge transconjunctival surgery for



DOI: 10.5963/LSMR0303007

posterior segment disease", Ophthalmology, vol. 115, pp 817-24, May 2005.

[5] G.A.Williams, "25-, 23-, or 20-gauge instrumentation for vitreous surgery?", Eye, vol. 22, pp 1263-6, Oct. 2008.

[6] M.J. Spirn, "Comparison of 25-, 23-, and 20-gauge vitrectomy", Curr Opin Ophthalmol. Vol. 20, pp 195-9, March 2009.

[7] A. Yanyali, E. Celik, F. Horozoglu, et al., "25-gauge transconjunctival sutureless pars plana vitrectomy", Eur JOphthalmol., vol. 16, pp 141-7, Jan. 2006.

[8] C. Guttman, "Intraoperative control comprehension of vitrectomy fluidics underlies safe and effective surgery", Ophthalmology Times, pp 18, Feb. 2010.

[9] O. Magalhaes Jr, L.Chong, C.DeBoer, et al., "Vitreous dynamics: vitreous flow analysis in 20-, 23-, and 25-gauge cutters", Retina, vol. 28, pp 236-41, Febr. 2008.

[10] S.D. Ţălu, S. Rus, I. Tămăşoi , and C. Dragoş, "Innovative Technologies in Vitreo-Retinal Surgery for Rhegmatogenous Retinal Detachment", IFMBE Proceedings, Volume 36, International Conference on Advancements of Medicine and Health Care through Technology, Part 1, Pages 13-18

[11] M. Charles, "Closed system and expanded instrumentation improves MIVS outcomes", Retina Today, pp 84 – 90, Jul/Aug 2011.

[12] Y. Oshima, T. Wakabayashi, T. Sato, M. Ohji, Y. Tano, "A 27-gauge instrument system for transconjunctival sutureless microincision vitrectomy surgery", Ophthalmology, vol. 117, pp 93 – 102, 2010.

[13] D.H. Bourla, E. Bor , R. Axer-Siegel, et al., "Outcomes and complications of rhegmatogenous retinal detachment repair with selective sutureless 25-gauge pars plana vitrectomy", Am J Ophthalmol., vol. 149, pp 630 – 634, Apr. 2010.

[14] M. Mura, S.H. Tan, M.D.De Smet, "Use of 25-gauge vitrectomy in the management of primary rhegmatogenous retinal detachment", Retina, vol. 29, pp 1299 – 1304, Sept. 2009.

[15] M.A.Von Fricken, N. Kunjukunju, C. Weber, et al., „25-gauge sutureless vitrectomy versus 20-gauge vitrectomy for the repair of primary rhegmatogenous retinal detachment", Retina,vol. 29, pp 444-50, Apr. 2009.

[16] M.M.Lai, A.J.Ruby, R.Sarrafizadeh, et al., "Repair of primary rhegmatogenous retinal detachment using 25-gauge transconjunctival sutureless vitrectomy", Retina, vol. 28, pp 729-34, May 2008.

[17] D.M. Miller, C.D.Riemann, R.E.Foster, et al., "Primary repair of retinal detachment with 25-gauge pars plana vitrectomy", Retina, vol. 28, pp 931-6, July 2008.

[18] S.J.Yang, S.Y.Yoon, J.G.Kim, et al., "Transconjunctival suturelsss vitrectomy for the treatment of vitreoretinal complications in patients with diabetes mellitus", Ophthalmic Surg Lasers Imaging, vol. 40, pp 461-6, May 2009; 40(5):461—6.

[19] P.Romero, M.Salvat, M.Almena, et al., "Experience with 25-gauge transconjunctival vitrectomy compared to a 20-gauge system. Analysis of 132 cases", J Fr Ophthalmol, vol. 29, pp 1025-32, Sept. 2006.

[20] F.Patelli, P.Radice, G.Zumbo, et al., "25-gauge macular surgery: results and complications", Retina, vol. 27, pp 750-4, June 2007.

[21] C. Parkes, M. Nagpal, B. Little, S. Prasad, "Drop and stop: the dropping and the dropped nucleus", Retina Today, vol. 1, pp 76 – 80, Jan/Feb 2011.

[22] S.Ţălu, D.Bembea, E. Sebestyen, L.Toader, H. Shah, "Traumatic endophthalmitis – therapeutic indications and results", Oftalmologia, vol. 54, pp 103-7, Oct.-Dec. 2010.



DOI: 10.5963/LSMR0303007