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25-Gauge transconjunctival sutureless pars plana vitrectomy

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PURPOSE. *To evaluate the effectiveness, feasibility, and safety of the transconjunctival sutureless vitrectomy (TSV) system for a variety of vitreoretinal diseases.*
METHODS. *In this retrospective study, the authors evaluated 71 eyes of 63 patients who underwent pars plana vitrectomy (PPV) with the 25-gauge TSV system. The indications for surgical intervention were diabetic vitreous hemorrhage (29 eyes), diabetic macular edema (14 eyes), macular epiretinal membrane (13 eyes), endophthalmitis (5 eyes), vitreous opacities secondary to Behçet's disease (4 eyes), vitreous hemorrhage secondary to branch retinal vein occlusion (4 eyes), and vitreous hemorrhage secondary to age-related macular degeneration (2 eyes). Epiretinal membrane and internal limiting membrane removal, endolaser photocoagulation, and air-fluid exchange were performed when required.*
RESULTS. *Mean follow-up was 3.6 months (range 1–8 months). Mean overall visual acuity (VA) was counting fingers (range light perception to 0.4) preoperatively and 0.2 (range 0.1 to 0.8) postoperatively (p=0.000). Statistically significant VA improvement was observed in eyes with vitreous hemorrhage, diabetic macular edema, and macular epiretinal membrane. VA improved postoperatively in all eyes with endophthalmitis and vitreous opacities secondary to Behçet's disease. The surgery was completed without conjunctival and scleral suturing in all eyes. Mean intraocular pressure (IOP) was 17.2 mmHg (range 10–26 mmHg) preoperatively, 12.4 mmHg (range 6–24 mmHg) on the first postoperative day, 16.6 mmHg (range 10–33 mmHg) at 1 week, and 15.4 mmHg (range 10–20 mmHg) at 1 month postoperatively. On the first postoperative day, IOP was below 10 mmHg (between 6 and 9 mmHg) in 12 eyes (16.9%). In these eyes, IOP was normalized within 1 week without affecting the visual outcome. Five eyes (7%) had transient increase of IOP controlled by topical antiglaucomatous medications. Vitreous washout using 25-gauge TSV system was performed in two eyes, in which vitreous hemorrhage recurred.*
CONCLUSIONS. *The TSV system was observed to be feasible, effective, and safe for a variety of vitreoretinal diseases. This minimally invasive and completely sutureless (transconjunctival) technique appears to decrease the convalescence period, operating time, and postoperative inflammatory response, and improve patient comfort. (Eur J Ophthalmol 2006; 16: 141-7)*

KEY WORDS. *Pars plana vitrectomy, Transconjunctival sutureless vitrectomy, 25-Gauge pars plana vitrectomy*

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INTRODUCTION

Pars plana vitrectomy (PPV) is conventionally performed through sclerotomies placed in the anterior pars plana. Sclerotomies are performed with a 20-gauge microvitreoretinal blade 3–4 mm behind the limbus, depending on the phakic status of the eye, and are closed at the end of the surgery with sutures (1). Suture-related complications such as suture erosion, scleral necrosis, and granuloma formation can be observed at the sclerotomy sites (2).

Sutureless PPV was proposed by Chen (3) in 1996, and was based on sclerotomy sites prepared 6 mm behind the limbus, with the aim of creating 0.3 mm length self-sealing scleral tunnels. This method aimed to avoid suture-related complications, and to shorten the operation time. However, related to the technique, surgical difficulties and several complications such as wound leakage, dehiscence and hemorrhage, retinal break, vitreous and/or retinal incarceration, and dialyses have been reported (4, 5). Furthermore, the scleral tunnel technique requires conjunctival dissection and subsequent suturing (5, 6).

In the last few years, 25-gauge transconjunctival sutureless vitrectomy (TSV) system and vitreoretinal surgical instruments have been developed, and successful results have been reported (7, 8). In this study, the effectiveness, safety, and feasibility of the TSV system were evaluated in a variety of vitreoretinal disorders.

