

## Early surgical results of a 23-gauge trocar combined with a one-directional valve system in primary and secondary pars plana vitrectomy

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Received: 10.03.2013 • Accepted: 27.11.2013 • Published Online: 15.08.2014 • Printed: 12.09.2014

**Background/aim:** To elucidate the early surgical advantages of a 23-gauge trocar combined with a one-directional valve system in transconjunctival pars plana vitrectomies.

**Materials and methods:** Early surgical results of 432 eyes of 432 patients (190 female and 242 male) who underwent 23-gauge (23G) transconjunctival sutureless vitrectomies (TSV) were evaluated. Sixty-three patients out of 432 underwent a second operation, 29 of them underwent silicone oil extraction, and 34 had phacoemulsification surgery with the help of vitreous infusion. If any sign of leakage was observed after the withdrawal of the cannulae, a suture was applied at the conjunctiva-scleral opening site.

**Results:** A total of 21 (4.8%) patients in the first operation and 7 (11.1%) cases in the second operation needed suture in at least 1 sclerotomy site. No one had intraoperative hypotony. On postoperative day 1, 37 initial surgery patients and 3 second TSV patients had hypotony; all of them resolved spontaneously 1 week after surgery. No one developed choroidal effusions or detachment. Intraocular pressure spikes more than 22 mmHg in day 1 occurred in 18 eyes after initial TSV; 6 of them had gas and 4 eyes had silicone tamponade.

**Conclusion:** 23G TSV is an effective and safe procedure for both first vitreoretinal surgery and second intraocular surgeries in eyes that had TSV previously.

**Key words:** 23G trocar, pars plana vitrectomy, postoperative hypotonia

### 1. Introduction

After Eckard's description of a 23-gauge (23G) self-sealing sutureless transconjunctival pars plana vitrectomy technique in 2005, it has been widely used in vitreoretinal surgery (1,2).

Owing to the small incision and lack of suture, 23G transconjunctival sutureless vitrectomy (TSV) decreases surgical time and minimizes surgical trauma, which decreases postoperative inflammation, patient discomfort, and postoperative recovery time. In addition, wound-related complications such as leakage, intraoperative and postoperative hypotony, risk of endophthalmitis, irritation due to sutures, and subconjunctival silicone oil and scleral pigmentary changes could also be avoided.

To stabilize intraocular pressure (IOP) during surgery and to achieve more stabilized wound configuration, a specially-designed 23G trocar combined with a 1-directional valve system with a cap was chosen.

To elucidate surgical advantages, we report the early results of our patients who underwent TSV in both primary operations and reoperations.

### 2. Materials and methods

In this study, 23G TSV with a 1-step trocar combined with a 1-way valve system with a cap (DORC, Holland) was performed in 432 eyes of 432 patients. All patients provided informed consent before the operation. A total of 432 patients (190 female and 242 male) were included in this study. The mean age was  $68.12 \pm 12.4$  years (minimum 48, maximum 79) (Table 1).

All patients underwent a complete ophthalmic examination, including pre- and postoperative visual acuity, IOP measurement, and anterior and posterior segment examinations. Hypotony was defined as IOP equal to or less than 6 mmHg.

The indications for vitrectomy were vitreous hemorrhage, proliferative diabetic retinopathy, both tractional and rhegmatogenous retinal detachment, epiretinal membrane, macular hole, dropped IOL, or nucleus extraction and silicone oil removal.

A posterior sub-Tenon's injection was performed for anesthesia in all patients at the inferonasal quadrant. The surgical approach consisted of displacing the conjunctiva

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**Table 1.** Demographic findings of patients and follow-up periods for primary and secondary TSV.

Patients n = 432	190 females, 242 males
Mean age: 68.12 ± 12.4 years (48–79)	Female 67.69 ± 10.5 years (48–76) Male 69.12 ± 13.2 years (49–79)
Mean follow-up period: 12.7 months (7–36)	Primary TSV mean 14.6 months (9–36) Secondary TSV mean 9.8 months (7–29)

about 2–3 mm laterally using a specially designed pressure plate (DORC, Holland) to stabilize the eye and hold the conjunctiva firmly to the sclera. Then a 20–30° angled tunnel incision was made through the conjunctiva, sclera, and pars plana, 3.5 mm from the corneoscleral limbus with a specially designed 23G sharp trocar overlying cannula combined with a valve system with a cap on it. The scleral incisions were made in the inferotemporal, superotemporal, and superonasal quadrants, obliquely parallel to the corneoscleral limbus (Figure 1). The infusion cannula was inserted into the inferotemporal quadrant while superior incisions were used for insertion of surgical manipulation devices such as a vitrectomy probe, endoillumination probe, back-flush needle, endodiathermia probe, and endolaser probe. With the help of a valve system, the plug insertion into the trocar system was not performed and hypotony was never encountered during the surgery (Figure 2).

