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CLINICAL INVESTIGATION

Expanded Indications for 25-Gauge Transconjunctival Vitrectomy

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Abstract

Purpose: We conducted 25-gauge (25G) transconjunctival vitrectomy to treat patients with various ocular diseases, and examined the possibility of expanding the indications for this system through combined use with 20G devices when needed.

Methods: The records of 167 patients (169 eyes) who underwent vitrectomy in our hospital between April and June 2004 were studied. Vitrectomy had been conducted using the 20G or 25G transconjunctival vitrectomy system.

Results: In 7 of the 169 eyes (4%), the 20G system was initially selected. Vitrectomy could be performed using the 25G system alone in 150 eyes (89%), while 20G devices were used in combination with the 25G system in 12 (7%). None of the 25G scleral wounds were sutured, while all the 20G scleral wounds were sutured at the completion of surgery. Low intraocular tension was noted in 15 of 162 eyes (9%), but all these eyes recovered within 2 to 4 days. In two eyes with macular hole, retinal detachment occurred, but reattachment was achieved after reoperation. No extensive vitreoretinal hemorrhage or postoperative infection was observed.

Conclusions: By combining the use of 20G devices, indications for the 25G system can be expanded. However, postoperative low ocular tension must be addressed by carefully considering surgical indications and prevention measures. **Jpn J Ophthalmol** 2005;49:397–401 © Japanese Ophthalmological Society 2005

Key Words: 20-gauge devices, 20-gauge transconjunctival vitrectomy, 25-gauge transconjunctival vitrectomy, liquid–air/gas exchange, low intraocular tension

Introduction

In conventional 20-gauge (20G) vitrectomy using a three-port system, which requires a large incision in the conjunctiva, problems of postoperative foreign body sensation, incarceration of the conjunctiva into the scleral wound, congestion, and hemorrhage due to the sutures are commonly encountered. In addition, the wide incision in the conjunctiva may interfere with subsequent glaucoma filtering surgery.

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In view of these problems, we designed a new 20G transconjunctival vitrectomy method, and examined the usefulness of this method in 431 patients (433 eyes).[1] This modality was indicated for 99% (429/433 eyes) of all ocular diseases. Moreover, it was not limited by intraocular instruments. However, since cannulas were not placed in all ports, conjunctival edema due to perfusion fluid occurred during the surgery. Moreover, one stitch is placed for the infusion cannula port and two sutures each for the cutter and light guide ports. For this reason, foreign body sensation, congestion, and bleeding may be slightly more marked than with the 25-gauge transconjunctival vitrectomy, but the frequency of incomplete closure and low intraocular tension may be low (1%, 3/433 eyes) because of the sutures.

The introduction of 25-gauge (25G) transconjunctival vitrectomy, which does not require conjunctival dissection or scleral suturing, has made vitrectomy a less invasive pro-

cedure. However, it has certain limitations, including the type of intraocular forceps that can be used,[2–4] and leakage of intraocular fluid may occur when peripheral vitrectomy is done thoroughly. The 25G surgical indication is thought to be limited to macular surgery and to not be suitable for proliferative vitreoretinopathy or proliferative diabetic retinopathy. The main reason is that with the 25G system, it is more difficult to maneuver in the vitreous body and there is more flexibility than with the 20G system.

In the present study, we actively performed peripheral vitrectomy and attempted to expand the indications for 25G vitrectomy to a broad range of ocular diseases. We examined the possibility of expanding indications in terms of case and disease coverage by the combined use of 20G devices when subretinal forceps were used. These forceps cannot be used in 25G sclerotomy.

With peripheral vitrectomy, incarceration of the vitreous into the scleral wound cannot be expected, and intraocular liquid leakage leading to low intraocular tension has been a concern. We therefore performed fluid–air/gas exchange in patients who underwent peripheral vitrectomy, and assessed the usefulness of this procedure.

Subjects and Methods

The records of 167 consecutive patients (169 eyes) (84 men and 83 women), 16 to 86 years of age (mean 63 years), who underwent vitrectomy in our hospital between April and June 2004 were studied. Vitrectomy was conducted using the Accurus 800CS surgical system (Alcon Surgical, Fort Worth, TX, USA) with a 20G (Alcon) or 25G (Dorc, Zuidland, the Netherlands) vitrectomy system. One-hundred-twenty eyes had primary operations. The 49 eyes that had reoperations comprised 1 eye with postoperative vitreous bleeding, 3 eyes with recurrent epiretinal membrane, 4 eyes with recurrent retinal detachment, and 41 eyes with intraocular lens implantation. Cataract surgery was conducted at the same time as the vitrectomy in 113 eyes. All surgeries were conducted after obtaining informed consent from the patient.