METHODS

In this retrospective study, we evaluated 71 eyes of 63 patients who underwent vitreoretinal surgery using the 25-gauge TSV system between August 2003 and April 2004. Twenty-nine of these eyes had persistent diabetic vitreous hemorrhage, 14 had diabetic macular edema unresponsive to macular laser photocoagulation, 13 had macular epiretinal membranes, 5 had endophthalmitis, 4 had vitreous opacities secondary to Behçet's disease, 4 had vitreous hemorrhage secondary to branch retinal vein occlusion, and 2 had vitreous hemorrhage secondary to age-related macular degeneration.

TABLE I - PREOPERATIVE CHARACTERISTICS OF PATIENTS WHO UNDERWENT 25-GAUGE TRANSCONJUNCTIVAL SUTURELESS VITRECTOMY

Characteristic	Mean	Range
Age (yr)	57	22 to 77
Preoperative IOP (mmHg)	17.2	10 to 26
Preoperative visual acuity	CF	LP to 0.4
Follow-up (mo)	3.6	1 to 8

IOP = Intraocular pressure; CF = Counting fingers; LP = Light perception

Cataract extraction with phacoemulsification and intraocular lens (IOL) implantation combined with TSV were performed simultaneously in six eyes with vitreous hemorrhage and two eyes with diabetic macular edema.

The possible merits and risks of the treatment were explained to the patients and an informed consent was obtained in accordance with the Helsinki Declaration prior to inclusion in the study. No Institutional Review Board approval was required for this study.

All patients received a best-corrected Snellen visual acuity (VA) measurement, anterior segment examination, intraocular pressure (IOP) measurement with applanation tonometry, and biomicroscopic evaluation with both fundus non-contact and contact lenses. B-scan ultrasonography was performed in all eyes in which visualization of the fundus was not attained.

The TSV system was not used in eyes with extensive fibrous proliferation detected by ultrasonography. Optical coherence tomography (OCT) was performed in patients with diabetic macular edema.

Three vertical and horizontal manually assisted OCT scans were obtained to locate the fovea and analyzed from each studied eye by the same experienced ophthalmologist, who was masked to the conditions of the patients. Patients were evaluated postoperatively using the same preoperative tests.

The TSV consists of a 25-gauge microcannula system and an array of vitreoretinal instruments specifically designed for this operating system. The 25-gauge microcannula system includes a microcannula without a valve, an insertion trocar, an infusion cannula, and a cannula plug (Fig. 1). The vitrectomy probe, microforceps, microvertical scissors, aspiration pick, silicone-tipped aspiration cannula, endoilluminator, endodiathermy probe, and endolaser probe are the special vitreoretinal instruments developed for the 25-gauge TSV system.

Surgical technique

All the operations were performed by the same surgeon (A.Y.) under sub-Tenon anesthesia. The microcannulas were inserted transconjunctivally with the help of the insertion trocars in the inferotemporal, superotemporal, and superonasal quadrants. The trocars were rotationally moved during insertion to create scleral incisions measuring 0.5 mm. The overlying conjunctiva was pulled aside with forceps during the entrance of the insertion trocar in order to avoid the alignment between conjunctival and scleral incisions. The infusion cannula was placed in the inferotemporal quadrant, and plugs were used to temporarily close the other entry sites. A cutting rate of 1500 cuts per minute and a vacuum level of 500 mmHg were used during PPV. The balanced salt solution (BSS) bottle height was set at 40 cm. The whole amount of infusion fluid used during the operation was not measured. Epiretinal membrane and internal limiting membrane (ILM) peeling, endolaser photocoagulation, and air-fluid exchange were performed when required.

