Table 2. Clinical data of 9 eyes causing DITC in 25- or 23-gauge MIVS

Eye No.	Age years	Gender	Diagnosis	Gauge size	Pre-operative IOP, mm Hg	Refractive error, dpt	Choroidal detachment	Size of RD (1–4 quadrants)	Final treatment
1	74	M	OPI	25	–	–	–	–	converted to 20-gauge PPV
2	59	M	RRD	25	4	–0.125	yes	4	counter assistance
3	59	M	RRD	23	5	–0.125	no	4	converted to 20-gauge PPV
4	51	M	RRD	25	4	–10.0	yes	4	counter assistance
5	58	M	RRD	25	5	–2.25	yes	4	converted to 20-gauge PPV
6	59	F	RRD	25	9	–2.25	no	4	counter assistance
7	79	F	MHRD	23	5	–10.0	no	4	counter assistance
8	55	F	RRD	23	7	–10.8	yes	3	counter assistance
9	42	F	RRD	23	14	–8.50	no	4	converted to 20-gauge PPV

OPI = Ocular perforating injury; RRD = rhegmatogenous RD; MHRD = RD due to macular hole in high myopia.

Table 3. Characteristics of 167 eyes with RD: pre-operative IOP, refractive error, choroidal detachment and size of RD in MIVS with and without 25- and 23-gauge DITC

	Overall	No DITC	DITC	p value
Number of eyes	167	160	7	–
Mean age ± SD, years	57.7 ± 10.7	57.7 ± 10.7	57.6 ± 11.2	0.6547[1]
Sex, n				0.3749[2]
Male	93	90	3	
Female	74	70	4	
Gauge, n				0.4340[2]
25-gauge MIVS	111 (66.5)	107 (96.4)	4 (3.6)	
23-gauge MIVS	56 (33.5)	53 (94.6)	3 (5.4)	
Mean pre-operative IOP ± SD, mm Hg	12.1 ± 3.9	12.3 ± 3.7	6.9 ± 3.6	0.0016[1]
Hypotony (<8 mm Hg), n	20/167 (12.0)	15/160 (9.4)	5/7 (71.4)	0.0003[2]
Mean refractive error ± SD, dpt	–3.7 ± 4.7	–3.5 ± 4.7	–6.3 ± 4.5	0.1049[1]
High myopia (>–8 dpt), n	30/167 (18.0)	26/160 (12.5)	4/7 (57.1)	0.0204[2]
Choroidal detachment, n	5/167 (3.0)	1/160 (0.6)	4/7 (57.1)	<0.0001[2]
Mean size of RD ± SD				
(1–4 quadrants)	2.2 ± 0.9	2.1 ± 0.9	3.9 ± 0.4	<0.0001[1]
Total RD (4 quadrants), n	18/167 (10.8)	12/160 (7.5)	6/7 (85.7)	<0.0001[2]

Figures in parentheses indicate percentages. SD = Standard deviation. [1] Mann-Whitney test. [2] Fisher's exact probability test.

Characteristics of Eyes That Had DITC

There were 9 eyes of 8 patients with DITC (4 men and 4 women; table 2), and their mean age ± standard deviation was 59.6 ± 11.1 years (range, 42–79 years). Eight of the 9 eyes (88.9%) with DITC had an RD including a macular hole retinal detachment (MHRD). For all eyes, the number with an RD was 242, and the incidence of DITC in these eyes was 3.3% (8 of 242 eyes). The other eye with DITC had only had suturing surgery for an ocular perforating injury 1 week before, and a dense vitreous haemorrhage was still present at the time of surgery. In the 8 eyes with a pre-operative RD, 7 had a total RD, 4 also had a choroidal detachment, 4 also had high myopia (>–8.0 dpt), and 6 were also hypotonic (<8 mm Hg).

To counteract the DITC, we performed the counter assistance technique on 5 eyes, as described in the Patients and Methods section (fig. 1; table 2).