The diseases in the treated eyes were proliferative diabetic retinopathy in 29 eyes, epiretinal membrane in 25, branch retinal vein occlusion in 18, vitreous opacity in 18, retinal detachment in 16, macular hole in 15, diabetic macular edema in 15, proliferative vitreoretinopathy in 10, central retinal vein occlusion in 9, macular hole retinal detachment in 5, retinal angiomatous proliferation in 4, neovascular maculopathy in 3, and pit-macular syndrome in 2 (Table 1).

For vitrectomies with the 25G system, the infusion pressure was maintained at 20 to 40 mmHg, the illumination level at H3, suction pressure at 50 (start) to 600 (end) mmHg, and the cutting rate at 1000 (start) to 800 (end) per minute. Before simultaneous cataract surgery, trocars were used to install three cannulas. The plug was inserted into the cannula. The cataract operation was conducted through an incision in the superior cornea, and a foldable intraocular lens (SA60AT; Alcon) was implanted. The corneal wound was closed with one stitch of nylon 10-0 (Alcon). Next, the plug was removed. An infusion device was inserted, and vitrectomy was conducted. Finally, the three cannulas were removed, and the surgery was completed. Exchange of intraocular fluid was performed for eyes in which the

Table 1. Surgical procedures and frequency of postoperative low ocular tension in 169 eyes

Surgical procedure: no. of eyes (%)	Exchange procedure: no. of eyes (%)	Low intraocular pressure: no. of eyes (%)		Disease: no. of eyes
20G: 7 (4)	Gas: 2 (1), Silicon oil: 5 (3)	0		Proliferative vitreoretinopathy: 7
25G + 20G devices: 12 (7) 25G: 150 (89)	None: 25 (15)	5/25 (20)*		Vitreous opacity: 16 Branch retinal vein occlusion: 6 Central retinal vein occlusion: 2 Epiretinal membrane: 1
	Air: 97 (57)	8/97 (8)	9/132 (7)*	Proliferative diabetic retinopathy: 28 Epiretinal membrane: 24 Branch retinal vein occlusion: 12 Vitreous opacity: 2 Retinal detachment: 16 Macular hole: 15 Diabetic macular edema: 15 Central retinal vein occlusion: 7 Macular hole retinal detachment: 3 Retinal angiomatous proliferation: 4 Proliferative vitreoretinopathy: 1 Neovascular maculopathy: 3 Pit-macular syndrome: 2
	Gas: 35 (21)	1/35 (3)		
	Silicon oil: 5 (3)	1/5 (20)		Macular hole retinal detachment: 2 Proliferative vitreoretinopathy: 2 Proliferative diabetic retinopathy: 1

25G, 25-gauge transconjunctival vitrectomy; 20G, 20-gauge transconjunctival vitrectomy.
*χ-squared test for independent variable, $P = 0.034$.

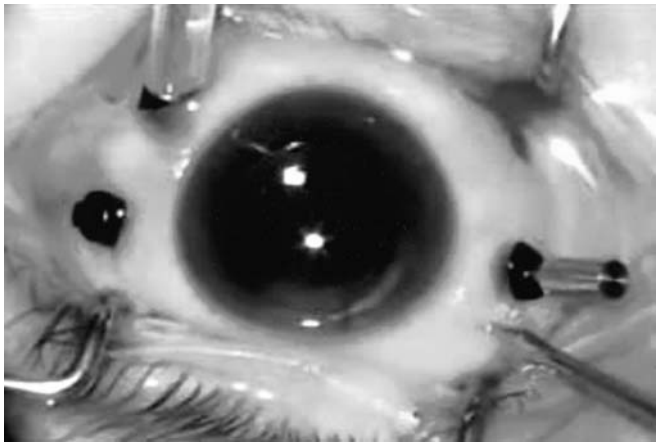

Figure 1. A 25-gauge (25G) vitrectomy system used in combination with 20G vitrectomy devices. At the 10:00 o'clock position, openings were made simultaneously through the conjunctiva and sclera using a 20G microvitreoretinal blade. From these 20G sclerotomies, 20G vitrectomy devices were inserted and vitrectomy was conducted. The conjunctival and scleral wounds were then closed together with Vicryl 8–0 sutures.