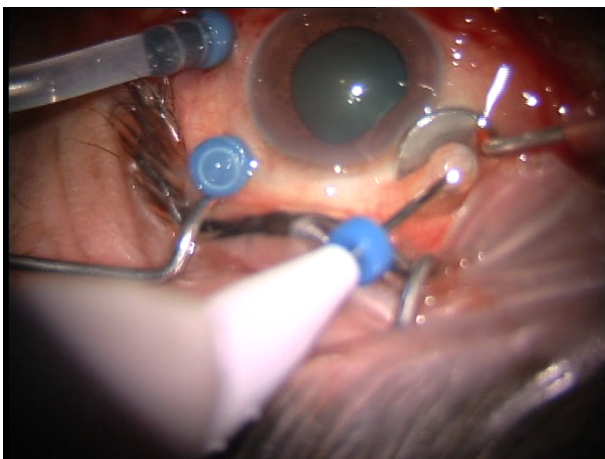
At the end of the surgery, the cannulae were withdrawn with specially designed cannular forceps (DORC, Holland). Gentle pressure with a cotton tip applicator was applied on the scleral tunnel incision site without extra intervention. To enhance the sealing of the conjunctiva-scleral incision, the displaced conjunctiva was returned to its original position. When subconjunctival bleeding

was observed, a short tamponade with gentle pressure and a cotton tip applicator over the bleeding site was applied until the hemorrhage was stopped. If any sign of leakage was observed, suture was applied at the previous conjunctiva-scleral opening. At the end of the surgery, an antibiotic and steroid combination was injected into the inferonasal quadrant that was used for posterior sub-Tenon's anaesthesia. All operations had been performed with same technique and by the same experienced surgeons who participated in this study.

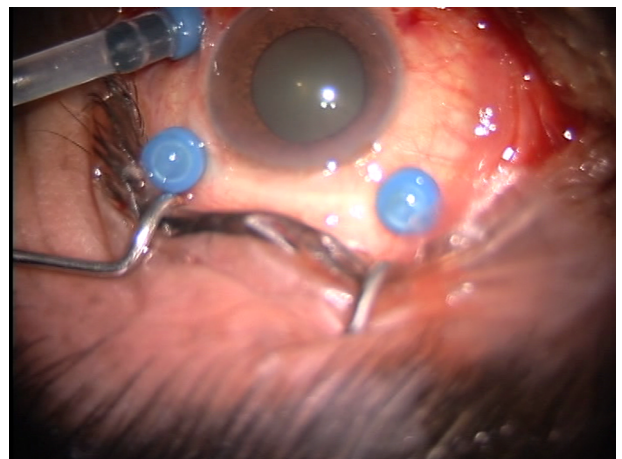
Sulfur hexafluoride (SF<sub>6</sub>) was used in 136 eyes, octafluoropropane (C<sub>3</sub>F<sub>8</sub>) was used in 198 eyes, air was used in 13 eyes, and silicone oil was injected in 64 eyes. Twenty-one eyes in the initial operation and 63 patients who underwent a second operation left with BSS, in which any fluid–gas exchange was not performed.

### 3. Results

All patients were evaluated for surgical safety and surgery-related problems, such as incision-related problems and anterior and/or posterior segment problems both intraoperatively and postoperatively. Sutures were required in a total of 21 (4.8%) patients with at least 1 sclerotomy, due to intraoperative wound leakages. Suture was needed in only 1 sclerotomy for 10 eyes (2.3%), while 6 eyes



**Figure 1.** Tunnel incision by 23G sharp trocar overlying cannula combined with valve system.



**Figure 2.** Cannulae with cap.

(1.3%) underwent closure of 2 sclerotomy sites and 5 eyes (1.1 %) required sutures in all 3 sclerotomy sites. Out of 37 sutures, 18 suture placements (48.6%) were performed in the superior quadrant on the dominant hand side, 12 sutures (32.4%) were necessary on the nondominant hand side, and only 7 sutures (18.9%) were needed in the inferotemporal quadrant, which was used for infusion cannulae.

All the cannulae remained stable in their appropriate place. No slippage or loss of the cannulae or any other anterior segment complication, such as damage to the crystalline lens by the cannulae, was observed.

No one had intraoperative hypotony, thanks to the help of the specially designed 1- directional valve cannula system with a cap, in which only outer-to-inner passage is possible. Therefore, no one had retinal or vitreous hemorrhage due to intraoperative decompression. Intraoperative tears on sclerotomies did not develop as a posterior segment related complication of cannulae.

