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## Recent Advances In Vitreoretinal Surgery

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**Ophthalmology is exploring new horizons everyday, both in the diagnostic as well as treatment aspects especially in the last century and vitreoretinal surgery has itself seen astounding progress keeping in tract with the other subspeciality. The advances have been achieved largely due to better understanding of the pathology of a various diseases as well as due to the technological upgradation in the instruments for vitreoretinal surgery. The main aim for any surgery now is to achieve best possible outcome with the least possible surgical intervention.**

### **Sutureless vitrectomy:-**

Inspite of development of more sophisticated instruments and laser for vitreoretinal surgery, patients need to undergo 20gauge sclerotomies and post operative morbidity because of sutured wound. The advent of sutureless cataract surgery showed path for the development of sutureless vitrectomy. Tunnel based sclerotomy by *Chen*<sup>1</sup> was suggested to create self sealing incision for vitreoretinal surgery but it requires a conjunctival peritomy and suturing and is associated with complications like wound leakage, extention, dehiscence, haemorrhage, vitreous &/or retinal incarceration, and difficulty in passing instruments. In 1990 *De Juan* and *Hickingbotham*<sup>2</sup> designed a variety of 25gauge (0.5mm diameter) vitreoretinal instruments and thus the era of sutureless vitrectomy began.

Transconjunctival sutureless vitrectomy system 25gauge developed by *Fujii et al*<sup>3</sup> has the advantage of creating a self sealing transconjunctival sclerotomies. The TSV consists of a 25gauge microcannula system and a wide array of vitreoretinal instruments specifically designed for this operating system consisting of microcannula, an insertion trocar, an infusion cannula, a plug forceps, and a cannula plug. The microcannula consists of a thin walled polyamide tube 3.6mm in length and with an inner/outer diameter of 0.57/0.62 mm. A collar is present at the extraocular portion, which can be grasped with forceps to manipulate the microcannula. A funnel shaped entry was designed to facilitate access of

instruments. Once inserted through the eye wall, sutures are not required to hold the microcannula in place. The 25gauge infusion cannula consists of a small metallic tube 5mm long with an inner/outer diameter of 0.37 / 0.56 mm. The intraocular portion of the infusion cannula is directly inserted into the eye through the microcannula. (Fig 1).



Fig. 1: 25G (Microcannula, Insertion trocar, Infusion cannula)

**A wide array of vitreoretinal microsurgical instruments complying with the 25gauge standards which have been designs include a high speed vitreous cutter, illumination probe, intraocular forceps, rigid retinal pick, flexible and extended retinal pick, tissue manipulator, laser probe, diathermy probe, aspirator and others.**

**The TSV system has been used in epiretinal membrane peeling, macular hole surgery, retinal detachment with no or minimal PVR, branch retinal vein occlusion sheathotomy, vitreous hemorrhage, endophthalmitis. It is useful especially in paediatric eyes where use of standard instruments may incur technical difficulties related to ocular size<sup>4</sup> as well in glaucoma prone patient undergoing vitreoretinal procedures where a mobile and healthy conjunctiva can be preserved for future antiglaucoma surgery.**

The TSV system is difficult to use in previously scarred operated eyes as it is difficult to enter sclera and trocar may bend, also in patients with thin sclera where wound does not close properly. It is difficult to infuse silicone oil through 25gauge cannula and in eye with

RD with PVR as the cutting and aspiration rate are reduced, its efficiency in dense fibrous proliferation may be limited.

In select cases where full capabilities of conventional vitrectomy system are not required, the 25gauge TSV system can offer better patient comfort, care and management by reducing operative time effectively. With more advancement in technology in future ophthalmologist will be performing a combined sutureless cataract and vitreoretinal surgery on an outdoor basis.

### Retinal Endoscope for vitreoretinal surgery:-

Ophthalmic endoscope was introduced in 1934 and from then till now they have evolved from a large rigid and bulky instrument to a very functional small hand held device.

**Instrumentation:** Xenon light source is used which provides a cold light imparting a near normal colour to the tissues and its intensity can be adjusted constantly by a manual or video signal driven diaphragm (Fig.:2).



Fig.2: Ophthalmic endoscopic system unit

**Two types of endoscopes are available; first one being the wide angle endoscope 19gauge with 110° field and the second one, a 20gauge one used for subretinal surgery with 50° field which employs a high resolution GRIN technology that provides high magnification.**

**Indications:** Laser Endoscope enhances the ability of the surgeon to image and dissect gliotic membranes in PVR especially in the regions of the pars plana, ciliary body and posterior iris. It also assists in complete photocoagulation thereby improving the probability of anatomic success. Endoscope can also be used in

