# Transconjunctival Sutureless 23-gauge Vitrectomy for Diabetic Retinopathy. Review

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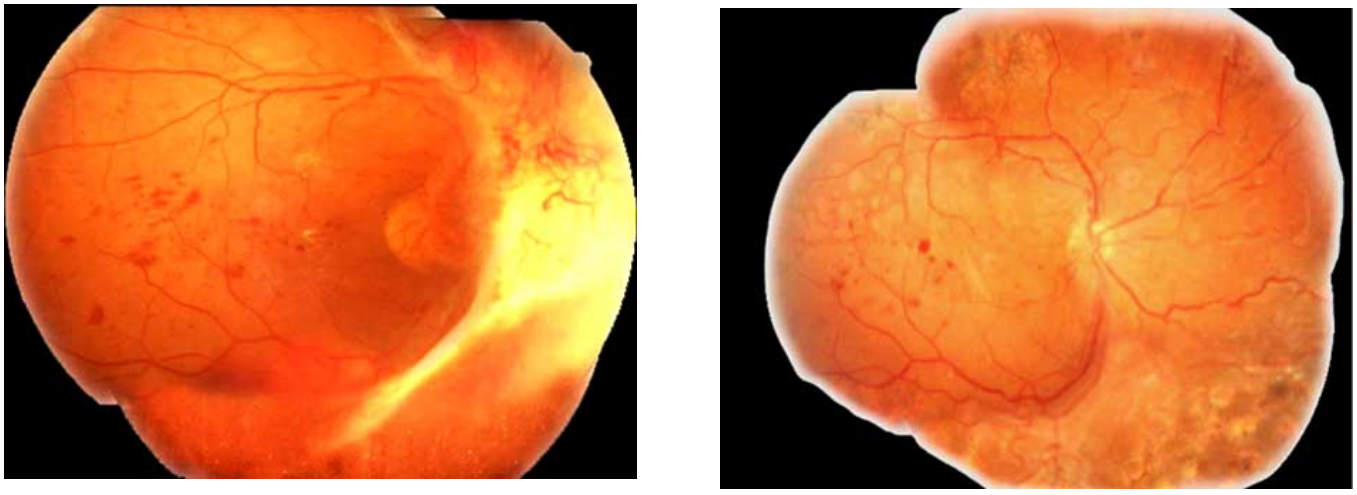
**Abstract:** This paper reviews the current experience and trends in 23-gauge transconjunctival sutureless vitrectomy for diabetic retinopathy in those patients that need a surgical intervention for either vitreous hemorrhage, fibrovascular proliferation with traction retinal detachment affecting or threatening the macula, traction-rhegmatogenous retinal detachment, or refractory macular edema with taut posterior hyaloid. Since the instruments in 23-gauge vitrectomy are less flexible and perform in a more similar way to 20-gauge instruments, the vitrectomy is more thorough and for more complex manoeuvres can be done. The 23-gauge transconjuntival sutureless vitrectomy avoids some of the shortcomings of the 25-gauge systems.

**Keywords:** Transconjunctival sutureless vitrectomy, Diabetic macular edema, Traction retinal detachment, Diabetic retinopathy, Vitreous hemorrhage.

Several complications of diabetic retinopathy need to be managed surgically. Pars plana vitrectomy (PPV) in diabetic patients has several established indications and some that are still under discussion. Vitrectomy offers relief from retinal traction, clearing of media opacities, and stabilization of the proliferation process. Vitreous hemorrhage, severe fibrovascular proliferation with traction retinal detachment, and traction-rhegmatogenous retinal detachment affecting or threatening the macula are classic indications for PPV, whereas diffuse macular edema is a nonstandard indication for this procedure [1-3] (Figs. **1** and **2**). Diabetic macular edema associated with posterior hyaloid traction was recently included as an indication for vitrectomy [4]. In addition, vitrectomy surgery with or without internal limiting membrane peeling has been performed in some patients with macular edema without a taut posterior hyaloid [5].

In general, with subsequent improvements in surgical techniques, instrumentation and skills, the timing threshold for surgery continues to decrease and newly discovered benefits of early treatment continue to be reported [6].



**A** **B**

**Fig. (1). A**) 25-year-old female who presented with traction-rhegmatogenous retinal detachment. Preoperative fundus photograph. Visual acuity was 20/200. **B**) Three months after 23-gauge transconjunctival sutureless vitectomy with bimanual dissection and gas tamponade, VA was 20/60.

