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Comparison of the operative times and intraocular pressure of sutureless vitrectomy with a 27- versus 25-gauge system in eyes with epiretinal membrane

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Abstract

Objectives: To compare the time of operation and the postoperative intraocular pressure (IOP) using a 27- versus 25-gauge three-port vitrectomy in eyes with epiretinal membrane (ERM).

Methods: The clinical records of eyes with ERM that underwent combined cataract surgery and vitrectomy from January to April 2016 were analyzed. Thirteen eyes were treated using a 27-gauge system (27-g group) and 12 eyes were treated using a 25-gauge system (25-g group). The operating times were determined from video recordings.

Results: The time of vitreous removal was significantly longer in the 27-g group (141.1 ± 34.1 s) than in the 25-g group (106.2 ± 24.1 s; P = 0.009). The IOP was significantly lower in the 25-g group than in the 27-g group on postoperative day 1 (27-g group, 18.3 ± 6.2 mmHg; 25-g group, 12.6 ± 3.6 mmHg; P = 0.008), but there was no significant difference on postoperative day 7. The times needed for removing the trocar and closing the port were not significantly different, but the number of the ports that required pressure to close was significantly greater in the 25-g group (35/36 ports) than in the 27-g group (31/39 ports; P = 0.0027), and the duration of pressure was significantly longer in the 25-g group (21.7 ± 13.8 s) than in the 27-g group (11.3 ± 5.2 s; P = 0.0183).

Conclusions: The 27-g system is better regarding closure of the scleral port, which may reduce postoperative complications, but the prolonged surgical time may be a disadvantage.

Keywords: Epiretinal membrane, 27-gauge vitrectomy, 25-gauge vitrectomy, Surgical time, Intraocular pressure

INTRODUCTION

Machemer et al. first performed vitreous surgery using a 13-gauge cutter (2.4 mm diameter) in the 1970s[1]. Standard vitrectomy in the 1980s and 90s was performed using the three-port technique (one port for intraocular illumination, another port for the infusion of the balanced salt solution, and another port for the vitreous cutter) and 20-gauge instruments (0.9 mm diameter)[2]. The 20-gauge instruments were inserted into the vitreous cavity through the 20-gauge scleral ports after making large conjunctival flaps. At the end of surgery, the scleral ports and conjunctival flaps were sutured to stop leakage from the incisions. In 2002, microincision vitrectomy surgery (MIVS) using 25-gauge instruments was introduced[3], and in 2004, MIVS using a 23-gauge system and an angled incision was reported[4]. Both of these MIVS techniques are now widely used. In these techniques, the vitrectomy is performed without making large conjunctival flaps or suturing. However, the closure of the scleral ports is sometimes incomplete, causing a low postoperative intraocular pressure (IOP)[5,6] and a high incidence of postoperative infectious endophthalmitis[7,8]. To resolve these complications, the use of a 27-gauge system was reported by Oshima et al.[9,10]. Compared with the 23- or 25-gauge systems, the closure of the scleral ports should be better with a 27-gauge system. However, the performance of the vitreous cutter, for both aspiration and cutting, may be poorer, and the intraocular illumination is less than with the 23- or 25-gauge systems, because the diameter of the vitreous cutter and the light pipe are smaller. Furthermore, the diameter of the micro forceps used for membrane peeling may affect the process of membrane removal.

We therefore conducted a retrospective study to compare the surgery time and IOP of 13 eyes with epiretinal membrane (ERM) that used a 27-gauge system versus 12 eyes with ERM that used a 25-gauge system.

SUBJECTS AND METHODS

We analyzed the clinical records of patients with idiopathic ERM that underwent combined phacoemulsification (PEA), intraocular lens (IOL) implantation, and vitrectomy from January to April in 2016 at Fujita Health University Hospital. Twenty-five eyes of 25 patients with idiopathic ERM were analyzed in this study. The inclusion criteria were as follows: 1) The preoperative presence of posterior vitreous detachment and cataract, 2) The absence of peripheral retinal degeneration, and 3) The absence of any ophthalmic disease other than ERM. The exclusion criteria were as follows: 1) A requirement for photocoagulation, cryopexy, or fluid-air exchange and 2) The presence of diabetes mellitus or other general diseases affecting the eye. Surgery of thirteen eyes used a 27-gauge vitrectomy system (27-g group), and 12 eyes used a 25-gauge vitrectomy system (25-g group). The 27-g group consisted of four male and nine female patients, with a mean age of 71.2 ± 7.2 years. The 25-g group consisted of three male and nine female patients, with a mean age of 67.0 ± 7.0 years. The patient characteristics are listed in Table 1.