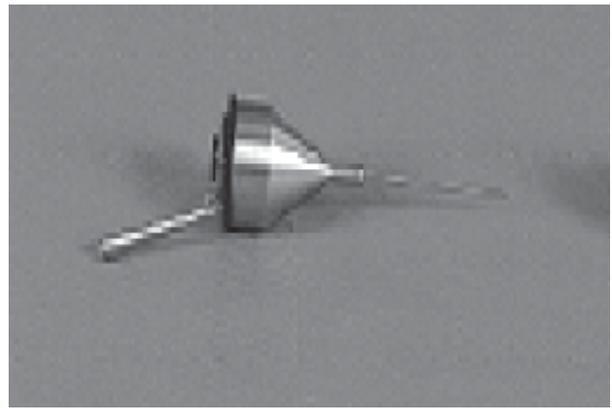


Fig.3: Endoscope

subretinal microsurgery like pigment epithelial endoscopic laser surgery for CNV where precise laser photocoagulation of the CNVM complex is done.

### Wide Angle Fundus Observation System :

Fundus visualization during entire vitreoretinal surgery is a must especially while operating complicated cases. Proper visualisation of posterior pole and periphery helps surgeon to perform difficult steps with safety

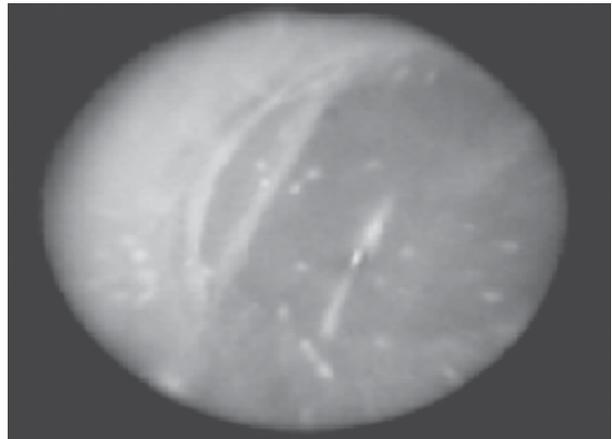


Fig.4: Endoscopic PEELS

and efficacy and also avoid unwanted complications. For this purpose non-contact wide angle observation systems like BIOM and EIBOS are ideal.

The wide angle viewing system currently include:

- The BIOM noncontact system with a field of view of 70°, 90° or 110° (Fig.:5) **BIOM 3**
- The EIBOS noncontact system with a field of view of 100° for 90 – diopter and 125° for 60 – diopter.
- The VOLK reinverting operating lens system (ROLS); can be used to visualise upto vitreous base and ora serrata.

- The AVI inverter.
- The iris medical contact wide-angle system.

**Wide angle viewing systems can be used in cases of retained lens mater and removal of displaced intraocular lens as surgery at the posterior pole as well as proper inspection of the periphery of the fundus is possible using the same viewing system. In cases of diabetic patients, panretinal**

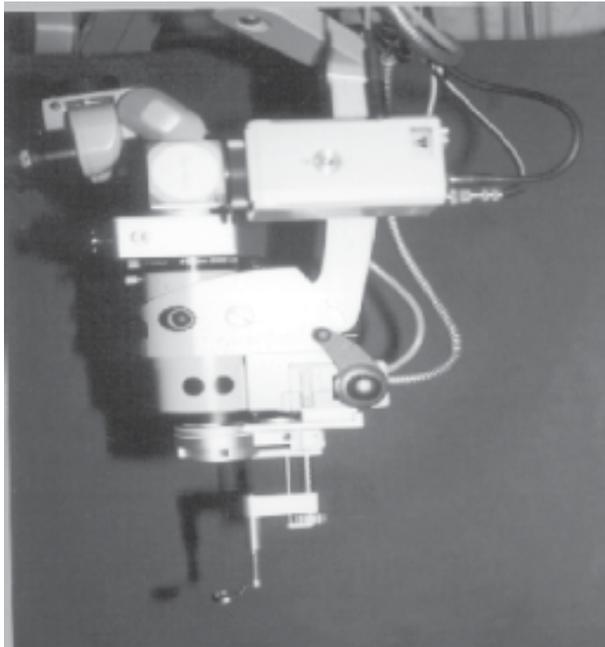


Fig.5: BIOM 3

**photocoagulation, dissection of tightly adherent membranes and gas fluid exchange are all facilitated. While working in one area, remote traction with impending development of tears or haemorrhage can be visualised in phakic, aphakic and pseudophakic patients. Surgical procedures like dissection of anterior proliferative vitreoretinopathy, gas fluid exchanges and silicone oil installation both a gas – silicone oil exchange as well as perfluorocarbon liquid silicone exchange can be performed with the same viewing system maintaining proper focus of the desired area. Surgery for retinopathy of prematurity is best performed using the noncontact systems, because of the decreased scleral rigidity of the infant eye and the small size of the cornea with a steep corneal curvature.**

### **Pulsed electron avalanche knife in vitreoretinal surgery:**

A new surgical instrument, called the pulsed electron Avlanche knife (PEAK) had been developed for precise, cold and tractionless dissection of tissue in liquid media.