peripheral vitreous was removed, preventing the blockage of intraocular fluid leakage by residual vitreous. The agent used for exchange was air, 20% sulfur hexafluoride (SF_6), or silicon oil 1000 cs (Alcon). In 25 eyes in which residual peripheral vitreous was not a problem and the residual vitreous could be expected to block intraocular fluid leakage, liquid–gas/air exchange was not conducted. These eyes comprised 16 eyes with vitreous opacity, 6 with branch retinal vein occlusion, 2 with central retinal vein occlusion, and 1 with epiretinal membrane (Table 1).

Postoperative low ocular tension was diagnosed on the first day after the operation when conjunctival edema due to intraocular fluid leakage was observed and the patient had an intraocular pressure of 10 mmHg or less.

In surgeries in which a combination of the 25G system and 20G vitrectomy devices was used, a plug was inserted into the cannula at the 9:30 position. Then, at the 10:00 position, openings were made through the conjunctiva and sclera together with a 20G microvitreoretinal (MVR) blade (Alcon) (Fig. 1). Twenty-gauge vitrectomy devices were inserted through these 20G sclerotomies to conduct the vitrectomy. The conjunctival and scleral wounds were closed with Vicryl 8-0 suture (Ethicon, Cornelia, GA, USA).

For 20G surgery, the following devices were used: 20G spatula (Dorc), 20G forceps (Dorc), 20G vitreous forceps (Dorc), 20G needle, and a 20G intraocular illuminated laser fiber (Alcon).

Results

Surgical Modality

In seven of the ten eyes with proliferative vitreoretinopathy (7 of a total of 169 eyes; 4%), the 20G system was initially selected for various reasons, including combined buckling surgery, extensive membrane proliferation, and the necessity of using an illuminated laser fiber. None of the cases necessitated switching from 20G to 25G during the operation.

In 150 of the 169 eyes (89%), surgery was successfully completed using the 25G system alone.

In 12 of the 169 eyes (7%), 20G devices were used in combination with the 25G system. In three eyes with neovascular maculopathy, a 20G spatula and 20G forceps were used to remove the choroidal neovascular membrane. In one eye with diabetic macular edema, a 20G spatula and 20G forceps were used to remove the macular deposit. In one eye with proliferative vitreoretinopathy, 20G forceps were used to remove the subretinal strand. In one eye with branch retinal vein occlusion, 20G vitreous forceps were used to remove the tip of a 25G cutter broken intraoperatively. In two eyes with macular hole retinal detachment, one eye with proliferative diabetic retinopathy and two eyes with proliferative vitreoretinopathy, a 25G needle could not be used to inject silicon oil, necessitating the use of a 20G needle. In two eyes with retinal detachment, because a tear was present on the periphery of the retina on the superior side and it was difficult to treat by photocoagulation using a 25G fiber probe, an intraocular illuminated laser fiber was used (this device was also used in cases with multiple complications).

Surgical Complications

A total of 162 eyes, consisting of the 150 eyes that underwent surgery with the 25G system alone and the 12 with 20G devices combined with the 25G system, were evaluated for surgical complications.

Intraoperative complications consisted of accidental entry of air into the anterior chamber from the infusion device in 16 eyes, and breakage of the 25G cutter tip in two eyes (Fig. 2). In one case, the broken tip fell into the eyeground and was picked up using 20G vitreous forceps. In the other eye, the cutter tip was damaged but did not separate from the main cutter and was removed from the 25G cannula. In both cases of cutter breakage, the tip of the cutter broke within 1 min after starting surgery. (After improvement of the early product, there have been no more occurrences of cutter breakage.) Among the 35 eyes with fluid–gas exchange, 5 showed "fish-egg" gas bubbles, which disappeared within a few days after surgery. It was easy to press the sclera for temporal peripheral vitrectomy without cutting the conjunctiva, but it was not easy in the scleral indentation for the nasal peripheral area. There were some cases with pits on the nasal side of the conjunctiva, but there was no need to suture the pits.