Twenty-three gauge transconjunctival sutureless vitrectomy (TSV) was first described by Claus Eckardt [7] as an alternative to the previously-described 25-gauge TSV reported by Fujii *et al.*, [8]. Twenty-five gauge vitrectomy causes no surgical trauma to the conjunctiva, requires no scleral suturing (and thus leaves no postoperative suture-

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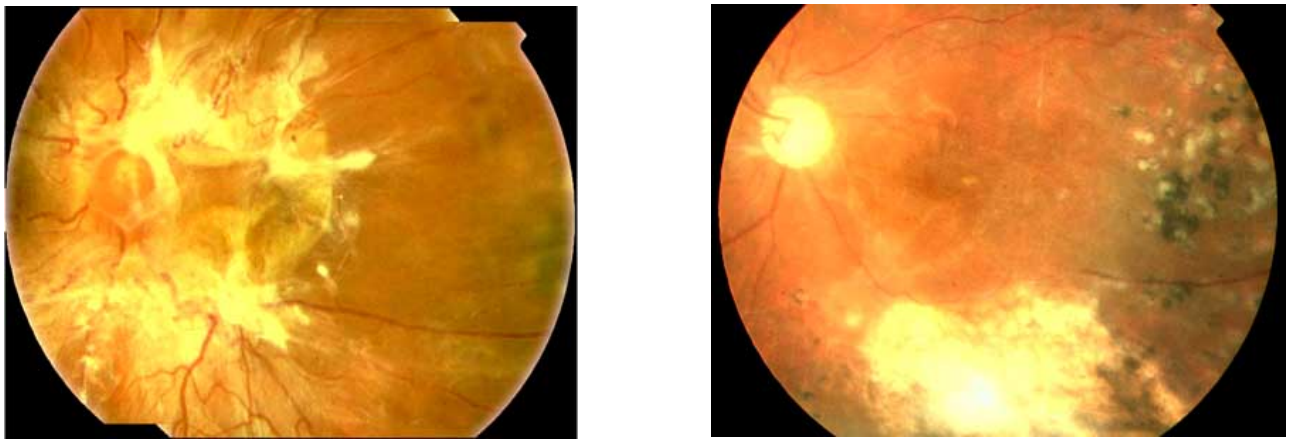

**A** **B**

**Fig. (2). A**) 65-year-old man with severe traction retinal detachment affecting the macula. Preoperative visual acuity was 20/400. **B**) One month after 23-gauge TSV with bimanual dissection and silicone oil tamponade, VA was 20/100.

related astigmatism), reduces postoperative rehabilitation time, and improves postoperative inflammation. Nonetheless, the technique has some disadvantages, mainly related to the excessive flexibility of the instruments, making some surgical maneuvers more difficult [9]. In addition, several associated postoperative complications have been reported, including wound leakage, hypotony, choroidal effusion, and endophthalmitis. It is currently under discussion whether endophthalmitis is more common with 25-gauge TSV than with 20-gauge vitrectomy [10-12].

In 23-gauge TSV, three microcannulas for the instruments and infusion line are inserted transconjunctivally into the area of the planned sclerotomy. The incisions are not made perpendicular to the scleral surface, but instead at a 30º to 40º angle parallel to the corneoscleral limbus. The tunnel-like nature of the sclerotomy facilitates self-sealing of the wound after removing the cannulas [7]. The use of sutureless PPV with 23-gauge vitrectors is gaining acceptance and offers advantages versus 25-gauge vitrectomy. The characteristics of the vitrector, particularly the fact that the cutting tip is closer to the edge of the vitrector, facilitate dissection of the fibrovascular proliferations occurring in diabetic retinopathy. In addition, an accessory 25-gauge wide-field endoillumination can be placed on a fourth sclerotomy, permitting bimanual dissection.

According to the Diabetic Retinopathy Vitrectomy study [13], the timing of vitrectomy for severe vitreous hemorrhage should be within 3 months for type 1 diabetes and within 6 months for type 2. In addition, this study reported that 15% of eyes with traction retinal detachment develop severe visual loss (<5/200) when surgery is not performed within 1 year.

Currently, the most frequent indication for vitrectomy is TRD involving the macula. TRD results from progressive fibrovascular proliferation and contraction. The variably separated posterior hyaloid exerts anteroposterior traction between the vitreous base and the fibrovascular adhesions, and there may also be tangential traction between each vitreoretinal adhesion. If fibrosis and contraction progress, a retinal break can develop and give rise to rhegmatogenous-traction retinal detachment, a serious complication with a guarded prognosis.