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Table 1. Patient characteristics

	27-g group	25-g group	P-value
Sex (male/female)	4/9	3/9	
Number of eyes (right/left)	13 (3/10)	12 (8/4)	
Age (years)	71.2 ± 7.2	67.0 ± 7.0	0.167
IOP (mmHg)	16.3 ± 3.5	15.1 ± 3.1	0.499

All data are expressed as the mean ± standard deviation.
IOP, intraocular pressure; g, gauge;

Institutional Review Board/Ethics Committee approval was obtained from Fujita Health University, and the study protocol adhered to the tenets of the Declaration of Helsinki.

Surgery

PEA was performed after the induction of trans-Tenon's retrobulbar anesthesia[11], and three trocars were inserted at a 0–15° oblique angle to the scleral surface through the conjunctiva into the vitreous space. The vitreous was removed using a 25- or 27-gauge vitreous cutter (two-dimensional cutting vitrectome; DORC International, Amsterdam, Netherlands). Figure 1 shows a comparison of the 25- and 27-gauge vitreous cutters. The surgical parameters of the vitrectomy machine (EVA; DORC International) were 6,000 cuts/min and a vacuum of 400 mmHg for the 25-gauge system and 680 mmHg for the 27-gauge system. Because the smaller tip required a larger vacuum pressure, these vacuum settings were recommended from the company. ERM was removed with micro forceps (Alcon, Inc., Fort Worth, TX, USA). The internal limiting membrane (ILM) was removed using brilliant blue dye[12] that helped visualize the ILM. The IOL was inserted into the capsular bag, and the trocar was removed from the scleral port. After making sure that all three ports were closed, the surgery was concluded. If the scleral port was leaky after removing the trocar, pressure was applied to the port for 5–30 s (Figure 2 A, B). If the port was still leaky, it was sutured. The hole of the conjunctiva was closed by cauterization.

Operative times and IOP measurements

Based on the video recordings, we measured the times to perform the PEA, trocar insertion, vitreous removal, membrane peeling, IOL insertion, trocar removal, and port closure. Additionally, we counted the number of ports that required the application of pressure to eliminate leakage, and measured the duration of the applied pressure. The IOP was measured with a non-contact tonometer (Tomey, Inc, Nagoya, Japan) on postoperative days 1 and 7.

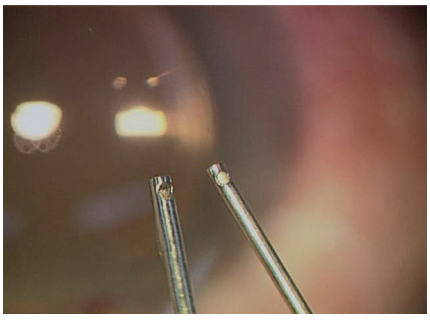
Statistical analysis

Student's *t*-test was used for the comparison of the operation times, and the chi-square test was used for the comparison of the number of ports that required pressure to stop the fluid leakage.

RESULTS

In all eyes, the surgery was completed without intraoperative complications, and no ports required suturing. Table 2 shows the time taken for the PEA, trocar insertion, vitreous removal, membrane peeling, IOL insertion, trocar removal, and port closure in the 25-g and 27-g groups. The time needed for vitreous removal was significantly longer in the 27-g group than in the 25-g group (25-g group, 106.2 ± 24.1 s; 27-g group, 141.1 ± 34.1 s; P = 0.009), with a standard deviation of 34.1 s. The time needed for the removal of the membrane was not significantly different between the two groups. Moreover, the total operation time was not significantly different between the two groups. The time needed for removing the trocar and closing the port was not significantly different, but the number of the ports that required pressure was significantly greater in the 25-g group than in the 27-g group (25-g group, 35/36 ports; 27-g group, 31/39 ports; P = 0.0027). The required duration of pressure for port closure was also significantly longer in the 25-g group (25-g group, 21.7 ± 13.8 s; 27-g group,

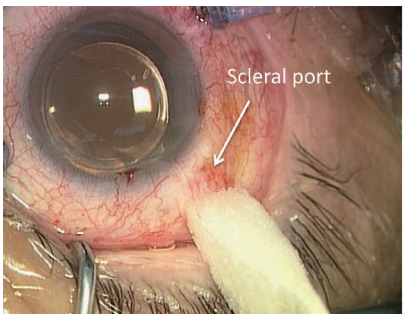
Figure 1.



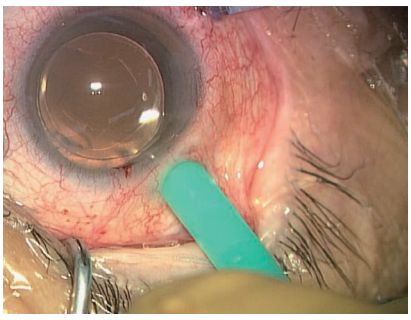
Comparison of the 27- and 25-gauge vitreous cutters. The left is the tip of the 25-gauge cutter on the left and the right is the tip of the 27-gauge cutter on the right. The diameter of the tip is smaller in the 27-gauge cutter.