A few postoperative complications were observed. In two eyes (1%) with macular hole, retinal detachment occurred as a result of traction at the periphery of the inferior retina by the residual vitreous, but reattachment was achieved after reoperation. No retinal detachment from the

25G sclerotomy wound, extensive vitreoretinal hemorrhage, or postoperative infection was observed.

None of the 25G scleral wounds were sutured, whereas all the 20G scleral wounds were sutured at the completion of surgery. Low intraocular tension was noted in 15 of 162 eyes (9%) (with choroid detachment in 4 eyes) but all eyes recovered within 2 to 4 days.

However, postoperative low intraocular tension was observed in 5 of 25 eyes (20%) in which intraocular fluid exchange was not performed. On the other hand, postoperative low intraocular tension occurred in 9 of 132 eyes (7%) in which intraocular fluid-air/gas exchange was conducted (Table 2). These eyes included 8 of 97 (8%) with air exchange, 1 of 35 (3%) with gas exchange, and 1 of 5 (20%) with silicon oil exchange. The rate of postoperative low intraocular tension was 7% (9 of 132 eyes) with intraocular fluid-air/gas exchange and 20% (5 of 25 eyes) without intraocular fluid exchange, and was significantly lower in cases with exchange ($P = 0.034$, χ-squared test for independent variable). Postoperative low intraocular tension occurred in 13 of 120 (11%) primary operations and 2 of 42 (5%) reoperations ($P = 0.243$, χ-squared test for independent variable).

In the 28 eyes with proliferative diabetic retinopathy, despite fluid–air exchange being conducted in 27, postoperative low intraocular tension occurred in three (11%). No cases required repeat vitrectomy due to postoperative vitreous hemorrhage.

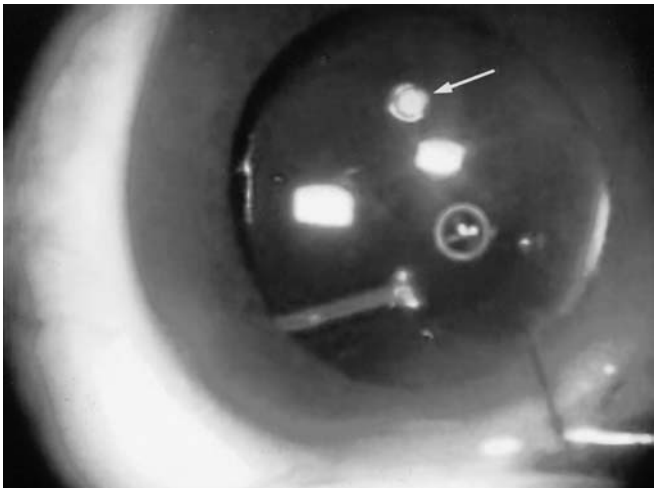

Figure 2. Cutter breakage occurred during surgery in two eyes. The tip of the cutter broke within 1 min after starting surgery. The *arrow* shows the tip of the broken cutter. (Cutter breakage was due to a defect in the early products. There has been no more cutter breakage since product improvement.)

Discussion

The conventional sutureless vitrectomy by self-sealing 20G sclerotomy reported in previous studies used the sclerotomy tunnel method.[5–7] As a result, complications such as intraocular fluid leakage from the wound, hemorrhage, vitreal or retinal incarceration, and retinal break have occurred.[8,9] In 2002, Hilton et al.[10] also studied office-based sutureless transconjunctival pars plana vitrectomy with a 23-gauge vitreous cutter.

In 1990, de Juan and Hickingbotham[2] produced a prototype 25-gauge vitrectomy instrument. In 2002, Fujii et al.[3] developed the 25-gauge transconjunctival sutureless vitrectomy system (TSV25) and published their results. This 25G system has several advantages: neither conjunctival incision nor suturing for sclerotomy is required; there is less congestion, less foreign body sensation, and less retinal incarceration into the scleral wound after surgery; and surgery time is shortened. However, there are also several potential disadvantages. In cases of retinal angiomatous proliferation and neovascular maculopathy, the possibility of postoperative low intraocular tension causing subretinal hemorrhage has to be considered. Since wound closure is achieved by

