

Long-term outcomes of 23-gauge transconjunctival sutureless vitrectomy

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Aim: To assess the long-term efficacy and safety of 23-gauge transconjunctival sutureless pars plana vitrectomy in the management of vitreoretinal diseases.

Materials and methods: In this study, 53 eyes of patients who underwent 23-gauge transconjunctival sutureless pars plana vitrectomy were included. A complete ophthalmological examination was performed preoperatively and at day 1, week 1, and months 1, 3, 6, and 12 after the surgery.

Results: The mean age of the patients was 56.3 years (range: 22-73). Overall, the mean preoperative best-corrected visual acuity was 20/800, and the final mean postoperative best-corrected visual acuity at the 12-month visit was 20/160. The overall rate of eyes having an increased best-corrected visual acuity was 75.4% at month 12. Subconjunctival haemorrhage was observed in 7 eyes (13.2%), move of trocar in 4 eyes (7.5%), and fluid leakage to conjunctival entry sites in 2 eyes (3.7%). Postoperative complications included cataract formation in 8 of 31 eyes (25.8%), elevated intraocular pressure in 8 eyes (15.1%), hypotonia in 4 eyes (7.5%), subconjunctival bleb of silicone oil in 1 of 15 eyes (6.6%), and conjunctival irritation in 2 eyes (3.7%).

Conclusion: According to the results of this study, vitreoretinal surgery with 23-gauge transconjunctival sutureless vitrectomy appears to be an effective and safe technique for the management of posterior segment diseases.

Key words: 23-Gauge pars plana vitrectomy, intraoperative complications, postoperative complications, transconjunctival sutureless vitrectomy

23-Gauge transkonjonktival sütürsüz vitrektominin uzun dönem sonuçları

Amaç: 23-Gauge transkonjonktival sütürsüz pars plana vitrektominin vitreoretinal hastalıklarının yönetiminde uzun dönem etkinliğini ve güvenilirliğini tespit etmek.

Yöntem ve gereç: 23-Gauge transkonjonktival sütürsüz pars plana vitrektomi uygulanan 53 hastanın 53 gözü bu çalışmaya alındı. Hastalar ameliyat öncesinde ve ameliyattan sonra birinci gün, birinci ay, üçüncü ay, altıncı ay ve on ikinci ayda muayene edildi. Olguların başlangıç ve takip muayenelerinde tüm göz muayene bulguları değerlendirildi.

Bulgular: Tüm hastalarda ortalama yaş 56,3 yıl idi (22-73 yıl). Hastalarımızda ameliyat öncesi ortalama görme keskinliği 20/800 düzeyinde idi. Ameliyat sonrası on ikinci ayda bu değer ortalama 20/160 düzeyine yükseldi. On ikinci aydaki değerlendirmede olguların % 75,4'ünde görme keskinliği düzeyinde artış belirlendi. Subkonjonktival kanama 7 gözde (% 13,2), trocârın yerinden çıkması 4 gözde (% 7,5) ve konjonktiva giriş yerinde sıvı sızdırması 2 gözde (% 3,7) tespit edildi. Ameliyat sonrası komplikasyonlar olarak 8 gözde (31 gözün 8'inde) katarakt (% 25,8), 8 gözde göz içi basınç yüksekliği (% 15,1), 4 gözde hipotoni (% 7,5), 1 gözde (15 gözün 1'inde) silikon yağına bağlı subkonjonktival bleb ve 2 gözde konjonktiva iritasyonu (% 3,7) belirlendi.

Sonuç: Bu çalışmanın sonuçlarına göre 23-gauge transkonjonktival sütürsüz pars plana vitrektomi arka segment hastalıklarının yönetiminde etkin ve güvenilir bir yöntemdir.