Table 4. Percentage of the incidence of 25- and 23-gauge DITC in the eyes with RD by hypotony, high myopia, choroidal detachment or total RD, and DITC score

	Overall n	No DITC n	DITC	
			n	%
Hypotony (<8 mm Hg)	20	15	5	25.0
High myopia (>–8 dpt)	30	26	4	13.3
Choroidal detachment	5	1	4	80.0
Total RD (4 quadrants)	18	12	6	33.3
DITC score				
0	113	113	0	0
1	41	40	1	2.4
2	8	7	1	12.5
3	4	0	4	100
4	1	0	1	100

Pre-Operative IOP, Refractive Error, Choroidal Detachment and Size of RD in Eyes with DITC

The pre-operative IOP, refractive error, choroidal detachment and size of the RD in the eyes undergoing MIVS for RD are shown in table 3. There were 8 eyes with an RD that had DITC and 1 had a recurrence of the RD (table 2, eyes No. 2 and 3). For the statistical analyses, we excluded eye No. 3 and used the remaining 7 eyes to compare the demographics to that of the 160 non-DITC eyes with an RD.

Pre-operatively, 6 of the 7 eyes had a total RD, 4 of 7 eyes also had a choroidal detachment, 4 of 7 eyes were also highly myopic (>–8.0 dpt), and 5 of 7 eyes were also hypotonic (<8 mm Hg). The mean IOP of the 7 DITC eyes with an RD was 6.9 ± 3.6 mm Hg which was significantly lower than that of non-DITC eyes at 12.3 ± 3.7 mm Hg ($p = 0.0016$ Mann-Whitney test). The percentage of eyes with DITC that were also hypotonic (<8 mm Hg) was 71.4% (5/7) which was significantly higher than that of non-DITC eyes which was 9.4% (15/160; $p = 0.0003$, Fisher's exact probability test).

The mean refractive error of the DITC eyes was –6.3 ± 4.5 dpt which was not significantly different from that of non-DITC eyes which was –3.5 ± 4.7 dpt ($p = 0.1049$; Mann-Whitney test). The percentage of eyes with DITC and also high myopia (>–8 dpt) was 57.1% (4/7), which was significantly higher than that of non-DITC eyes which was 12.5% (26/160; $p = 0.0204$; Fisher's exact probability test).

The percentage of eyes with DITC and also choroidal detachment was 57.1% (4/7), which was significantly higher than that of non-DITC eyes which was 0.6% (1/160; $p < 0.0001$; Fisher's exact probability test). The mean size of the RD of DITC eyes was 3.9 ± 0.4 quadrants, which was significantly greater than that of the non-DITC eyes which was 2.1 ± 0.9 quadrants ($p < 0.0001$, Mann-Whitney test). The percentage of eyes with a total RD in the eyes with DITC was 85.7% (6/7), which was also significantly higher than that of non-DITC eyes which was 7.5% (12/160; $p < 0.0001$, Fisher's exact probability test).

Incidence of DITC in Eyes with Hypotony, High Myopia, Choroidal Detachment or Total RD, and DITC Score

The distribution of eyes with DITC and also hypotony, high myopia, a choroidal detachment or a total RD, and the DITC scores are shown in table 4. The incidence of DITC was 25.0% (5/20) in eyes with hypotony, 13.3% (4/30) in eyes with high myopia, 80.0% (4/5) in eyes with choroidal detachment and 33.3% (6/18) in eyes with a total RD. The incidence of eyes with a DITC score of 0 was 0% (0/113), 2.4% (1/41) in eyes with a DITC score of 1, 12.5% (1/8) in eyes with a DITC score of 2, 100% (4/4) in eyes with a DITC score of 3, and 100% (1/1) in eyes with a DITC score of 4.

Discussion

Our findings showed that the DITC cases were rare with an overall incidence of 0.6% (9 of 1,525 eyes). The cases of DITC were found to be associated with eyes with RD, hypotony, choroidal detachment and high myopia. We suggest that the DITC is associated with the balance between a resistance to insertion and the IOP. If this resistance is high because of the construction of the trocar or its dullness, then DITC may occur. If the material and shape of the trocar and sclera were all the same, i.e. same resistance to insertion, DITC would only occur in eyes with hypotony or a choroidal detachment due to suprachoroidal fluid. Thus, if the resistance to insertion was higher or IOP was low or suprachoroidal fluid existed, the DITC would most likely occur at the beginning of MIVS.

Eyes with severe or long-standing RD are often hypotonic and have choroidal detachment, so it is reasonable that the size of the RD was also significantly correlated with DITC as were hypotony and choroidal detachment. Although it is unclear how the high myopia was associated with DITC because a thin sclera should reduce the resistance to insertion, one explanation might be a pre-

disposition toward the development of hypotony and choroidal detachment [13].