Table 2. Cases with low intraocular pressure after surgery

Age (years)	Sex	Disease	Primary or reoperation	Exchange procedure	IOP 1 day after surgery (mmHg)	Days taken to recover IOP >10 mmHg
74	Female	Branch vein occlusion	Primary	None	8	2
69	Female	Branch vein occlusion	Reoperation	None	9	2
71	Male	Vitreous opacity	Primary	None	8	3
46	Male	Branch vein occlusion	Primary	None	8	3
33	Male	Vitreous opacity	Primary	None	10	2
59	Male	Macular hole	Primary	Air	4	4
42	Female	Pseudo-macular hole	Reoperation	Air	9	2
62	Male	Proliferative diabetic retinopathy	Primary	Air	8	2
54	Male	Branch vein occlusion	Primary	Air	9	2
51	Male	Pseudo-macular hole	Primary	Air	3	4
73	Female	Branch vein occlusion	Primary	Air	10	2
69	Female	Proliferative diabetic retinopathy	Primary	Air	9	2
60	Female	Proliferative diabetic retinopathy	Primary	Air	8	3
28	Male	Retinal detachment	Primary	Gas	9	3
60	Female	Macular hole retinal detachment	Primary	Silicon oil	6	2

IOP, intraocular pressure.

incarcerating the residual vitreous into the scleral wound, this modality is not suitable for diseases such as proliferative diabetic retinopathy, for which peripheral vitrectomy is required. For cases that require peripheral vitrectomy, it may be necessary to suture the scleral wound.

In the present study, we conducted thorough peripheral vitrectomies, as with conventional 20G vitrectomy. Our results indicate that the indications for this procedure can be extended to proliferative diabetic retinopathy. In proliferative vitreoretinopathy, surgery, it was possible to use 20G devices with the 25G system in three of ten eyes. We were able to expand the indications for the 25G system to 150 of the 169 eyes (89%) in the present series. Therefore, we believe that the 25G system has the potential to become the standard vitrectomy procedure in the near future.

Low intraocular tension reportedly occurs in approximately 30% of cases treated with the 25G system, but the condition is generally resolved within several days.[3] In proliferative diabetic retinopathy, removal of the peripheral vitreous is important for preventing anterior fibrovascular membrane formation after surgery. Conducting peripheral vitrectomy increases the risk of postoperative low intraocular tension, and postoperative hemorrhage is a concern in proliferative diabetic retinopathy cases. For this reason, proliferative diabetic retinopathy has not been considered a good indication for the 25G system. Of the 28 eyes with proliferative diabetic retinopathy in the present study, despite fluid–air exchange being conducted in 27 of the cases, 11% developed postoperative low intraocular tension. However, none required repeat vitrectomy because of postoperative vitreal hemorrhage.

Postoperative low intraocular tension was observed in 5 of 25 eyes (20%) in which intraocular fluid exchange was not done, in contrast to only 9 of 132 eyes (7%) in which intraocular fluid-air/gas exchange was conducted, indicating a low incidence of this complication in exchange cases. These findings indicate that despite not suturing the 25G scleral wounds, thorough peripheral vitrectomy followed by fluid–air/gas exchange, especially gas exchange, reduces the incidence of postoperative low intraocular tension. For those cases that developed postoperative low intraocular tension, there were fortunately no serious postoperative complications such as massive intraocular hemorrhage. Even when gas or air exchange is performed after surgery, suture of the wound may be needed for cases that cannot maintain normal intraocular tension.

For the 25G system, there has been a lag in the development of angular vitrectomy devices such as subretinal forceps, subretinal spatula, and vitreous horizontal scissors, as well as devices with dual functions such as the illuminated laser fiber. In the present study, 20G devices were used in combination with the 25G system in 12 of 169 eyes (7%), further expanding the indications for the 25G system from 150 (89%) to 162 (96%) of the 169 eyes. However, the present study is an interventional case series; the findings of this study have to be further validated by a prospective, comparative study between 20G and 25G. Furthermore, the distribution of cases differs depending on the facility; therefore, it is not necessarily true that 96% of the cases are indicated for 25G surgery in all facilities. In some facilities, there may be a higher frequency of postoperative low intraocular tension. To prevent serious postoperative complications, intervention such as suturing should be considered cautiously when intraocular fluid leakage or inability to maintain normal intraocular tension is noted after surgery.

In the future, with further appropriate application of 20G devices, the 25G system is anticipated to become the standard vitrectomy system.

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