Anahtar sözcükler: 23-Gauge pars plana vitrektomi, intraoperatif komplikasyonlar, postoperatif komplikasyonlar, transkonjonktival sütürsüz vitrektomi

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Introduction

The 20-gauge pars plana vitrectomy (PPV) procedure is the most commonly performed operation in modern vitreoretinal practice. The disadvantages of 20-gauge PPV include excess traumatic conjunctival and scleral manipulation, less postoperative patient comfort, more postoperative corneal astigmatism, extended visual recovery, and greater postoperative intraocular inflammation (1). Suture related problems such as suture erosion, scleral necrosis, and granulation formation may occur in this technique (2). Development of vitreoretinal surgical techniques is of interest in efforts to ensure minimal damage or lesions to tissues. Chen (3) described a new technique of creating self-sealing pars plana sclerotomies in 1996. In 2002, Fujii et al. (4) developed the feasibility of a 25-gauge transconjunctival sutureless pars plana vitrectomy (TSPPV) system. Although this method had found favour with many vitreoretinal specialists, a significant proportion has found the thin 25-gauge instrumentation to be too flexible (5). In response, Eckardt (6) developed a 23-gauge instrumentation method for TSPPV in 2005. TSPPV depends on smaller diameter instruments and conjunctival displacement before making the transconjunctival sclerotomies so that the conjunctiva covers the sclerotomy after surgery is completed.

In this study, we evaluated the long-term outcomes and complications of 23-gauge TSPPV in the management of vitreoretinal disease.

Materials and methods

All procedures were conducted in accordance with the Declaration of Helsinki, and informed consent was obtained from all patients. This prospective study was performed with standard 23-gauge TSPPV in 53 eyes of 53 patients who were admitted to the Turkish Ministry of Health Ankara Ulucanlar Eye Education and Research Hospital Retina Clinic between July 2006 and September 2007. Patients with a history of prior vitreoretinal surgery and any corneal pathology were excluded from the study. Prior to the surgical intervention, a complete ophthalmologic examination was performed, including best-corrected visual acuity (BCVA), intraocular pressure (IOP) with applanation tonometry, slit-lamp biomicroscopy, and dilated fundus examination. Visual acuity was measured

with the Snellen chart. For statistical analysis, Snellen values were converted to the logMAR chart. Follow-up examinations were performed at day 1, week 1, and months 1, 3, 6, and 12 after surgery. All patients diagnosed with nonclearing vitreous haemorrhage had a preoperative ultrasonography for the detection of coexisting retinal detachment.

The 23-gauge TSPPV was performed for the following retinal conditions: proliferative diabetic retinopathy with vitreous haemorrhage ($n = 25$), rhegmatogenous retinal detachment ($n = 13$), central retinal vein occlusion with vitreous haemorrhage ($n = 5$), idiopathic macular hole ($n = 4$), idiopathic epiretinal membrane ($n = 3$), and vitreous condensation secondary to Behçet's disease ($n = 3$). The preoperative characteristics of patients are summarised in Table 1.

All surgeries were performed under local anaesthesia by retrobulbar injection. The Dutch Ophthalmic Research Company (DORC, Zuidland, Netherlands) 23-gauge system was used in all cases. The technique used in every case was the insertion of a cannula, using a bevelled trocar, following displacement of the conjunctiva to purposefully misalign the conjunctival and scleral incisions with oblique entries. Transscleral cannulae were placed through the pars plana in the superonasal, superotemporal, and inferotemporal quadrants, according to standard vitrectomy protocol. All eyes underwent core vitrectomy followed by the removal of the posterior hyaloid membrane and vitreous traction. Retinal photocoagulation was performed in the selected eyes. In the required eyes, the fluid in the vitreous cavity was exchanged with air, gas, or silicone oil after vitrectomy. The infusion line was then clamped, the superonasal cannula was removed, and the conjunctiva was repositioned to cover the sclerotomy completely. The infusion line was then unclamped and the sclerotomy site was inspected for fluid leakage. The superotemporal cannula was removed in the same fashion, using the clamp-unclamp technique of infusion followed by inspection. Finally, the inferotemporal cannula and infusion line were removed en bloc, followed by the repositioning and inspection of the conjunctiva. Inferonasal subconjunctival antibiotics and corticosteroids were then injected.

Table 1. Preoperative characteristics of the studied patients.