It produces a paracentral zone of cellular structure disruption surrounding a crater and a peripheral zone of structurally intact but permeable cells. The instrument induced a damage radius that varied from 55m to 300m or the range of voltages and pulses typically used during surgery. For comparison, damage radius for microsurgical scissors is around 50m and for diathermy is around 400 to 950 microns. The PEAK also damages tissue upto 1.4mm away by creation of water flow that forms at the tip of convex probes during collapse of a cavitation bubble. Concave probes, which prevent formation of the water jet, eliminates this effect.

PEAK may greatly facilitate both posterior segment surgeries like membrane dissection and sheathotomy as well as anterior segment procedures trabeculectomy and iridectomy.

### **Novel mid infra red laser based cutting in vitreoretinal surgery :**

Profuse bleeding due to retinal tearing represents a common problem when working in the posterior chamber especially in a diabetic eye. Traditional mechanical oscillating blade cutters have the disadvantage that they create traction on an already damaged and vulnerable retina which can cause additional bleeding and damage, being detrimental to the patient and making it very difficult for the surgeon to visualise during the surgery.

Investigation are on for tuning of laser energy in order to target the protein in the vitreous, rather than bulk fluid, and it is proposed that such a cutting device could be constructed. It had been found that targeting the amide bands in the proteins present in the vitreous cavity, by mid – infra red laser energy a possible new way of performing vitreoretinal surgery can be initiated where collateral damage associated with high cutting or liquefaction rates can be minimised. This could thus either higher aspiration rates whilst working in the center of the eye, or more precise removal of membranes in more delicate regions of the eye without any traction on the retinal being caused.

### Pharmacological vitreolysis:

Many agents have been used for experimental studies which when injected into the vitreous cavity cause vitreolysis and posterior vitreous detachment with minimal surgical manipulation. Some of the agents used are tPA, chondroitinase, Plasmin, dispase, etc. such procedures can be used for treatment of macular edema especially in diabetic cases.

### Vitreon:

It is a perfluorocarbon liquid used in vitreoretinal surgery with a molecular weight of 624 with specific gravity of 2.03 and refractive index of 1.33. Experiments have shown that it can be left in the eye for about 5 –30 days for short-term tamponade. By that time the endolaser would have created a good chorioretinal adhesion and the PFCL can be replaced with a suitable agent for retinal tamponade.

### Surgical options for treatment of vein occlusions :

**Radial neurotomy for treatment of central retinal vein occlusion:** Retinal vascular occlusive disease is the 2<sup>nd</sup> leading cause of permanent retinal blindness. The etiology of central retinal vein occlusion (CRVO) is not well understood.

The anatomy of the optic disk including the cribriform plate and scleral ring may contribute to the development of retinal vaso-occlusive diseases. Some view Neurovascular compression within the confined space at this location may play a pathoetiologic role in CRVO. Some view CRVO as possibly due to a compartment like syndrome cause by increased pressure around the optic nerve head. If this is the case, they hypothesize that making an incision to decompress the optic nerve head would relieve the obstruction.

There is no effective treatment for ischaemic central retinal vein occlusion. The two major negative outcomes are neovascular glaucoma and severe central visual loss. Radial optic neurotomy along with pars plana vitrectomy, panretinal photocoagulation and intraocular gas injection can be done in patients with CRVO to relieve pressure on the central retinal vein.

Radial neurotomy can be done with a MVR blade (Fig.:6).



Fig. 6: Radial Neurotomy Knife

The incision is made on the nasal side to avoid damage to the nerve fibres leading from the macula. The incision is made in radial fashion i.e. parallel to the nerve fibres so as to minimize the severing of the nerve fibres and also taking care to avoid major blood vessels. The MVR blade is inserted into the tissue just past the point where the diamond shape MVR blade reaches it's maximum width and the inner most edge of the incision is just close to but not touching the central vessels. The tissues and structures involved in the incision include the optic nerve head, the cribriform plate, the scleral ring and the adjacent sclera.