Another reason for the DITC with both the 25- and 23-gauge instruments might be because the tip of the trocar is not slit-shaped but beveled. A microvitreoretinal (MVR) blade has been used to make a slit-shaped incision to make it easier for the trocar to penetrate the sclera and to enhance wound closure [14]. This MVR trocar was found to have a lower resistance to insertion than that of the conventional trocar cannula with a beveled needle trocar [14]. So, the new MIVS trocar cannula with an MVR blade might decrease the incidence of DITC. However, we believe that 20-gauge PPV is still a useful system for eyes with the 4 ocular risk factors.

Suprachoroidal fluid effuses during conventional 20-gauge PPV when the 20-gauge MVR blade is pulled out from the sclera which usually collapses the choroidal detachment. The 20-gauge instruments have not only a 4-mm infusion cannula but also a 6-mm infusion cannula which can perforate the sclera and choroid more easily. On the other hand, suprachoroidal fluid cannot effuse from the trocar cannula of the 23- and 25-gauge instruments, although suprachoroidal fluid has been demonstrated to also be a complication of 23-gauge MIVS [15].

The incidence of DITC with 23-gauge instruments was significantly higher than that with 25-gauge instruments. The trocar cannula of the 23-gauge system has been reported to have some difficulties in creating scleral ports including the presence of suprachoroidal fluid as an intra-operative complication and hypotony as a postoperative complication after 23-gauge MIVS [15–19]. However, we cannot simply compare the result of 25-gauge MIVS with that of 23-gauge MIVS. Because, for the surgeon's preference, we performed 23-gauge MIVS more often for complicated cases such as RD or proliferative vitreoretinopathy but not for macular diseases such as macular oedema or epiretinal membrane.

The pre-operative presence of a choroidal detachment was the greatest risk factor for DITC (4/5, 80.0%; table 4) in our cases, although choroidal detachment was not often present in eyes with an RD. The DITC score was also a good index to predict the occurrence of DITC during MIVS for eyes with an RD because scores ≥ 3 indicated that the incidence of DITC would be 100%. In addition, DITC is rarely (1/154, 0.6%) found in eyes with a DITC score of ≤ 1. This is important because it was then not necessary to consider DITC if only 1 or none of the 4 risk factors was present. Although performing MIVS is possible in eyes with a DITC score of 0 and 1, an alternative plan of 20-gauge PPV might be recommended with DITC scores of 2–4. Considering the 4 eyes in which MIVS was finally switched to 20-gauge PPV because we could easily create the 20-gauge ports even for such cases, it is recommended that 20-gauge PPV should be used first for the eyes which have multiple risk factors, i.e. those with DITC scores of ≥ 2.

The diseases which had DITC during MIVS were eyes with rhegmatogenous RD, MHRD and after initial surgery for an ocular perforation. So, eyes with other vitreoretinal diseases will probably not have DITC during MIVS. However, we believe that hypotony might be critical and lead to a DITC even in eyes without an RD, choroidal detachment and the conditions after the initial surgery for an ocular perforation. MHRD has also been reported to create a predisposition toward hypotony and choroidal detachment [13]. The MHRD is the reason why these patients do not have good vision. So, although there was only 1 eye with an MHRD in our series, it had DITC. We believe that MHRD might be the one condition that has the highest potential for DITC.

Our study has several weaknesses, including the retrospective aspect with no controls and surgeries by only one surgeon. However, because the DITC frequently happened at the beginning of MIVS, it is valuable to evaluate the incidence of DITC as it is related to different pre-operative ocular conditions without considering the experience of different surgeons.

Our findings indicated that DITC during MIVS occurs mainly in patients with RD. A large area of RD, choroidal detachment, high myopia and hypotony were significant risk factors for DITC in eyes with an RD. We recommend that MIVS should be performed cautiously for patients with these risk factors.

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Disclosure Statement

Proprietary interests, none.

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Successful Outcomes of 25- and 23-Gauge Vitrectomies for Giant Retinal Tear Detachments

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■ **BACKGROUND AND OBJECTIVE:** The authors examined the feasibility of performing 25- and 23-gauge micro-incision vitrectomy surgery (MIVS) for a giant retinal tear.

■ **PATIENTS AND METHODS:** The medical records of 12 eyes of 11 patients with giant retinal tear who underwent MIVS using perfluorocarbon liquids were reviewed. All patients were observed for at least 6 months postoperatively.