Diathermia through the conjunctival opening at the end of operation was not performed in any case. No one had required postoperative suture placement during the follow-up period for bleb formation as a sign of subconjunctival leakage of gas tamponade or silicone oil.

Thirty-seven patients (8.5%) had hypotony after primary TSV on postoperative day 1, and 3 patients had hypotony after the second operation; all of them resolved spontaneously 1 week after surgery. Out of 37 eyes, 17 eyes had SF6, 14 eyes had C3F8, and 6 eyes had BSS as a vitreous tamponade. In eyes filled with SF6, 6 eyes underwent surgery for the epiretinal membrane, 6 eyes for vitreous hemorrhage, 3 eyes for macular holes, and 2 eyes for proliferative diabetic retinopathy. In eyes with C3F8, 7 eyes underwent surgery for epiretinal membrane peeling, 4 eyes for macular holes, 2 eyes for vitreous hemorrhage, and 1 eye for proliferative diabetic retinopathy. Four eyes

that were operated on for vitreous hemorrhage and 2 eyes for dropped IOL extraction in whom no tamponade was used developed temporary hypotony. Three patients who had hypotony after the second surgery for silicone oil extraction were also left without any tamponade (Table 2). Nine patients with hypotony had sclerotomy sutures at in least 1 sclerotomy; 6 of them had only 1 suture and 3 had 2 sutures. No one developed choroidal effusion or detachment due to leakage and hypotony postoperatively at any time during the follow-up period. Vitreous or retinal incarceration or endophthalmitis was not observed in any case.

Three patients who had degenerative myopia did not develop sclerotomy-related problems such as leakage or hypotony during the follow-up period. Suture placements were not required in any of them.

A total of 63 patients underwent further intraocular surgery; 29 of them had undergone silicone oil extraction operation and 34 phacoemulsification surgery after TSV surgery. Three sclerotomy incisions were done for silicone oil removal and 1 sclerotomy was performed in the inferotemporal quadrant for insertion of an infusion cannula to use for stabilizing the anterior chamber and to prevent its excessive deepening during phacoemulsification. The mean time for the second operation was 6.4 months (9 weeks–13 months) after TSV. We did not have any difficulties in performing new sclerotomies and corneal incisions in the second operations and did not observe any problems related to previous sclerotomies, such as reopening, leakage, or hypotony during the operation and or the follow-up period in any patient who had or had not sutures in previous surgery. Only 7 (11%) patients out of 63 needed sutures for scleral closure. All of them had undergone silicone oil extraction. Four patients had also needed suture placement in the initial surgery, while 3 had not.

**Table 2.** Surgical indications and vitreous tamponade in eyes that had postoperative hypotony after primary and secondary TSV.

	SF6	C3F8	BSS
Primary TSV n = 37	ERM = 6 VH = 6 MH = 3 PDR = 2	ERM = 7 MH = 4 VH = 2 PDR = 1	VH = 4 IOL dropped extraction = 2
Secondary TSV n = 3			Silicon oil extraction = 3

TSV: Transconjunctival sutureless vitrectomy.

ERM: Epiretinal membrane.

MH: Macular hole.

VH: Vitreous hemorrhage.

PDR: Proliferative diabetic retinopathy.

The mean preoperative IOP was  $13.15 \pm 8.7$  mmHg (9–18 mmHg) and mean postoperative IOP was  $10.8 \pm 4.15$  mmHg (5–28 mmHg) 1 day after surgery and it was  $14.36 \pm 5.12$  mmHg (10–20 mmHg) after 1 month.

A total of 40 patients had hypotony on postoperative day 1, and all of them resolved without treatment in 1 week. No one developed choroidal effusion or detachment after either surgery. Intraocular pressure spikes more than 22 mmHg occurred in 18 eyes (4.1%) on postoperative day 1; 6 of them (1.3%) had a gas tamponade and 4 eyes (0.9%) had silicone oil. No one needed another intervention, such as silicone oil removal for increased IOP. IOP spikes after the second surgery were not observed and no one had IOP-related complications after either surgery (Table 3).

#### 4. Discussion

For a wide variety of vitreoretinal surgical indications, 23G TSV is a safe and effective surgical technique. In this study, we applied the 23G TSV technique to patients for both primary surgeries and reoperations. A total of 21 (4.8%) eyes out of 432 required suturing due to leakage after removal of cannulae in the initial operation and 7 out of 63 (11%) had scleral sutures in the second operation. Although the incidence of suture requirements was higher in the second operation group than in the initial surgery group in our series, the number of patients in each operation group was not comparable; therefore, statistical analysis was not performed. Chieh et al. reported that 38% of 118 eyes required suture placements and the suture placement incidence was 15% in Singh et al.'s series of 93 patients (3,4). Gupta et al. reported that sclerotomy sutures were required intraoperatively in 22% out of 92 patients (5). Woo et al. performed suture placements in 11.2% of their patients, and found that a younger age (less than 50 years), vitreous base dissection, and history of prior vitrectomy were risk factors for requirement of suture placement (6). The mean age of our patients was  $68.12 \pm 12.4$  and a total of 24 patients were younger than 50 years old. Even if we did not observe any difference in the young age group, the number of young patients in our study was much lower than that of the older patients and therefore no statistical evaluation was possible.