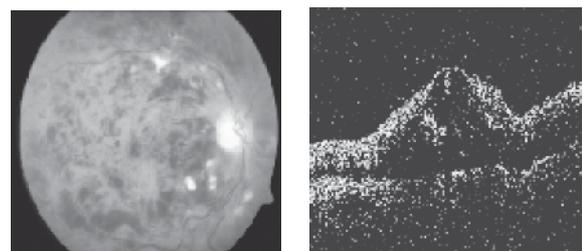


Fig.: 7(A,B) Pre op colour fundus photo and OCT - CRVO

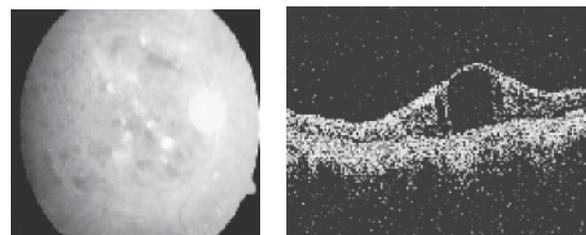
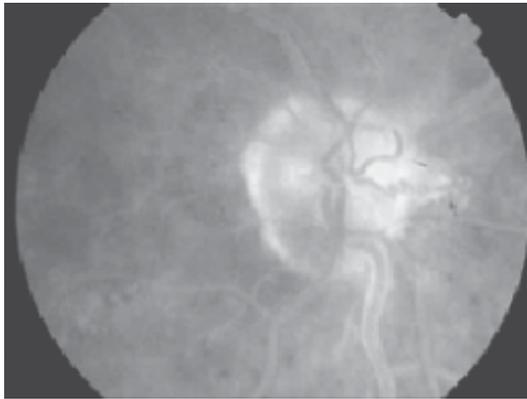


Fig.7: (C,D) Post radial neurotomy colour fundus photo and OCT

**While this technique may decompress the tight scleral ring, (Fig.:7)** some do suggest that part of the effect may be due to the formation of collateral vessels at the site of the neurotomy and these collateral vessels may allow restoration of more normal venous flow, allowing resolution of haemorrhage and edema with improvement in vision. **(Fig.:8)**



**Fig.8: Post Radial Neurotomy FFA showing retinochoroidal anastomosis**

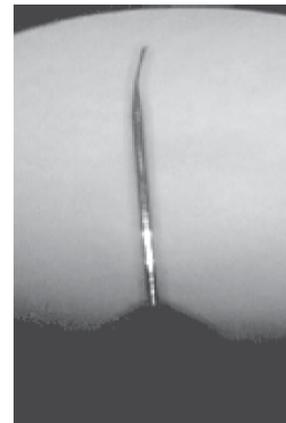
**Potential complications include retinal detachment, vitreous haemorrhage, globe perforation, laceration of the central retinal vein &/ or artery, optic nerve damage**

**Adventitial Sheathotomy for BRVO:** Branch retinal vein occlusion (BRVO) is the most common retinal vascular disorder after diabetic retinopathy. The BRVO Study demonstrated that laser photocoagulation improved vision in patients who had vision of 20/40 or worse due to macular edema; however patients with visual acuity worse than 20/200 did not improve significantly than with observation alone.<sup>5</sup>

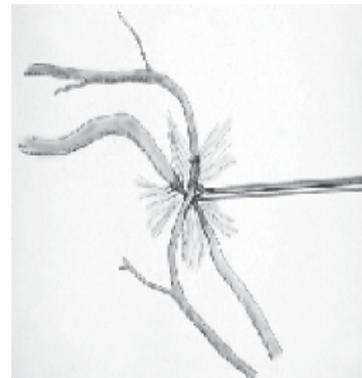
BRVO usually occurs at the arteriovenous crossings, and the arteriole crosses over the vein between 70%-99% of time. As the arteriole and venule share a common adventitial sheath at A/V crossings, Compression of the vein may lead to turbulent flow in the vein which in combination with the preexisting endothelial vascular damage from the different conditions like Hypertension, atherosclerotic, inflammatory, or thrombophilic conditions creates a local environment favorable to intravascular thrombus formation. Histopathologic studies confirm the importance of arteriovenous crossings in the pathogenesis of this condition. Inner retinal ischemic atrophic areas have been described distal to the occlusion site. Variable degrees of arteriolar sclerosis

have been reported. An intravascular fresh or recanalized thrombus often is found at the site of vein occlusion.

A pars plana vitrectomy with posterior hyaloid peeling is done after which ICG dye can be injected to stain the internal limiting membrane for ILM peeling. Using the sheathotomy knife, the artery & vein are separated at the crossing. FGE is done C3F8 gas is injected **(Fig.9).**

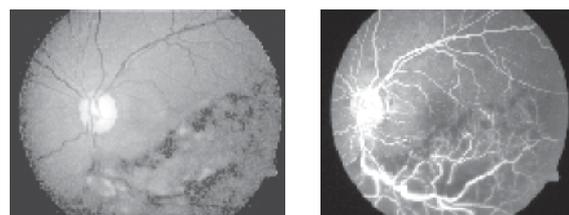


**Fig.9 (A) Adventitial sheathotomy blade**



**Fig.9 (B) Adventitial sheathotomy—diagrammatic representation**

**Anatomic and functional improvement of retina has been achieved in patients with BRVO through adventitial sheathotomy (Fig.:10).**