■ **RESULTS:** An intraoperative re-attachment was achieved in 12 eyes (100%) and 11 eyes (92%) remained attached without intraocular tamponade. Silicone oil was used in 9 of 12 eyes and removed 2 weeks after the initial vitrectomy except in one eye. The postoperative retinal complications included macular pucker in two eyes, subretinal perfluorocarbon liquid in two eyes, retinal folds in one eye, cystoid macular edema in one eye, and redetachment due to proliferative vitreoretinopathy in one eye.

■ **CONCLUSION:** Although the study had a short follow-up period, primary MIVS appears to be safe and feasible for giant retinal tear surgery.

[Ophthalmic Surg Lasers Imaging 201X;XX:XX-XX.]

INTRODUCTION

A retinal detachment with a giant retinal tear (≥ 90°) is difficult to treat successfully for even experienced vitreous surgeons. There have been different treatments for giant retinal tears, including pneumatic retinopexy, wide scleral buckling, and conventional 20-gauge pars plana vitrectomy (PPV) with gas or silicone oil tamponade using perfluorocarbon liquid (PFCL). Management using PFCL increased the successful reattachment rate from approximately 40% to 80%.[1-8]

The use of 25- and 23-gauge micro-incision vitrectomy (MIVS) was first reported in 2002 and 2005, respec-

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TABLE

Characteristics, Operative Details, and Postoperative Course of 12 Eyes With GRTs After Micro-incision Vitrectomy Surgery

Eye	Age (Y)	Lens Status	GRT (Degree)	GRT Location	G	Triple Surgery	Operative Time (Min)	SO	Decimal Pre VA	Decimal Final VA	Final Success	Postop Complications	FU (Mo)
1	15	Phakic	150	ST	25	N	71	N	0.1	0.7	Y	Pucker	39
2	26	Phakic	90	ST	25	Y	84	N	0.15	0.09	Y	N	6
3	26	Phakic	135	ST	25	Y	86	N	0.06	0.7	Y	RFs, SubPFCL	6
4	61	Phakic	150	S	25	Y	98	Y	0.7	1.0	Y	N	12
5	60	Phakic	120	ST	23	Y	75	Y	0.02	0.5	Y	N	24
6	60	Phakic	90	ST	23	Y	53	Y	1.0	1.0	Y	N	12
7	44	Phakic	150	S	23	Y	66	Y	HM	0.09	Y	N	12
8	35	IOL	150	T	23	N	119	Y	0.03	0.05	N	PVR	12
9	51	IOL	90	N	23	N	76	Y	1.0	1.0	Y	N	6
10	60	Phakic	120	I	23	Y	86	Y	CF	0.3	Y	SubPFCL	6
11	35	Phakic	90	T	23	Y	76	Y	0.4	0.1	Y	Pucker	6
12	45	IOL	135	T	25	N	41	Y	0.7	1.0	Y	CME	6

GRT = giant retinal tear; G = gauge; SO = silicone oil; pre = preoperative; VA = visual acuity; postop = postoperative; FU = follow-up; ST = superotemporal; RFs = retinal folds; SubPFCL = subretinal perfluorocarbon liquid; S = superior; HM = hand motions; IOL = intraocular lens; T = temporal; PVR = proliferative vitreoretinopathy; N = nasal; I = inferotemporal; CF = counting fingers; CME = cystoid macular edema.

tively.[9-11] These techniques have become commonly used throughout the world. The increase in popularity of MIVS was enhanced by the clinical studies demonstrating significant reductions in conjunctival injection and postoperative pain and discomfort. Despite the increased indications for MIVS for rhegmatogenous retinal detachments and the recent advances in giant retinal tear repair using PFCL, there are no publications on case series of giant retinal tear treated by MIVS.[12-18]

Thus, the purpose of this study was to determine the visual outcome and retinal complications of 12 consecutive eyes with a giant retinal tear treated by MIVS by a single surgeon.

PATIENTS AND METHODS

We reviewed the medical records of 12 eyes of 11 consecutive patients with a giant retinal tear (Table) who had undergone MIVS by one surgeon with either a 25- or a 23-gauge trocar cannula (Alcon Laboratories, Inc., Fort Worth, TX). The preoperative demographics of the patients are shown in the table. All of the surgeries were performed at the Surgical Retina Clinic of the Tohoku University Hospital between August 2007 and July 2010. The inclusion criteria were retinal detachment with a giant retinal tear of 90° or greater and treated by a single surgeon (HK). The exclusion criteria were prior vitrectomy and trauma.