Patients		Number	%
Sex	Female	23	43.4
	Male	30	56.6
	Total	53	100
Diagnosis	Proliferative diabetic retinopathy with vitreous haemorrhage	25	47.2
	Rhegmatogenous retinal detachment	13	24.5
	Central retinal vein occlusion with vitreous haemorrhage	5	9.4
	Idiopathic macular hole	4	7.5
	Idiopathic epiretinal membrane	3	5.7
	Vitreous condensation secondary to Behçet's disease	2	5.7
	Total	53	100

Statistical analysis was performed using a 2-tailed paired t-test and the statistical significance was set as $P < 0.05$. All statistics in this study were analysed with SPSS for Windows (SPSS Inc., Chicago, IL, USA).

Results

This study prospectively enrolled 53 eyes of 53 patients who underwent 23-gauge TSPPV. Of the 53 patients, 30 (56.6%) were male and 23 (43.4%) were female. The mean age of the patients was (mean \pm SD) 56.3 ± 8.9 (range: 22-73) years. All of patients were followed for 12 months.

The mean preoperative BCVA was 20/800 (range, hand motions: 20/30). The mean overall postoperative BCVA was 20/1000 (range, hand motions: 20/30) at day 1, 20/800 (range, hand motions: 20/30) at week 1, 20/500 (range, hand motions: 20/30) at month 1, 20/400 (range, hand motions: 20/25) at month 3, 20/200 (range, hand motions: 20/25) at month 6, and 20/160 (range, hand motions: 20/20) at month 12. Postoperative visual acuity increased in 14 patients (26.4%) on day 1, 19 patients (35.8%) at week 1, 26 (49.1%) at month 1, 31 (58.5%) at month 3, 37 (69.8%) at month 6, and 40 patients (75.4%) at month 12. The visual acuity recorded at the last follow-up was better than the first visit in 40 eyes (75.4%), worse

in 7 eyes (13.2%), and the same in 6 eyes (11.3%). The difference between preoperative BCVA and postoperative BCVA on day 1 ($P = 0.72$) and week 1 ($P = 0.11$) were not statistically significant. A statistically significant increase in BCVA was established at the 1-, 3-, 6-, and 12-month visits compared to the preoperative BCVA ($P = 0.001$). Secondary epiretinal membrane formation ($n = 2$, 3.8%), optic atrophy ($n = 2$, 3.8%), subretinal membrane formation ($n = 1$, 1.9%), cystoid macular oedema ($n = 1$, 1.9%), and phthisis bulbi ($n = 1$, 1.9%) were the leading causes of visual loss at the 12-month visit.

The mean overall preoperative IOP was (mean \pm SD) 13.1 ± 4.09 mmHg (range: 9-20 mmHg). The mean overall postoperative IOP was 14.3 ± 7.37 mmHg (range: 5-40 mmHg) on day 1, 14.7 ± 7.12 mmHg (range: 10-43 mmHg) at week 1, 14.4 ± 4.60 mmHg (range: 10-35 mmHg) at month 1, 14.03 ± 3.74 mmHg (range: 11-30 mmHg) at month 3, 13.7 ± 4.03 mmHg (range: 10-35 mmHg) at month 6, and 13.34 ± 4.30 mmHg (range: 12-21 mmHg) at month 12. Hypotony (IOP < 8 mmHg) was observed in 4 (7.5%) eyes on postoperative day 1. IOP in these cases normalised within 7 days with pressure patching. IOPs higher than 22 mmHg were detected in 8 (15.1%) eyes on postoperative day 1 and were treated with antiglaucoma drops (brinzolamide

1%). A common feature of these 8 patients was that they all received 1000-cSt silicone oil, and 6 of these patients transiently required ocular hypertension treatment, with IOP normalising before silicone oil removal. At month 1, 1 eye required silicone oil removal, and IOP values were observed to be between 12 and 19 mmHg during the follow-up. Secondary to the natural progression of advanced proliferative diabetic retinopathy, one additional patient developed intractable neovascular glaucoma. Molteno tube implantation was performed in this patient at month 6 for neovascular glaucoma. The IOP of 41 patients (77.3%) remained within the normal limits at all times during the postoperative period (range: 9-20 mmHg). The difference between preoperative and postoperative IOPs on day 1 ($P = 0.36$) and at week 1 ($P = 0.17$), month 1 ($P = 0.21$), month 3 ($P = 0.33$), month 6 ($P = 0.54$), and month 12 ($P = 0.81$) were not statistically significant. The changes in the mean best-corrected visual acuities are shown in the Figure.