**Fig.: 10(A, B) Colour fundus photo and FFA photo – pre op BRVO**

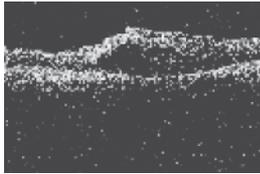


Fig.: 10(C) pre op OCT

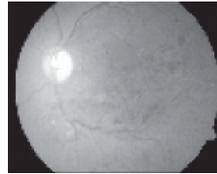


Fig.: 10(D) Post radial neurotomy colour fundus photo

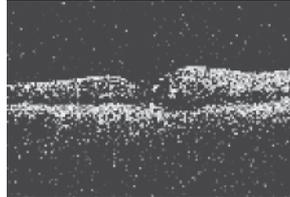
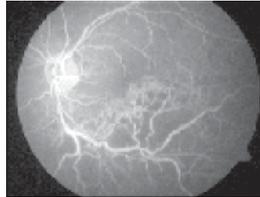


Fig.: 10(E,F) post adventitial sheathotomy FFA and OCT

It has been noted that application of this procedure appeared to be limited to arteriovenous crossing near the optic nerve, because vessels at this location appeared to be both large enough and of sufficient strength to tolerate the manipulation associated with creating small cuts between artery and vein.

#### **Retinal endovascular surgery (REVS) for central and hemispheric retinal vein occlusion:**

Retinal endovascular surgery techniques were developed to cannulate retinal blood vessels in order to inject drugs directly into the retinal vasculature. REVS with retinal venous injection of tissue plasminogen activator is eye with central and hemispheric vein occlusion may promote retinal reperfusion and recovery of vision.

Tissue plasminogen activator has been used for a number of years to treat stroke patients. A recently described technique uses t-PA by cannulating a branch retinal vein. After a vitrectomy, a branch vein is cannulated and a 3-4 ml bolus of t-PA is infused into the vein.

This technique may work via several different mechanisms. Vitrectomy with peeling of the posterior hyaloid face may help reduce macular edema. t-PA itself may lyse the clot, and the bolus of fluid may flush the thrombus downstream.

There has been debate about the mechanism of action. In the treatment of stroke, most of the success of t-PA has come within first few hours of the thrombotic event. Soon after forming, the thrombus becomes

organized and in a long-standing occlusion, it may be difficult to dissolve. Other evidence suggests that the inner retina may suffer irreparable damage after several weeks and that even if a clot is dislodged, the retina may be too damaged to recover. Also, if collateral vessels have time to form, t-PA may be route away from the thrombus and may not reach it in sufficient amount to dislodge the clot.

While initial report of this technique is encouraging, further studies into mechanisms of action, as well as the success of this technique is needed.

Surgical intervention for treatment of diabetic maculopathy

- Surgical induction of PVD in cases of macular edema especially if the cortical vitreous is adherent and thickened in macular region there by not allowing required focal or grid laser photocoagulation.
- ILM peeling for non-resolving diabetic maculopathy inspite laser and medical therapy.
- Surgical aspiration of subretinal fluid with removal of hard exudates along with macular massaging with PFCL accompanied by endophotocoagulation and fluid gas exchange in cases of serous detachment of macula.
- Surgical removal of hard exudates with subretinal forceps.

#### **Macular translocation surgery:**

Macular translocation involves moving the neurosensory retina of the macular region in an eye with recent onset subfoveal pathology to a new location with presumable healthier RPE and choriocapillaries. The most common indication of macular translocation is recent onset subfoveal CNV other being RPE defects created after removal of subfoveal CNV and cases having central geographic atrophy.

The basic pathology of AMD is usually limited to macular area. The inner aspect of Bruch's membrane is diffusely thickened, impeding adequate passage of nutrients from the choroid to the pigments epithelium and metabolic products from the RPE to choroid. Multiple modalities of treatment like laser photocoagulation, photodynamic therapy or Transpupillary Thermotherapy have shown to be

helpful to stabilize the vision in about 70% of cases but one limitation in all these treatments is the inability to correct for the absence of RPE- Bruch's membrane – choriocapillaries support of the photoreceptors that occurs with macular degeneration.

The mechanisms responsible for visual loss in eye with AMD may be either reversible or irreversible. In early stage of neovascular AMD, the visual loss may be due to subretinal fluid or haemorrhage in the macular region. In later stages of the disease fibrovascular proliferation causes permanent damage of the photoreceptors. Therefore by moving the neurosensory retina in an eye with recent onset subfoveal lesion to a new location with presumably healthier RPE and choriocapillaries away from the area of pathology, the fovea may be able to recover or maintain its visual function. In addition by moving the fovea away, removal or destruction of CNVs may be possible

Macular translocation has been defined<sup>6</sup> as any surgery that has a primary goal of relocation the central neurosensory retinal or fovea intraoperatively or postoperatively specifically for the management of macular disease.

Effective macular translocation is defined as successful intraoperative or postoperative relocation of the fovea overlying subfoveal lesion to an area outside the border of the lesion.