In eyes with diabetic macular edema, ILM that was stained with 0.1% (1 mg/mL) indocyanine green (ICG) under intravitreal air was peeled from the macula using 25-gauge microforceps, following PPV and posterior hyaloid removal. Coexisting cataract was observed in four eyes with vitreous hemorrhage and in two eyes with macular edema. In these eyes, cataract extraction with phacoemulsification via a clear corneal tunnel was performed simultaneously with TSV. An IOL was implanted in the capsular bag in all eyes. In these cases, all the microcannulas were inserted and closed temporarily with plugs before phacoemulsification. After phacoemulsification, the corneal tunnel was temporarily closed with a 10/0 nylon suture, which was removed at the end of surgery. In eyes with macular epiretinal membrane, membrane removal with ILM peeling was performed with 25-gauge microforceps, following PPV. In eyes with endophthalmitis, a total vitrectomy and intravitreal vancomycin and amikacin injections were performed. In eyes with vitreous opacities secondary to Behçet's disease, vitreous opacities were removed. At the end of

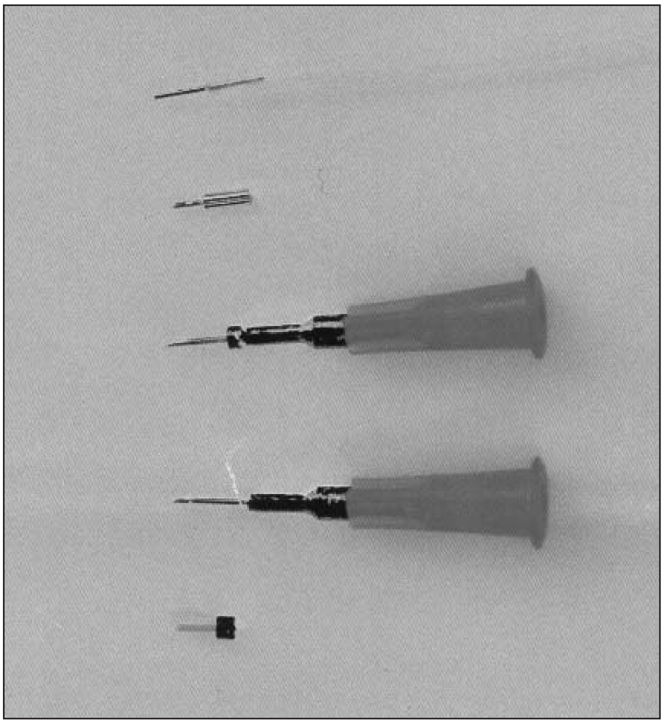

Fig. 1 - *The 25-gauge microcannula system; infusion cannula, cannula plug, insertion trocar with microcannula, insertion trocar and microcannula (from top to bottom).*

TABLE II - SURGICAL INDICATIONS AND PREOPERATIVE AND POSTOPERATIVE VISUAL ACUITIES (VA) OF THE PATIENTS

Indications	N (%)	Mean pre-operative VA	Mean post-operative VA	p Value*
Vitreous hemorrhage	35 (49.3)	HM	0.2	0.000
Diabetic macular edema	14 (19.7)	0.1	0.2	0.002
Macular epiretinal membrane	13 (18.3)	0.2	0.4	0.001
Endophthalmitis	5 (7)	LP	0.2	†
Vitreous opacities (BD)	4 (5.7)	CF	0.2	†

*Wilcoxon test.
†Statistical analysis was not performed because of small number of patients
HM = Hand motions; LP = Light perception; BD = Behçet's disease; CF = Counting fingers

the procedure, the insertion trocars were removed without air or fluid leakage. The conjunctiva overlying the sclerotomy was slightly displaced to disrupt the alignment between both entry sites, and an antibiotic and corticosteroid combination was injected into the subconjunctival space. No sutures were required to close the scleral or conjunctival openings in any eye.

Main outcome measures were IOP, VA, and intraoperative and postoperative complications. Preoperative and postoperative best-corrected Snellen VA were converted into logMAR (the logarithm of the minimal angle of resolution) units for statistical analysis. One-way analysis of variance, Tukey, Student's t, and Wilcoxon tests were used for statistical analysis.