After the purpose and procedures of the operation were explained, an informed consent was obtained from all patients. The procedures used conformed to the tenets of the Declaration of Helsinki and this study was approved by the Review Board of the School of Medicine, Tohoku University.

All surgeries were performed under retrobulbar anesthesia. A conjunctival peritomy was not made in all cases, and all surgeries were performed using the Accurus Vitrectomy System (Alcon Laboratories, Inc.). The crystalline lenses were extracted from all patients except one, who was a teenager. After resecting the vitreal core, the peripheral vitreous was shaved as much as possible. After the shaving, PFCL was injected on the disc and the vitreous cavity was filled with PFCL. Finally, endophotocoagulation was performed around all retinal tears. Silicone oil, sulfur hexafluoride, or perfluoropropane was used for intraocular tamponade. Antibiotics and corticosteroids were injected subconjunctivally in all cases postoperatively.

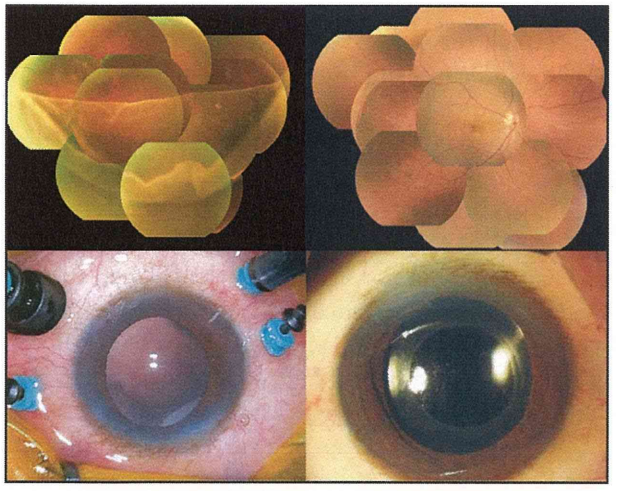

Figure. Representative eye with a giant retinal tear (GRT). Fundus and intraoperative photograph of the eye of a 61-year-old man (eye 4) with a retinal detachment from a GRT. The eye had undergone 25-gauge vitrectomy. (Upper left) Preoperative photograph of the right fundus showing a 150° GRT. (Upper right) Postoperative photograph of the right fundus showing complete re-attachment of the retina. (Lower left) Intraoperative photograph of 25-gauge ports for the infusion, chandelier light pipe, and cutter. The ports are placed in the inferotemporal, inferonasal, superonasal, and superotemporal quadrants. The superotemporal port was created at the lower side than adjusted to perform endophotocoagulation easily for the GRT. (Lower right) Photograph of the ocular surface 2 weeks postoperatively. The ocular surface is smooth with no subconjunctival hemorrhage and no conjunctival injection.

The outcome measures were the initial anatomical success rate, final anatomical success rate, postoperative visual acuity, and intraoperative and postoperative complications. The anatomical success after the initial surgery was defined as a complete reattachment of the retina after the silicone oil had been removed or all gas in the eye had disappeared. All of the patients had a complete ophthalmological examination at 6 months or more after the surgery. The final anatomical success was defined as a complete reattachment without intraocular tamponade at 6 months after the primary surgery.

The best-corrected visual acuity (BCVA) was measured using the Landolt C visual acuity chart, and the decimal acuities were converted to logarithm of the minimum angle of resolution (LogMAR) units. For statistical analyses, counting fingers visual acuity was set to 2.0 LogMAR units and hand motions visual acuity was set to 3.0 LogMAR units as used previously.[19,20] The preoperative and postoperative visual acuities were analyzed using statistical packages including Wilcoxon signed-rank test and Spearman's correlation coefficient by rank test.

RESULTS

The preoperative, intraoperative, and postoperative findings are summarized in the table. There were 9 men and 2 women whose mean ± standard deviation age at surgery was 43 ± 15 years. Their preoperative decimal BCVA ranged from hand motions to 1.0. The mean total operative time was 78 ± 19 minutes. We performed 25-gauge MIVS in 5 eyes and 23-gauge MIVS in 7 eyes. Triple surgery (phacoemulsification and aspiration, intraocular lens implantation, and MIVS) was performed on 8 eyes (67%). Only MIVS was performed on 4 eyes (33%) because 3 eyes had already undergone cataract surgery and the other eye belonged to a 15 year old with a clear lens. PFCLs were used in all 12 eyes.