Figure 2.

A



B



Closure of the scleral port. A leaking scleral port. The irrigating solution is leaking from the scleral port and is absorbed by the sponge. B Pressure on the port. The port is pressed with a plastic stick to close the port.

Table 2. Operative times and the number of ports that required pressure

	27-g group	25-g group	P-value
IOP (mmHg)			
Postoperative day 1	18.3 ± 6.2	12.6 ± 3.6	0.008*
Postoperative day 7	14.3 ± 3.3	13.8 ± 2.9	0.476
Operation time (sec)			
PEA	217.5 ± 60.3	180.6 ± 37.4	0.083
Port insertion	79.1 ± 14.1	81.4 ± 24.1	0.759
Vitreous removal	141.1 ± 34.1	106.2 ± 24.1	0.009*
Membrane removal	323.0 ± 73.2	325.4 ± 109.0	0.943
IOL insertion	69.7 ± 21.5	69.4 ± 0.4	0.981
Trocar removal + port closure	48.0 ± 15.5	59.2 ± 17.4	0.104
Pressure on the port	11.3 ± 5.2	21.7 ± 13.8	0.0183
Total operation time	1400.1 ± 137.4	1367.5 ± 192.2	0.618
Number of ports that required pressure	31/39 (79%)	35/36 (97%)	0.0027

All data are expressed as the mean ± standard deviation. *P < 0.05
IOP, intraocular pressure; g, gauge; PEA, phacoemulsification; IOL, intraocular lens;

11.3 ± 5.2; P = 0.0183). The IOP was significantly lower in the 25-g group than in the 27-g group on postoperative day 1 (25-g group, 12.6 ± 3.6 mmHg; 27-g group, 18.3 ± 6.2 mmHg; P = 0.008), but there was no significant difference on postoperative day 7. In the 25-g group, one eye showed hypotony (IOP = 6 mmHg) on postoperative day 1, but the pressure was normal on postoperative day 7.

DISCUSSION

Smaller incisions are less invasive. For surgery on other organs, the da Vinci robot machine has been developed to minimize the invasiveness[13,14]. PEA was introduced in 1967 for the removal of the opaque crystallin lens through a 3 mm incision instead of lens removal with cryopexy through a 10–12 mm incision[15]. Sutureless PEA with an incision < 3 mm is currently the standard technique for cataract surgery. In vitreous surgery, the size of the scleral port has become smaller to minimize invasiveness within the eye[1-5]. The development of 23- and 25-gauge systems for sutureless vitrectomy was an especially significant step. However, the 25-gauge scleral port is not necessarily leakproof, and incomplete closure of the port induces hypotony and endophthalmitis[6-8]. The 27-gauge system was developed with the assumption that a smaller port would reduce these complications[9]. In the present study, only one eye showed hypotony, in the 25-g group. The IOP was significantly greater in the 27-g group than in the 25-g group. No endophthalmitis was found in either group. Furthermore, the required duration of applied pressure on the port was significantly shorter in the 27-g group, and the number of ports that required pressure was smaller in the 27-g group. When a self-sealing port is achieved, no pressure is needed, but a leaky port requires significant pressure on the port. These results suggested that the 27-gauge system can achieve better closure of the port.

However, the time required for vitreous removal was significantly longer in the 27-g group than in the 25-g group. While some eyes with ERM do not have posterior vitreous detachment, in our study, we only selected eyes with preoperative posterior vitreous detachment, to directly compare the results under the same conditions for both groups. The time needed for the vitrectomy therefore did not include the time needed for forming a posterior vitreous detachment. The results suggested that the efficacy of aspiration of the cutter was lower using the 27-gauge system. The difference was only 34.9 s in this study, but when the 27-gauge system is applied to more complicated retinal diseases, such as proliferative diabetic retinopathy, retinal detachment, proliferative vitreous retinopathy, or macular hole, this slower cutting and aspiration might be a disadvantage. Unexpectedly, the time required for the removal of membranes was not significantly different between the two groups, and dimmer intraocular illumination or smaller forceps did not affect the membrane removal procedure. The total operation time was not significantly different in this study, but as previously mentioned, there might be a larger difference in more complicated surgical procedures.

The small sample size in this study may be a potential limitation. We performed vitrectomy in 128 eyes with ERM during this period, but the strict exclusion criteria to obtain a meaningful comparison reduced the sample size, so further study may be needed.

In conclusion, the 27-gauge system is advantageous in terms of closure of the scleral port, which may reduce the incidence and severity of postoperative complications, but the prolonged operation time for vitreous removal might be a disadvantage, especially in more complicated procedures.

Conflict of interest

None

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