RESULTS

Preoperative characteristics of the patients are shown in Table I. Of the 63 patients, 22 were men and 41 were women. Mean follow-up period was 3.6 months. Mean overall VA was counting fingers (range light perception to 0.4) preoperatively and 0.2 (range 0.1 to 0.8) postoperatively (Tab. II). The improvement in VA was statistically significant (p=0.000, Student's t test). Overall VA improved in 63 eyes (88.7%) and remained stable in 8 eyes (11.3%) and no major intraoperative complication was encountered. IOP changes after 25-gauge TSV are shown in Table III. IOP changes between preoperative and postoperative 1 day and postoperative 1 day and postoperative 1 week were statistically significant (p=0.000, Tukey test). IOP changes between postoperative 1 week and postoperative 1 month were not statistically significant (p=0.058, Tukey test). On the first postoperative day, IOP was below 10 mmHg (between 6 and 9 mmHg) in 12 eyes (16.9%). In these eyes, IOP was normalized within 1 week without affecting the visual outcome.

In eyes with vitreous hemorrhage secondary to proliferative diabetic retinopathy (29 eyes), branch retinal vein occlusion (4 eyes), and age-related macular degeneration (2 eyes), the vitreous hemorrhage was removed successfully. VA was hand motions preoperatively in all of these eyes, which improved to a mean of 0.2 postoperatively. The improvement in VA was statistically significant (p=0.000, Wilcoxon test). Transient increase of IOP (4 eyes) and recurrence of vitreous hemorrhage (2 eyes) were the postoperative complications of this subgroup. Recurrent vitreous hemorrhages did not resorb spontaneously, so vitreous washout using the 25-gauge TSV system was performed at postoperative month 1. Vitreous hemorrhage did not recur in these eyes.

In 14 eyes that underwent PPV and ILM removal for diabetic macular edema unresponsive to macular photocoagulation, mean VA improved from 0.1 preoperatively to 0.2 postoperatively. This improvement was statistically significant (p=0.002, Wilcoxon test). Mean foveal thickness was 392 um preoperatively and 266 um at postoperative month 1. No postoperative complications were encountered in these eyes.

Macular epiretinal membrane removal was performed successfully in 13 eyes. Mean VA improved from 0.2 preoperatively to 0.4 postoperatively. The improvement in VA was statistically significant (p=0.001, Wilcoxon test). No postoperative complications were observed in these eyes.

In five eyes with endophthalmitis, intravitreal antibiotic injections were applied following PPV with the 25-gauge TSV system, and mean VA improved from light perception preoperatively to 0.2 postoperatively. VA improved postoperatively in all eyes. Statistical analysis was not performed because of small number of patients.

In four eyes that underwent surgery for vitreous opacities secondary to Behçet's disease, mean VA improved

TABLE III - INTRAOCULAR PRESSURE CHANGES AFTER 25-GAUGE TRANSCONJUNCTIVAL SUTURELESS VITRECTOMY

	Preoperative	Postoperative 1st day	Postoperative 1st week	Postoperative 1st month	p Value*
Mean IOP (range)	17.2 mmHg (10–26)	12.4 mmHg (6–24)	16.6 mmHg (10–33)	15.4 mmHg (10–20)	0.000

*One-way analysis of variance
IOP = Intraocular pressure

from counting fingers to 0.2. VA improved postoperatively in all eyes. Statistical analysis was not performed because of small number of patients. Transient increase of IOP controlled by topical antiglaucomatous medications was observed in one eye in this subgroup.

The mean total operative time was 21 minutes (range 16 to 34 minutes). No difficulties were encountered during the insertion of the trocars into any eye. Passage of the 25-gauge instruments through the trocars was found to be easy, and the required procedures were performed with ease in all eyes. A cutting rate of 1500 cuts per minute and a vacuum level of 500 mmHg with a bottle height set at 40 cm were adequate to avoid a collapse of the globe. Furthermore, these settings did not induce an elevated IOP causing corneal opacity in any eye. There were no complications such as wound leakage, extension, dehiscence and hemorrhage, or vitreous or retinal incarceration at the external side of the sclerotomies. The internal side of the sclerotomies was not evaluated by ultrasound biomicroscopy. No sutures were required to close the scleral or conjunctival openings in any eye.