We used 25-gauge MIVS in the first four cases with giant retinal tears (Table and Figure) and did not inject silicone oil in the first three cases. However, the third case had a postoperative retinal slippage and retinal folds but the retina remained attached during the follow-up period. Thereafter, we used silicone oil in all cases with a giant retinal tear to avoid retinal slippage and attained complete retinal attachment. We could not inject silicone oil through the 25-gauge cannula in the fourth case, and we switched to 23-gauge instruments in the subsequent cases so that silicone oil could be injected into the vitreous cavity. In the final case (eye 12), we used a new 25-gauge system that allowed us to inject silicone oil through the 25-gauge cannula. Silicone oil was used in the latter 9 of 12 eyes and removed 2 weeks after the initial vitrectomy, excluding one eye (eye 8) that developed proliferative vitreoretinopathy (PVR). None of our cases using silicone oil developed glaucoma requiring trabeculectomy.

An intraoperative reattachment was achieved in 12 eyes (100%) and 11 eyes (92%) remained attached at the last follow-up examination. The mean follow-up period was 12 ± 10 months with a range of 6 to 39 months.

The mean final BCVA was 0.46 ± 0.48 LogMAR units, which was better than the preoperative BCVA of 0.99 ± 0.90 LogMAR units but not significant ($P = .053$, Wilcoxon signed-rank test). The postoperative BCVA was significantly correlated with the preoperative BCVA ($P = .01$, Spearman's correlation coefficient by rank). The BCVA in 8 of the 12 eyes (67%) improved by more than 0.15 LogMAR units, and the visual improvement was significantly correlated with the preoperative VA (P

= 0.001; Spearman's correlation coefficient by rank test) for all 12 eyes. A final decimal BCVA of 0.5 or better was obtained in 7 of the 12 eyes (58%).

Six of the eyes developed retinal complications (50%); two eyes had a postoperative macular pucker needing additional surgery (17%), two eyes had a retention of subretinal PFCL (17%), one eye developed retinal folds (8%), one eye had cystoid macular edema (8%), and one eye had a redetachment of the retina due to PVR (8%). One of the two eyes with a macular pucker was treated surgically several months after the first operation and the pucker was completely removed (eye 1). Another eye with a macular pucker was also treated surgically several months after two vitreous surgeries (first vitrectomy to obtain a reattachment and second vitrectomy to remove the silicone oil) and the pucker was completely removed (eye 11). In the two eyes with a retention of subretinal PFCL, the PFCL was located in the posterior pole but not at the fovea, and the subretinal PFCL was removed completely in one eye when the silicone oil was removed (eye 10). In the other case, consent was not obtained from the patient (eye 3). The eye with the retinal folds was also not treated because of the good decimal BCVA of 0.7 and the lack of consent (eye 3). The eye with a postoperative cystoid macular edema was treated with posterior sub-Tenon injection of triamcinolone acetonide and the cystoid macular edema resolved (eye 12). The redetachment of the eye was treated surgically and reattachment was obtained with silicone oil tamponade (eye 8). However, the silicone oil in the case could not be removed because of hypotony during the follow-up period.

DISCUSSION

The highest primary success rate for giant retinal tear treated by 20-gauge PPV was that of Chang et al., who first introduced 20-gauge PPV using PFCL without scleral buckling in 1989.[6] Their rate was 94% with a minimum follow-up period of 6 months. Thus, the use of 20-gauge PPV to treat giant retinal tear has made the reattachment rate high using PFCL without buckling.[21] However, because the giant retinal tear is still difficult to treat, most ophthalmological institutes report primary success rates of approximately 70%. With additional surgeries, the highest success rate was better than 90%.[22,23] Although there are no reports of case series of giant retinal tear treated with MIVS, we achieved an anatomical success rate of more than 90% after the initial surgery with MIVS, which suggests that even MIVS has similar results as reported by Chang et al.[6] Although the follow-up period in our patients was 6 months or more with a mean of 12 months, the number of treated patients was sufficient for us to conclude that MIVS as a primary surgery for giant retinal tear had better but not significantly better success rates than that with conventional 20-gauge PPV as reported recently by Lee et al.[1] (71 of 99, 71.7%; $P = .12$, Fisher's exact probability test) and Al-Khairi et al.[23] (92 of 117, 78.6%; $P = .26$, Fisher's exact probability test).