**Classification of macular translocation surgery<sup>7</sup>:-**

**MT with large curvilinear incision of the retina**

- MT with 360 degrees retinotomy
- MT with large retinotomy.
- MT with punctate or no retinotomy
- With chorioscleral shortening.
- Chorioscleral infolding (imbrication or inpouching)
- Chorioscleral outfolding (outpouching)
- Without chorioscleral shortening

**Basic principles of surgery:**

As a general principle vitrectomy is followed by creation of retinal detachment by infusion of fluid under the retina either through sclera or from inside through the retina. Once detachment is created either complete

or incomplete the retinal is rotated around the optic nerve head to a desired degree and reattached. Many modification have been made by leading vitreoretinal surgeon do get optimum visual results by minimize manipulation and thereby surgical complications. (Fig.:11)

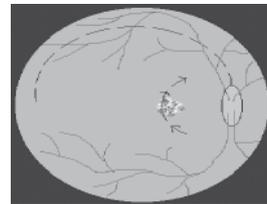


Fig.11 (A)

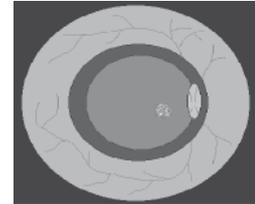


Fig.11 (B)

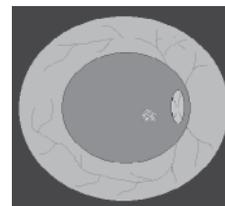


Fig.11 (C)

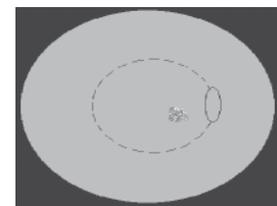


Fig.11 (D)

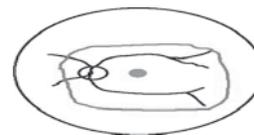


Fig.11 (E)



Fig.11 (F)

**Schematic representation of various steps of macular translocation**

- *Machemer* advocated total RD with 360° peripheral retinotomy with created around 4500mm of macular translocation<sup>8</sup>.
- *Toth* and *Machemer*, alongwith *Eckardt* and *conrad* have used transretinal infusion to create detachment, using wide field chandelier illumination or illuminated cannula, wide field viewing systems<sup>9</sup> or performing oblique or rectus muscle transposition.<sup>10</sup>
- *Ninomiya* and *Tano* described detachment of temporal retina only and created 180° peripheral retinotomy with a superior or inferior radial incision to move the fovea superiorly or inferiorly<sup>11</sup>.
- A retinal detachment may be created on the temporal side without a retinotomy after which sclera is shortened by scleral resection resulting in shift of choroid and sclera in relation to the fovea.<sup>12,13</sup>

- *De Juan* has described method of limited translocation in which only temporal retina is detached and limbal parallel acute shortening of choroid and sclera is done thereby achieving about 1500mm of translocation and later CNV was photocoagulated.<sup>13</sup>

Complication of the macular translocation surgery include retinal detachment, PVR, cataract, neovascularisation of iris, corneal decompensation, recurrence of membrane, CME, diplopia. The rate of retinal detachment after MT surgery has decreased in past few years largely due to refinement in surgical techniques, use of PFCL, wide angle viewing system, wide field illumination and technique of inducing retinal detachment using fine gauge needles for fluid injection.

### Retinal prosthesis:-

Currently two different kinds of retinal prosthesis are being investigated, epiretinal or subretina. The epiretinal one does not disturb the relationship between the RPE and retina, however its position should remain same after implantation and should be able to remain steady despite ocular movements.

The subretinal one disturbs the relationship between the RPE and choroid but can access the visual signal integration system at the earliest possible and thereby allowing the signals to be processed by the maximal amount. Described below are some of the investigators who are currently involved with retinal prosthesis.

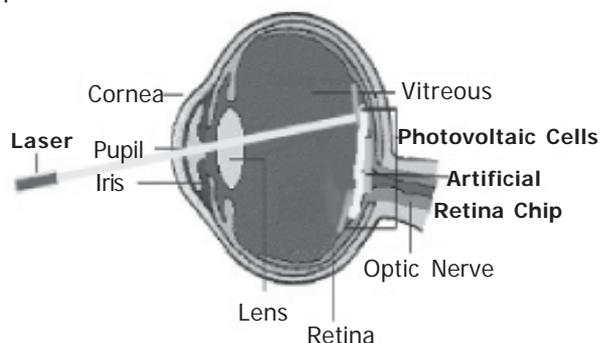


Fig. 12: Schematic representation of retinal implant

### Epiretinal

Eckmiller: – Retinal implant news, Bonn

Rizzo:- The retinal implant group, MIT, Harvard; the chip is positioned near ganglion cells. A camera is mounted on the eyeglasses to capture image and a digital signal processor transmits a light image to the

chip two computer chips are used along with a tiny solar panel and a long circuit.