DISCUSSION

We currently perform 25-gauge PPV in approximately 15% of our routine PPV cases. In this study, we performed PPV with the 25-gauge TSV system in eyes with persistent vitreous hemorrhage, diabetic macular edema unresponsive to macular laser photocoagulation, macular epiretinal membrane, endophthalmitis, and vitreous opacities secondary to Behçet's disease. In these eyes, PPV, epiretinal membrane and ILM removal, endolaser photocoagulation, and air-fluid exchange procedures were performed with ease. No difficulties were encountered during the passage of the instruments through the insertion trocars. No major intraoperative complications were observed. Mean overall VA improved significantly from counting fingers (range light perception to 0.4) preoperatively to 0.2 (range 0.1 to 0.8) postoperatively. Overall VA improved in 88.7% of eyes and remained stable in 11.3% of eyes. Significant improvement in mean preoperative to mean postoperative VA was observed in eyes with vitreous hemorrhage, diabetic macular edema, and macular epiretinal membrane. VA improved postoperatively in all eyes with endophthalmitis and vitreous opacities secondary to Behçet's disease. Fujii et al (8) have also reported that the 25-gauge TSV system can be used with comfort and success in many vitreoretinal procedures that do not involve extensive intraocular tissue dissection, such as epiretinal membrane peeling, vitreous hemorrhage removal, macular hole surgery, branch retinal vein occlusion sheathotomy, diabetic macular edema, and uncomplicated retinal detachment surgeries.

In some eyes operated with the TSV system, temporary IOP alterations have been reported in the postoperative period (8). In the same study, relative hypotony (6 to 9 mmHg) has been observed in 22.8% of eyes on the first postoperative day. In our study, mean IOP decreased significantly on the first postoperative day (mean 12.4 mmHg) and then increased significantly at postoperative 1 week (mean 16.6 mmHg). Mean IOP at postoperative 1 month (mean 15.4 mmHg) was not significantly different from mean IOP at postoperative 1 week. We observed relative hypotony in 16.9% of eyes and IOP was normalized within 1 week without affecting the visual outcome. We assume that slight displacement of the conjunctiva, overlying the sclerotomies while inserting and removing the trocars, prevents intraocular air or fluid leakage. We observed a temporary IOP rise in 7% of eyes and Fujii et al (8) have also reported a temporary IOP rise in 8.5%.

Numerous studies have shown that sutureless small-incision cataract surgery reduces the postoperative inflammatory response (9-11). Similarly, it has been proposed that there is a reduced postoperative inflammatory reaction and faster postoperative recovery with the 25-gauge TSV system, compared with the conventional method of PPV (7, 8). In addition, there would be no suture-related irritation or local inflammatory reaction at the sclerotomy sites (8). The frequency of local inflammatory reaction has been reported as 32% with Dacron, and 5% with polyglycolic acid suture (12). Eyes operated with the TSV system have been observed to be less-injected on the first postoperative day when compared with conventional PPV (8). Furthermore, there is no limbal stem cell damage due to conjunctival dissection, so it may be advantageous in eyes with corneal or conjunctival diseases such as dry eye. In our study, we observed a less traumatic postoperative appearance, and few complaints due to ocular surface irritation.

Vitrectomy is indicated in certain cases of endophthalmitis (13, 14). Performing a complete vitrectomy (with peripheral vitreous removal) is theoretically beneficial by debulking more inflammatory debris and toxins, allowing better penetration and distribution of intraocular antibiotics and removing the scaffold for the formation of epiretinal membranes (15). In our study, with the use of TSV system and wide-angle viewing system, a complete vitrectomy was performed at ease in eyes with endophthalmitis. Furthermore, since eyes with endophthalmitis have severe inflammation, the selected surgical procedure should not provoke this inflammation. The TSV allows a completely sutureless closed vitrectomy, obviates the need for conjunctival peritomy and suturing, and decreases surgically induced trauma and postoperative inflammatory response.

We used the 25-gauge TSV system in four cases with vitreous opacities secondary to Behçet's disease, and mean VA improved from counting fingers to 0.2. It has been suggested that PPV is effective in the treatment of complications of uveitis, such as medium opacities on the visual axis, vitreous hemorrhage, and cystoid macular edema (16). It has been advocated that PPV eliminates the inflammatory components and growth factors in the vitreous, and decreases macular edema (17, 18). In these eyes, it may be possible to induce only minimal surgical trauma due to the minimal touch of small diameter (25-gauge) microsurgical instruments to the sensitive uveal tissues. After consideration of all these facts, the TSV system may be advantageous in the surgery of complications of uveitis.