**Vitrectomy for proliferative diabetic retinopathy.** A three-port pars plana vitrectomy is performed. All the classic surgical maneuvers can be carried out with 23-gauge TSV. A 6-mm cannula can be used in cases with extensive peripheral fibrosis or anterior retinal displacement that may obscure the tip of the cannula. Lensectomy can be added if lens opacity prevents adequate visualization or prevents surgery of the vitreous base.

In eyes with complete vitreous separation, the usual indication is nonclearing vitreous hemorrhage; the vitreous is removed and panretinal photocoagulation is performed.

If there is incomplete posterior hyaloid detachment, surgery is directed at separating the posterior hyaloid. This requires stripping the posterior cortical vitreous from the retina and cutting the vitreoretinal adhesions at the vascular epicenters. The ease of dissection is determined by the extent of posterior hyaloid separation, the type of vitreoretinal adhesions (focal or broad), the degree of fibrosis, and the presence of epiretinal membranes, retinal detachment, and retinal breaks.

Several surgical techniques have been developed for membrane removal, including *segmentation* in which traction forces are eliminated by removing the posterior hyaloid and or fibrovascular tissue connections to adjacent traction areas and isolating these independent segments [14]. Another technique is *delamination*, which involves cutting the connections between the posterior hyaloid and/or fibrovascular tissue and the internal limiting membrane. In *en bloc dissection*, the vitreous and associated vitreoretinal membranes are removed as a single unit. The technique used currently combines delamination and segmentation using a bimanual approach.

In eyes with incomplete posterior vitreous detachment and one or more focal adhesions, core vitrectomy is performed and the cortical vitreous is identified, with or without the use of intravitreal triamcinolone [15]. If there is an area of wide separation between the vitreous and retina, the vitreous cutter can be used to incise the posterior hyaloid at this

region to gain access to the subhyaloid space. When a smaller separation exists, an opening can be made with a barbed microvitreoretinal blade. Once the subhyaloid space is accessed, the opening is extended circumferentially 360 degrees or minimally, depending on the degree of vitreous separation. This maneuver releases peripheral vitreous from its posterior attachments, thus reducing the risk of iatrogenic retinal breaks. Then the vitreoretinal proliferations and epiretinal membranes are addressed. The dissection, which is usually initiated in the peripapillary region, can be made with the vitreous cutter if there is adequate space between the vitreous and retina. If the separation cannot accommodate the vitreous cutter, more detailed dissection using scissors, picks and/or forceps is required using a bimanual approach. Several radial cuts are made in the posterior hyaloid between focal areas of fibrovascular adhesion to extend this separation anteriorly. To increase the separation between the hyaloid or proliferative tissue, small amounts of hyaluronic acid can be injected through a cannula. Once the focal adhesions are isolated, they are usually excised parallel to the retinal surface. If epiretinal membranes are also present, they are usually peeled toward the vascular epicenter and removed. After separation and removal of all posterior hyaloid and fibrovascular adhesions, the dissection is continued anteriorly.

Broad vitreoretinal adhesions are more difficult to remove, particularly if there are underlying retinal folds. In these cases the edge of the adhesion must be elevated, and each individual adhesion is excised using membrane peeler-cutter scissors.

In eyes with no posterior vitreous separation, core vitrectomy is performed, but the subhyaloid space cannot be entered in the mid-periphery with the vitreous cutter. A barbed MVR blade can be used to access the subhyaloid space in the peripapillary region. Then radial cuts are made, and the hyaloid is stripped to the periphery in all quadrants. Hemorrhage beneath the posterior hyaloid can be aspirated using a soft-tipped cannula, the vitreous cutter, or if clotted, peeled with forceps. In some cases in which the retina is not completely reattached despite vitreoretinal dissection, a relaxing retinectomy may be required.

After completing the vitrectomy, panretinal photocoagulation with or without cryotherapy of the sclerotomies is performed. Then, the peripheral fundus is examined under scleral depression and fluid-air exchange is peformed. Depending on the state of the retina after surgery, extended tamponade of non-expansible gas or silicone oil is left as tamponade. It should be noted that with 23-gauge TSV, injection of silicone oil is feasible, but very slow. To facilitate this step, one of the sclerotomies can be enlarged to 20 gauge to introduce silicone oil in the vitreous cavity.

A recent variation of vitrectomy for proliferative diabetic retinopathy is the use of intravitreally injected anti-VEGF medication as an adjuvant. One such agent, bevacizumab at 1.25 mg, is injected into the vitreous cavity 2 to 5 days before pars plana vitrectomy. This medication decreases bleeding during surgical dissection of the fibrovascular membranes and induces regression of neovessels. Certain complications can occur, as described by Arévalo *et al.,* [16]. These authors reported that traction retinal detachment can occur or progress shortly following administration of intravitreal bevacizumab in patients with severe proliferative diabetic retinopathy. In our experience, the best effect with intravitreal anti-VEGF medications is achieved when the vitrectomy is done 2 days after the injection.