Humayun – intraocular retinal prosthesis group, North Carolina State prosthesis project Johns Hopkins; small external camera is used to capture image and a chip is implanted near ganglion cell layer resulting in a 10 x 10 pixel capability.

### Subretinal :

Zrenner:– Retinal Implant, Tubingen

Yagi;- Hybrid retinal implant

Chow:- Optobionics; composed of micro-photo-diode sub units the implant is intended for use in disorders where photoreceptors are lose, while the remaining retinal layers are spared e.g., retinitis pigmentosa, ARMD. It is stimulated by light, which is converted to electric impulses inducing biological visual signals in the remaining functional retinal cells. Several initial studies have been carried out in animals with success. The device has been implanted in 6 human eyes with RP and 1 yr follow up has shown no major complications. Patients have reported improved vision and appreciation of black and white images in well-lit room. US FDA approval is awaited for larger human trials.

At these early stages of research, predicting the time of availability and ultimate efficacy of retinal prosthesis is difficult. However, progress has been mad in the last decade, and human subjects have been able to identify crude shapes and phosphenes, and animal testing has been encouraging.

### RPE transplantation:

RPE dysfunction is believed to be the main cause of many debilitating diseases of which ARMD and retinitis pigmentosa are the most common problems. In these diseases, photoreceptors ultimately are affected, causing severe vision loss because of the loss or dysfunction of RPE cells rather than any abnormality of the photoreceptor themselves.

In last few years tremendous amount of research has been made in the area of RPD transplantation. Two techniques have been used, the external (anterior transvitreal) approach and the internal (posterior transscleral) approach. In both the cases RPE cells are introduced into the subretinal space as cell suspension or sheets of RPE cells.

The types of cells currently being used for transplanting are: human fetal RPE, immortalized RPE, porcine fetal RPE, and autologous (obtained from the same eye that is being transplanted, from a remote location). RPE cells can be harvested from cadaver eyes within 24hrs of death and can be preserved at 4° for upto 48 hrs. Cyroprecipitate obtained from human blood donors can be used for adhesion cultivation and transfer of RPE cells.

Survival of the grafted transplanted RPE cells can be monitored by labeling them with carbon particles, fluorescent dye, radioactive level (3-H thymidine) and lad-2. Studies have shown that fetal RPE cells don't not survive and repopulate because of the unavailability of extracellular matrix receptors required for attachment and spreading. However, cleaning and resurfacing the inner collagenous layer increased the RPE attachment, decreased apoptosis, and allowed cells to repopulate.

As a part of FDA controlled phase 1 clinical trial, intact sheets of RPE cells are transplanted, at least till 3 months, no rejection has been reported. Rejection has been shown to occur early in patients with wet AMD than in patients with dry AMD, most likely because of compromised blood retinal barrier in wet AMD.

Rejection seems to be worse in patients with both major histocompatibility complex incompatibility.

Prednisone has been shown to play role in delaying rejection by suppressing humoral response. Cyclosporine, given intravitreally prolongs the survival of transplanted RPE cells by inhibiting the first phase of T-cell activation while azathioprine delays rejection by inhibiting delayed hypersensitivity reaction and cellular cytotoxic activity.

Some of the issues which still need to be addressed before RPE cell transplantation becomes a clinically viable surgical procedure are collection and preservation techniques, prolongation of survival of grafted cells, control of long term immune responses, and techniques that would allow a monolayer formation of the grafted cells.

#### **Iris pigment epithelial cell transplantation:**

This method was introduced by Gelance et al<sup>14,15</sup>. There are two different methods by which the procedure can be performed.

**One step surgery:** Here IPE cells are harvested from

one or two basal iridectomies and re-injected into the subretinal space in 20% serum. An injection of 20,000–50,000 cells has shown a viability of 70%-80 %.

**Two step surgery:** IPE cells are harvested through iridectomy and cultured until a desired number is reached after which they are injected in the subretinal space near macula after removal of any subretinal membranes. Here approximately about 20,000 to 2,00,000 cells are injected.

#### **Retinal Cell Transplantation:**

The main aim of transplanting retinal photoreceptors is to re-establish appropriate cellular connections and thereby some functional capacity. During surgical experiments on animals, Transplanted fetal tissue do survive and differentiate, but do not show normal retinal orientation<sup>16</sup>. While enzymatically separated adult photoreceptor cells transplanted into subretinal space survive and tend to develop synaptic terminals but outer segments tend to degenerate.<sup>17,18</sup> However, the functional capacity of these transplanted cells has not been tested since the visually directed behavior of these animals was not assessed. Despite the paucity of evidence that this technique is useful, mechanically dissociated fetal retinal of 14–18 weeks' gestation have been grafted in patients with advanced RP. No rejection or complication has been reported and some patients have reported subjective improvement of vision.<sup>19</sup>