In a previous study (7), to evaluate the time efficiency of the TSV system, the 25-gauge TSV and the 20-gauge PPV were used by the same surgeon in similar cases; the mean operation time was significantly longer with the 20-gauge vitrectomy (26 minutes) than with the 25-gauge vitrectomy (17 minutes). It has been shown that the time-saving benefit results from the opening and closing of the conjunctiva and sclera. However, in order to benefit from all these advantages, it has especially been emphasized that the 25-gauge TSV system should be used in selected cases not requiring extensive intraocular tissue dissection (7, 8). In our study, since the TSV system was not used when extensive fibrous proliferation was detected by ultrasonography and biomicroscopy, shifting to 20-gauge PPV was not required in any eye. We also observed a reduction in the operation time (mean 21 minutes) with the 25-gauge TSV system; however, we did not have the opportunity to compare it with the 20-gauge system.

It is difficult to examine the sclerotomy sites adequately through biomicroscopy and indirect ophthalmoscopy. This becomes possible with the introduction of ultrasound biomicroscopy, which is an excellent tool for examination of the pars plana. It has been reported that the rate of ultrasonically visible vitreous incarceration in pars plana sclerotomies is 85.4% after standard conventional sutured sclerotomies, and 85.2% after modified sutureless sclerotomies (19). In the same study, it has also been reported that longitudinal ultrasound biomicroscopy examination of incarcerated vitreous at the sclerotomies over a postoperative period of 6 months does not reveal any progression. In 25-gauge TSV, the possible mechanism for closure of sclerotomy wound is vitreous incarceration. Vitreous incarceration in sclerotomies can cause anterior vitreoretinal traction and subsequent retinal tears or detachments during the postoperative period. In our study, although no vitreous or retinal incarceration was observed at the external side of the sclerotomies, the internal side of the sclerotomies was not evaluated by ultrasound biomicroscopy. Additionally, our follow-up period (mean 3.6 months) is relatively short. Thus, we were not able to evaluate the closure of sclerotomy wound, and possible vitreous incarceration and its progression. Further studies with a long follow-up period and ultrasound biomicroscopy examination are required.

The 25-gauge TSV has several shortcomings. In 25-gauge TSV, the ability of the surgeon to move the eye during the operation is more limited due to small and more flexible intraocular instruments, when compared with the 20-gauge vitrectomy system. In addition, there is a limited range of commercially available 25-gauge intraocular instruments since the system is new and the sclerotomies are small. For these reasons, it would be more appropriate to perform the 25-gauge TSV in eyes without complex or peripheral vitreoretinal pathology. This is especially important during the learning curve of the surgeon using the small, flexible intraocular instruments. Furthermore, the aspiration flow in 25-gauge TSV is lower than the aspiration flow in 20-gauge vitrectomy system. Therefore, maximum aspiration settings should be used to prevent the occlusion of the 25-gauge vitreous cutter with the aspirated material. In our study, a cutting rate of 1500 cuts per minute and a vacuum level of 500 mmHg were used during PPV. The BSS bottle height was set at 40 cm. We observed neither occlusion of the vitreous cutter nor hypotony during 25-gauge TSV.

In our study, we did not observe any postoperative complications except for transient increase of IOP in 7% of all eyes included in the study, and recurrent vitreous hemorrhage in 3.3% of eyes with vitreous hemorrhage secondary to proliferative diabetic retinopathy.

There was no reason leading us to believe that these complications were specifically related to the use of TSV.

In these eyes, IOPs were controlled by topical antiglaucomatous medications, and vitreous hemorrhage did not recur after vitreous washout with the TSV system. There is theoretically increased risk for endophthalmitis due to unsutured scleral and conjunctival openings in the 25-gauge TSV. However, this devastating complication was observed in neither Fujii et al's (8) nor our study.