Before surgery, 39 eyes were phakic, 13 eyes were pseudophakic, and 1 eye was aphakic. Intraoperative iatrogenic cataract formation was not observed in any of the eyes, and 8 eyes (15.1%) were operated

on for cataract simultaneously with the vitrectomy. During the follow-up period, 12 eyes of the 31 phakic eyes (38.7%) had progression of cataracts, and 8 of these patients (25.8%) underwent cataract extraction and intraocular lens implantation.

In patients undergoing 23-gauge TSPPV, a complete vitreous fill of fluid, air, gas, or silicone oil tamponade decision was carried out at the conclusion of each case. As a result, 16 eyes (30.1%) were infused with fluid, 15 eyes (28.3%) were infused with silicone oil, 12 eyes (22.6%) were infused with gas, and 10 eyes (18.8%) were infused with air. Silicone oil tamponade was achieved with 1000-cSt silicone oil and gas tamponade was obtained with perfluoropropane. Postoperative complications occurred in 2 patients with rhegmatogenous retinal detachment; these patients developed proliferative vitreoretinopathy and retinal redetachment at month 1. The retina was successfully reattached with subsequent 23-gauge TSPPV in these cases. The silicone oil was completely removed from all of the eyes, with no significant residual oil in the anterior chamber or in the vitreous cavity seen in indirect ophthalmoscopy at the end of 6 months.

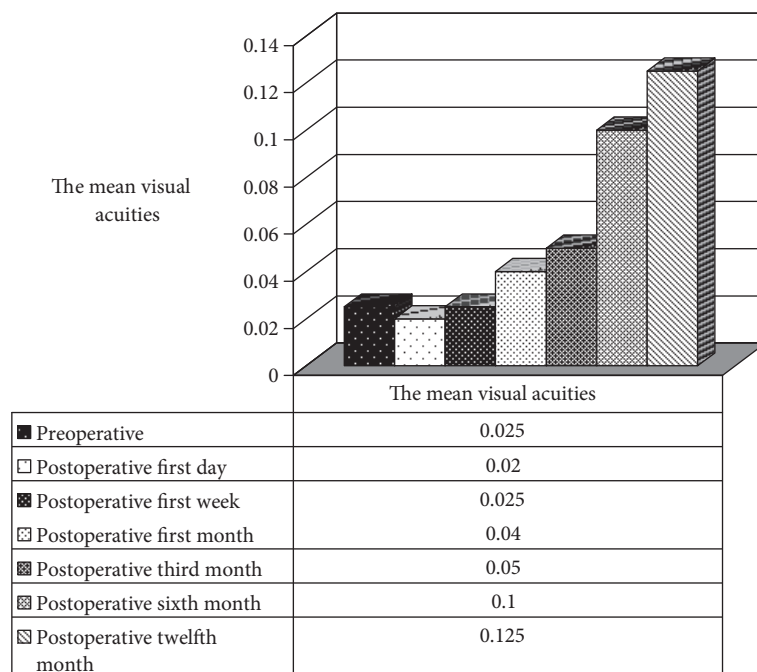


Figure. Changes in mean best-corrected visual acuities.

The most commonly reported intraoperative complications were subconjunctival haemorrhage (7 eyes, 13.2%), move of trocar during manipulation (4 eyes, 7.5%), and fluid leakage to conjunctival entry sites (2 eyes, 3.7%). In 1 case (1.9%) with vitreous haemorrhage and tractional retinal detachment, sclerotomy of the dominant-hand side was converted into a 20-gauge procedure for the peeling of advanced subretinal and fibrovascular proliferative membrane. Subconjunctival egress of silicon oil (1 of 15 eyes, 6.6%) and subconjunctival leaking of infusion fluid (1 of 16 eyes, 6.2%) while removing the upper temporal and upper nasal cannula were observed at the end of the surgery. Due to leaking sclerotomies, 3 eyes (5.6%) required sutures at the end of the case. Postoperative complications included cataract formation in 8 of 31 eyes (25.8%), elevated IOPs in 8 eyes (15.1%), hypotonia in 4 eyes (7.5%), subconjunctival bleb of silicone oil in 1 of 15 eyes (6.6%), and conjunctival irritation in 2 eyes (3.7%). A localised bleb of

subconjunctival silicone oil was removed during slit-lamp examination with a 23-gauge needle in a patient without reaccumulation of subconjunctival oil. There were no cases of postoperative retinal or choroidal detachment. Through the follow-up visits, none of the 53 eyes developed endophthalmitis. Complications related with 23-gauge TSPV seen during operation, at the end of surgery, and at the postoperative period are summarised in Table 2.