## VITRECTOMY FOR DIABETIC MACULAR EDEMA

In cases of diffuse macular edema, vitrectomy is only indicated in cases refractory to focal laser and several intravitreal injections of triamcinolone or anti-VEGF. In cases of attached posterior hyaloid without a thickened vitreous membrane, some authors have described benefits from vitrectomy with or without internal limiting membrane peeling [5]. Nevertheless, this indication for vitectomy remains uncertain. Anti-VEGF or triamcinolone can be left at completion of surgery. In cases of diffuse macular edema with taut posterior hyaloid observed by ophthalmoscopy and optical coherence tomography, the benefits include opening, elevating, and removing the posterior hyaloid [4].

Among the reports of 23-gauge TSV for diabetic retinopathy, Eckardt in his first paper [7] described the outcome of 41 cases treated with 23-gauge TSV using the DORC (Dutch Ophthalmic Research Center) system; among them, 11 cases were diabetic retinopathy. The author reported that the instruments are less flexible than in 25-gauge TSV, and noted that vitrectomy is still somewhat slower than with 20-gauge vitrectomy. In 2 of the cases of proliferative diabetic retinopathy, slight bleeding into the vitreous cavity occurred in the first few days after the operation. The author reported no case of postoperative hypotony and concluded that 23-gauge TSV seems to offer all of the advantages of the minimally invasive TSV system developed by Fujii *et al.,* [7] plus the benefits of larger, sturdier instrumentation.

After the initial experience of Eckardt, Fine *et al.,* [17] described their experience with 23-gauge vitrectomy in a variety of vitreoretinal surgical indications and reported a safety profile that compared favorably with published rates for 25-gauge vitrectomy. Among the complications, there were 2 cases of postoperative hypotony that resolved spontaneously, and 1 patient needed intraoperative suture at the sclerotomy site due to gas leakage. Among their patients, 24 vitrectomies were done for diabetic retinopathy, consisting of 12 traction retinal detachments and 12 non-clearing vitreous hemorrhages. The authors found a statistically significant improvement in visual acuity after 23-gauge TSV in both groups of patients. Visual acuity increased from a mean of 20/175 to 20/62 in those with traction retinal detachment and from 20/1345 to 20/189 in those with vitreous hemorrhage. The authors had no case of intraoperative retinal tears or postoperative retinal detachment. This is likely because vitrectomy performed with a 23-gauge vitrector is more complete, the illumination systems are better, and access to the retinal periphery is less complex. The opening time in this study was around two minutes.

The latest report of 23-gauge TSV is by Kim *et al.,* [18] Among the indications, 11 cases were vitreous hemorrhages, 10 diabetic macular edema, and 1 tractional retinal detachment. Intraoperative suture placement was necessary in 7.5% and the authors reported no serious postoperative complications.

Traditional 20-gauge sclerotomies are 1.15-mm wide and require sutures, 25-gauge vitrectomy utilizes a no tunneled sclerotomy that has a 0.5-mm lumen, and 23-gauge vitrectomy employs a 0.72-mm sclerotomy. The important difference in 23-gauge sclerotomies, however, is that the sclerotomy is tunneled, which likely accounts for the improved wound closure versus 25-gauge sclerotomies. It should be mentioned that hypotony can have severe consequences and be associated with increased rates of endophthalmitis, retinal or vitreal incarceration, and suprachoroidal hemorrhage.

## CONCLUSION

The 23-gauge system obviates some of the shortcomings of 25-gauge systems since the instruments are less flexible and perform more like 20-gauge instruments, allowing more thorough peripheral vitrectomy and highly complex maneuvers. This instrument system creates tunneled sclerotomies through the use of a slanted MVR blade followed by a blunt trocar that provides a self-sealing incision. Moreover, the fact that the cutting part of the vitrector is closer to the tip is particularly useful in cases of proliferative diabetic retinopathy. Nonetheless, 23-gauge vitrectomy systems still have some of the important limitations of 25-gauge systems, such as the lack of a fragmatome, which could be needed in cases of combined surgery with dense cataracts. Lastly, fewer instruments are available than with 25-gauge vitrectomy, since the system was introduced more recently, although any 25-gauge instrument can be used in 23-gauge TSV, but not vice versa.

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