We performed lens-sparing vitrectomy for our first case (a 15 year old). Although we believe that the lens might become cataractous postoperatively in most patients after multiple vitreous surgeries, the lens of the first case that underwent two vitreous surgeries did not progress to cataract during the 3 years of follow-up. To remove the peripheral vitreous completely, lens-sparing vitrectomy might also be possible for eyes with giant retinal tear using a wide viewing system. However, the lens of patients older than 50 years or those with opacities should be removed during the initial vitrectomy.

In our 12 eyes, a reattachment was obtained after the initial MIVS in 11 eyes (92%) but subsequent surgery was necessary in 10 eyes (83%), including silicone oil removal 2 weeks after the initial vitrectomy in 8 eyes (67%), macular pucker removal in two eyes (17%), and surgery for a redetachment due to PVR in one eye (8%). Kertes et al. reported that 12 (7.4%) of their 162 patients who had undergone 20-gauge PPV with PFCL for giant retinal tear developed a macular pucker.[7] We found that two (17%) of the eyes developed a macular pucker needing additional surgery, which is slightly high but comparable to that reported by Kertes et al. ($P = .24$, Fisher's exact probability test).[7] The other postoperative complications of subretinal PFCL, retinal folds, and PVR have been reported to be 2 of 12 (16.7%),[1] 24 of 212 (11.3%),[8] and 10 of 128 (7.8%)[24] for conventional 20-gauge PPV in eyes with giant retinal tear. These rates are also not significantly different from ours ($P = .71$, .60, and .64, respectively, Fisher's exact probability test).

Our findings indicate that the advantages of MIVS for giant retinal tear are high rates of retinal attachment after the initial surgery, ease of injecting silicone oil, and comparable rates of postoperative retinal complications. However, there are limitations of using MIVS

for giant retinal tear. For example, the number of surgical instruments is limited and a greater requirement for wide angle viewing systems is needed.

Although there is no perfectly safe procedure for giant retinal tear, we recommend that eyes with a giant retinal tear should first undergo 23-gauge MIVS. We also recommend a silicone oil tamponade with 23-gauge MIVS to treat complex retinal detachments as reported.[13] However, 25-gauge MIVS with silicone oil tamponade was also reported to be efficient and can be considered in the surgical management of complex vitreoretinal disease.[14] Although we used the new 25-gauge system on only one case (eye 12), we believe that it can be as useful as the 23-gauge system. However, further investigations are needed to determine whether it is best to use the 25-gauge system for giant retinal tear.

Our technique required two vitreous surgeries (vitrectomy to obtain a reattachment and to inject silicone oil tamponade and surgery to remove the silicone oil). We removed the silicone oil 2 weeks after the primary MIVS if a reattachment developed because intraocular silicone oil can lead to postoperative complications such as glaucoma or PVR. We believe that a scarring adhesion between the retina and retinal pigment epithelium layer can develop within 2 weeks after photocoagulation.

In principle, we do not use an encircling buckle combined with primary MIVS for giant retinal tear, although the absence of an encircling scleral buckle was reported to be significantly associated with redetachment after 20-gauge PPV.[22,23] Further investigations are needed to determine whether an encircling buckle should be combined with MIVS for giant retinal tears. However, we believe that an encircling buckle should be combined with MIVS for giant retinal tears with other severe conditions such as PVR or those associated with severe atopic dermatitis. Even if an encircling buckle is used in combination with PPV, we believe that MIVS is more suitable than 20-gauge PPV because MIVS has the original advantage of having a cannula, which protects the sclerotomy port and might reduce occurrence of intraoperative iatrogenic retinal breaks.[25-27]

A comparison of visual acuities after PPV by conventional 20-gauge PPV and by MIVS is needed to assess the efficacy of MIVS on the final visual prognosis. Our study has limitations, including the short follow-up period, small number of patients, and surgery performed by a single surgeon. The number of patients is small because giant retinal tear is a rare disease. Nevertheless, our findings indicate that MIVS is a feasible method and can lead to comparable retinal reattachment rates. In addition, because there are patients who develop a redetachment a few years after 20-gauge PPV, a follow-up of several years is recommended after MIVS.

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