Discussion

A new technique of creating self-sealing pars plana sclerotomies was described by Chen (3). Kwok et al. (2) described the modified sutureless sclerotomy technique, especially in eyes with small interpalpebral space. Korobelnik et al. (7) subsequently studied 292 self-sealing sclerotomies, of which 22 (7.5%) required suturing. Fujii et al. (4) first described the 25-gauge TSPV, including straight entry through the sclera

Table 2. Complications related with 23-gauge transconjunctival sutureless pars plana vitrectomy.

Complications		Number	%
Intraoperative	Subconjunctival haemorrhage	7	13.2
	Move of trocar during manipulation	4	7.5
	Fluid leakage to conjunctival entry sites	2	3.7
	Conversion to 20-gauge	1	1.9
End of surgery	Subconjunctival egress of silicon oil (15 eyes)	1	6.6
	Subconjunctival leaking of infusion fluid (16 eyes)	1	6.2
	Suture necessary for sclerotomy	3	5.6
Postoperative	Cataract formation (31 eyes)	8	25.8
	Elevated IOPs	8	15.1
	Hypotonia	4	7.5
	Subconjunctival bleb of silicone oil (15 eyes)	1	6.6
	Conjunctival irritation	2	3.7
	Retinal detachment	-	-
	Choroidal detachment	-	-
Endophthalmitis	-	-	

perpendicular to the limbus. They established that the use of 25-gauge TSPPV may effectively reduce operative time in selected cases (4). Many investigators observed transient postoperative hypotonia after 25-gauge vitrectomy (5-8). Additionally, many vitreoretinal specialists found that the 25-gauge instrumentation was too flexible and thin (5). Eckardt (6) developed 23-gauge instruments that were more rigid than those of the 25-gauge system, allowing better peripheral vitrectomy and higher complexity manoeuvres. The wider lumens of the 23-gauge instruments also improved illumination and fluid flow and reduced the net vitrectomy time (6). However, using the larger gauge system theoretically introduces additional concerns related with wound leakage, including hypotony, choroidal detachment, the leakage of tamponade agents resulting in a subsequent shorter tamponade effect, filtering bleb formation at sclerotomy sites, subconjunctival tamponade agents, and endophthalmitis. Eckardt (6) also described the oblique tunnel incision of the 23-gauge TSPPV system using a 2-step approach, which reduces the potential complication of postoperative wound leakage. Recently, standard straight 25-gauge incisions were changed to oblique incisions to decrease postoperative leakage and to improve wound closure (9,10).

Lott et al. (11) reported that postoperative visual acuity improved in 68% of the patients, worsened in 16%, and remained unchanged in 16% with 23-gauge TSPPV. In our study, visual acuity increased in 75.4% of the eyes. Visual acuities on the first and last visits were statistically compared and significant changes were found ($P < 0.05$). No significant change in the BCVA on day 1 and at week 1 was observed. A statistically significant increase in the BCVA was noted at the 1-, 3-, 6-, and 12-month visits when compared to the preoperative visual acuity.

Elevated IOP is a frequent complication in pars plana vitrectomy (PPV) (12). Higher IOPs were detected in 28.5% of eyes after 25-gauge TSPPV and silicone oil injection (13). Shah et al. (14) reported that 11.1% of patients developed ocular hypertension after 25-gauge TSPPV with silicone oil. Of these, all but 1 (5.5%) could not be controlled with antiglaucoma drops and required silicone oil removal. An additional patient (5.5%) developed

recalcitrant ocular hypertension due to neovascular glaucoma. Higher IOPs were detected in 15.1% of our cases. Elevated IOP was controlled with topical medication in 6 of 8 eyes (75%). Silicone oil removal at month 1 was required in 1 eye. An additional patient developed intractable neovascular glaucoma secondary to the proliferative diabetic retinopathy.