Parolini et al. observed requirement of suture placements in 3.9% of their patients (7). Erakgun and Egrilmez reported that 3% of their 40 patients required sutures (8), but they observed silicone oil migration to the subconjunctival space in some.

Postoperative leakage may be associated with some important complications, such as reduced endotamponade effect, postoperative chemosis, discomfort, and interference with subsequent glaucoma filtering surgery. To avoid possible complications, we prefer transconjunctival suture placement, most of them for preventive purposes in our patients. Even though our incidence of suture placements in both initial and second operations was lower than those of some other authors' series, the suture incidence in initial surgery was little higher but still correlated with Parolini's and Erakgun's series. Fortunately, we did not observe any silicone oil migration under the conjunctival space and subconjunctival leakage that could have caused bleb formation in either the initial or the second operation.

Wound leaks and hypotony may cause an influx of bacteria that increases the risk of endophthalmitis. We did not observe endophthalmitis in our series; we propose that TSV does not increase the risk of endophthalmitis. Fine et al. observed 1 case of sterile endophthalmitis in their series of 77 cases, which was less than our total number of cases (9).

We observed transient early postoperative hypotony in day 1 in 37 cases (8.5%) after initial TSV. All of them resolved spontaneously in 1 week, which was also the most common complication in our series. Schweitzer et al. observed postoperative hypotony in 21.1% of their cases; postoperative hypotony was the most common complication in their series also (10). Postoperative hypotony was observed in 6.5% of cases in Gupta et al.'s series and 3.4% in Chieh et al.'s series (3,5). It was seen in 3 out of 164 cases in de Preobrajensky et al.'s report and 4 cases out of 50 (8%) in Misra et al.'s series (11,12). Our postoperative hypotony incidence is correlated with other series. Woo et al. observed postoperative hypotony in 11.3% of cases at 2 h, 6.5% at 5 h, and 3.8% at day 1 (6). It is well known that the level of IOP may change due to diurnal variation. Moreover, postoperative hypotony

**Table 3.** Distribution of suture requirements and IOP changes after primary and secondary TSV.

	Primary TSV (n = 432)	Secondary TSV (n = 63)
Suture requiring leakage	21 (4.8%)	7 (11.1%)
Postoperative hypotony ( $\leq 6$ mmHg)	37 (8.5%)	3 (4.7%)
Postoperative IOP spike ( $>22$ mmHg)	18 (4.1%)	0

TSV: Transconjunctival sutureless vitrectomy.

depends on several other factors such as surgical technique, indication, equipment, and intraocular tamponades. Therefore, the incidence of hypotony may vary in different series. All of our operations were performed with the same technique and equipment and by the same experienced surgeons. Due to a low number of patients who developed hypotony after surgery with different indications using different tamponades, we could not statistically analyze the relationship between these factors in our study.

Choroidal detachment did not develop in our series. Parolini et al. observed 1 choroidal detachment (0.1%) in their 943 cases, and it spontaneously resolved 1 week after surgery (7). Two eyes of 114 patients (1.7%) developed choroidal effusion in Chieh et al.'s series (3).

A total of 63 patients in our series underwent further surgery after initial TSV; we did not have any difficulties in performing new sclerotomies and/or corneal incisions in second operations. Even though the shortest time between the initial and the second operation was a little longer than 1 month, no problems related to previous

sclerotomies, such as reopening and leakage during the second operation under pressure, were observed. According to our observation, a 1-month period is sufficient for sclerotomy healing between 2 operations and suture placement incidences in the second operation were not related to having a suture in the initial operation.

Severe subconjunctival hemorrhage, suture related inflammation, and conjunctival scarring were not observed in our series in the initial operation or after the reoperation period.

Owing to small incisions and a lack of sutures in most of the patients, 23G TSV minimizes surgical trauma, improves patient comfort, decreases suture related inflammation, and diminishes long-term conjunctival scarring with proper scleral wound healing.

According to the early postoperative results of our observation, 23G TSV with a valved trocar system is a safe procedure for wound closure, intraocular pressure stabilization, and ocular complications due to hypotony for both initial operations and reoperations.

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