In conclusion, the TSV system is a feasible, effective, safe, and practical procedure for a variety of vitreoretinal disorders. The TSV allows for completely sutureless closed vitrectomy, obviates the need for conjunctival peritomy and suturing, and decreases surgically induced trauma, operation time, convalescence period, and postoperative inflammatory response. We suggest that the indications of the TSV system will expand with the development of new 25-gauge vitreoretinal surgical instruments.

None of the authors has any financial interest in the study.

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REFERENCES

1. Van Kuijk FJ, Uwaydatt S, Godley BF. Self-sealing sclerotomies in pars plana vitrectomy. Retina 2001; 21: 547-50.
2. Kwok AKH, Tham CCY, Lam DSC, Li M, Chen JC. Modified sutureless sclerotomies in pars plana vitrectomy. Am J Ophthalmol 1999; 127: 731-3.
3. Chen JC.Sutureless pars plana vitrectomy through self-sealing sclerotomies. Arch Ophthalmol 1996; 114: 1273-5.
4. Rahman R, Rosen PH, Riddell C, Towler H. Self-sealing sclerotomies for sutureless pars plana vitrectomy. Ophthalmic Surg Lasers 2000; 31: 462-6.
5. Milibak T, Suveges I. Complications of sutureless pars plana vitrectomy through self-sealing sclerotomies (letter). Arch Ophthalmol 1998; 116: 119.
6. Lam DS, Chua JK, Leung AT, et al. Sutureless pars plana anterior vitrectomy through self-sealing sclerotomies in children. Arch Ophthalmol 2000; 118: 850-1.
7. Fujii GY, De Juan E Jr, Humayun MS, et al. A new 25-gauge instrument system for transconjunctival sutureless vitrectomy surgery. Ophthalmology 2002; 109: 1807-13.
8. Fujii GY, de Juan E Jr, Humayun MS, et al. Initial experience using the transconjunctival sutureless vitrectomy system for vitreoretinal surgery. Ophthalmology 2002; 109: 1814-20.
9. Kaiya T. Observation of blood-aqueous barrier function after posterior chamber intraocular lens implantation. J Cataract Refract Surg 1990; 16: 320-4.
10. Oshika T, Yoshimura K, Miyata N. Postsurgical inflammation after phacoemulsification and extracapsular extraction with soft or conventional intraocular lens implantation. J Cataract Refract Surg 1992; 18: 356-61.
11. Sanders DR, Spigelman A, Kraff C, et al. Quantitative assessment of postsurgical breakdown of the blood-aqueous barrier. Arch Ophthalmol 1983; 101: 131-3.
12. Tardif YM, Schepens CL, Tolentino FI. Vitreous surgery. XIV. Complications from sclerotomy in 89 consecutive cases. Arch Ophthalmol 1977; 95: 229-34.
13. D'Amico DJ, Noorily SW. Postoperative endophthalmitis. In: Albert, Jacobiec, eds. Principles and Practice of Ophthalmology. Philadelphia: W.B. Saunders Company; 1994: 1159-69.
14. Michaels GR. Vitreous Surgery. St. Louis: C.V. Mosby Company; 1981: 209-367.
15. Morris R, Witherspoon CD, Kuhn F. Endophthalmitis. In: Roy H, ed. Master Techniques in Ophthalmic Surgery. Baltimore: Williams & Wilkins: 1995: 560-72.
16. Nolthenius PA, Deutman AF. Surgical treatment of the complications of chronic uveitis. Ophthalmologica 1983; 186: 11-6.
17. Dick AD. The treatment of chronic uveitic macular edema. Is immunosuppression enough? Br J Ophthalmol 1994; 78: 1-2.
18. Mieler WF, Aaberg TM. Vitreous surgery in the management of peripheral uveitis. Dev Ophthalmol 1992; 23: 239-50.
19. Kwok AKH, Tham CCY, Loo AVP, Fan DSP, Lam DSC. Ultrasound biomicroscopy of conventional and sutureless pars plana sclerotomies: a comparative and longitudinal study. Am J Ophthalmol 2001; 132: 172-7.