Hypotony is a serious complication and among the most important causes of visual loss in 23-gauge TSPPV. The postoperative hypotony rate was reported to be between 2.5% and 6.5% of cases after 23-gauge TSPPV (15,16). We considered hypotony to be present when the IOP was less than 8 mmHg, as did Ibarra et al. (5). In the present study, hypotony was detected in 4 eyes (7.5%) on postoperative day 1, but it was resolved within 7 days with pressure patching postoperatively. Lakhnopal et al. (17) reported that 2 of 140 cases (1.4%) exhibited shallow choroidal detachments after 25-gauge TSPPV, which were resolved in 1 week. We did not observe choroidal effusions after 23-gauge TSPPV.

One of the main complications that appeared in the postoperative period was cataract formation. It was observed in 79.3% of cases after 25-gauge TSPPV (5) and 42% of cases after 23-gauge TSPPV (18). This complication was the result of contact by the instruments with the posterior capsule in an attempt to access the vitreous more anteriorly or by contact between the infusion pathway and the crystalline during transscleral indentation (1). In the present study, iatrogenic intraoperative cataract formation was not observed in any case during surgery. Cataract progression was noted postoperatively in 38.7% of the phakic eyes, and 25.8% of these eyes underwent cataract extraction and intraocular lens implantation.

A previously reported series of 25-gauge vitrectomies demonstrated wound leakage requiring suture placement in 7% of the cases (17). Lott et al. (11) reported that no sutures were required to close sclerotomies in 100 patients undergoing 23-gauge TSPPV. In our series, 3 eyes (5.6%) required sutures at the end of the case for leaking sclerotomies. We had to convert to the 20-gauge technique in 1 case (1.9%), for peeling of advanced subretinal and fibrovascular membrane.

The 23-gauge TSPPV obviates the need for conjunctival peritomy and suturing, and also has

the advantages of the minimally invasive, sutureless vitrectomy system. Severe chemosis was noted in a study by Lott et al. (11) after 23-gauge TSPPV. In the present study, 2 patients (3.7%) complained about subjective conjunctival irritation on postoperative day 1. The postoperative silicone oil bleb formation rate was reported as 5.7% after 25-gauge TSPPV (19). In the present study, subconjunctival bleb of silicone oil was observed in 1 of 15 eyes (6.6%).

The reported incidence of endophthalmitis was 0.018% after 20-gauge vitrectomy and 0.23% after 25-gauge TSPPV (20). No cases of endophthalmitis were observed in our study, despite the theoretically increased risk of infection created by unsutured sclerotomies. This result may be attributable to the superior wound construction, with a longer scleral tunnel, that is generated with the 23-gauge system. Furthermore, an oblique incision (not straight) with 23-gauge TSPPV is less likely to provide a tract for the bacteria to enter the eye.

Tewari et al. (18) reported that retinal tearing during 23-gauge transconjunctival sutureless vitrectomy (TSV) occurred in only 1 of 81 eyes (1.2%). Park et al. (21) reported that retinal tearing during posterior manipulations occurred in 8.6% of

eyes from the 23-gauge group and 15.2% of eyes from the 20-gauge group. In the present study, retinal tears were not observed.

Azar-Arevalo et al. (22) reported that 20-gauge PPV surgery induced central curvature changes, as well as asymmetrical peripheral changes. Their analysis shows that the corneal optical quality and the asymmetry of the anterior chamber curvature deteriorate after 20-gauge PPV. Citirik et al. (23) compared the changes in corneal curvature after 25-gauge TSPPV and conventional PPV. They reported that 25-gauge TSPPV does not significantly alter the corneal curvature, while the conventional pars plana incision changes the shape of central cornea. Less surgically induced astigmatism and early stabilisation in the 23-gauge TSPPV compared to the 20-gauge PPV were reported (24).

According to the results of this study, vitreoretinal surgery with 23-gauge transconjunctival sutureless vitrectomy appears to be an effective and safe technique for the management of posterior segment diseases. Postoperative cataract formation was the most common complication observed. Postoperative endophthalmitis was not noted in this long-term case series.

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