#### **Stem cell research:**

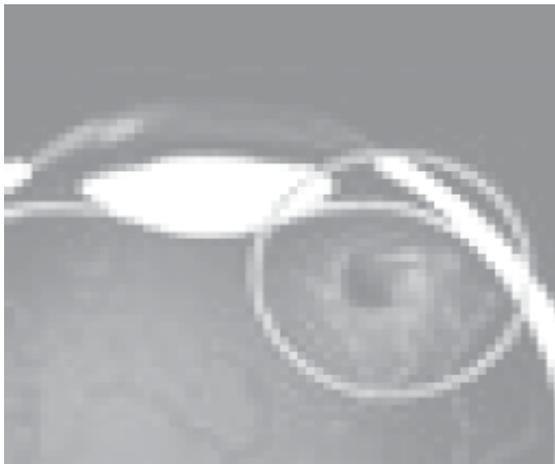
Scientists have discovered stem cells (immature precursor cells) in the eye of adult rodents, and studies are now under way to see if these cells can be transplanted into humans to replace diseased photoreceptors.

Experiments are also underway to use stem cells for drug delivery devices to deliver vascular endothelial growth factor inhibitors, lutein and zeaxanthin as well as other drugs.

#### **Sustained release ganciclovir implant:**

CMV retinitis affects 12% - 46% of individuals with AIDS and is frequently bilateral. The current management of CMV retinitis includes systemic anti – CMV therapy, local intravitreal injections of ganciclovir and foscarnet, and more recently intravitreal sustained release ganciclovir implant (Vitrasert). High dose intravenous ganciclovir and foscarnet is effective in suppressing viral replication in the short term by

breakthrough infection is common during the maintenance phase with upto 50% of patients experiencing recurrent disease. Implantation can be done as primary therapy at the time of CMV retinitis diagnosis or as salvage therapy once the conventional treatment has failed. The implant is effective as salvage treatment in recurrent CMV retinitis in majority of the cases. It avoids the need for repeated intravitreal injections and associated frequent hospital visits, provides a longer period of disease control, and may be used to retain useful a vision in majority of patients helping to improve their quality of life- **(Fig: 13)**



**Fig. 13: Sustained release ganciclovir implant**

#### **Sustained release intravitreal steroid implant:**

Intravitreal steroid are generating immense interest for treatment of macular edema secondary to vascular or inflammatory causes. Moreover due to its antiangiogenic effect it is being also considered for the treatment of wet AMD.

Two main forms of implant are under investigation

- A biodegradable implant that contains a steroid and is placed in the eye. One such implant, produced by Oculex, deliver dexamethasone. This agent is surgically placed in the eye and resulted in 4-6 weeks of delivery of steroid (the vehicle takes longer to dissolve).
- A reservoir implant, produced by control delivery systems, Bausch and Lomb, the reservoir implant is placed in the eye and results in the release into the eye of fluocinolone.

As it is, each preparation has both benefits and drawbacks. A biodegradable product offer the advantages of shorter duration of action and the fact that a plastic device is not place in the eye, but retain the disadvantage of a shorter duration and less reliable

pharmacokinetics. The plastic implant, meanwhile, has more reliable pharmacokinetics and a longer duration of action upto 3 years but it may increase toxicity because of prolonged release of corticosteroid mainly like cataract and glaucoma.

#### **Triamcinolone used for visualization of the vitreous and posterior hyaloid:**

Complete removal of vitreous and posterior hyaloid is important in many vitreoretinal surgeries but because of transparency of the vitreous, it is sometimes difficult sometimes to visualise these structures completely. Prior to core vitrectomy 1-2 drops of triamcinolone aqueous suspension can be injected in the mid vitreous. Triamcinolone particles in the fluid filled space are freely mobile, unlike those trapped in the gel structure of the vitreous, which helps in accurate visualisation of the posterior hyaloid and vitreous, and its complete removal. Triamcinolone has no reported retinal toxicity and may help in preventing fibrin reaction and PVR postoperatively.

#### **Use of t-PA in vitreoretinal surgery:**

t- PA is a serine protease helps conversion of plasminogen to plasmin. Recently it has been used as an aid in various vitreoretinal procedures.

- Removal of fibrin blood clots .
- Aid in causing PVD.
- Premacular haemorrhage.

Implantable miniaturized telescope (IMT) is a new approach to aid vision in patients with age related macular degeneration. The telescope consists of 3X telescope that is contained in carrying device made of PMMA that can be implanted in the capsular bad. It



**Fig.14: Implantable telescope**

provides improvement of the central visual acuity in the implanted eye for reading, while the other eye

can be used for peripheral navigational vision. The implant has a universal power; fine adjustment of vision can be achieved by wearing low power plus or minus spectacles. The advantage of the implant is that it provides magnification of vision without the need to hold the device by hand, which avoids the relative movements between the eye and the hand. Some patient may notice transient difficulty in orientation.

**(Fig.:14)**

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