The Egyptian Journal of Hospital Medicine (October 2022) Vol. 89, Page **5865-5870**

Comparative Study between Chandlier Assisted 23, 25 and 27 Gauge Bimanual Vitrectomy for Diabetic Tractional Retinal Detachment and Vitreous Hemorrhage

Mahmoud Abd El-Badie Mohamed, Ahmed Mahmoud Abd EL-Hady,
Ashraf Mohammed Gad Elkareem, Khaled Ibrahim Ali*
Department of Ophthalmology, Faculty of Medicine, Al-Azhar University, Assiut, Egypt
***Corresponding author:** Khaled Ibrahim Ali, **Mobile:** (+20) 01006291987, **E-Mail:** khaledhaikel1987@gmail.com

ABSTRACT

Background: Hematogenous retinal detachment is just one of many surgical indications where the 27G system has been shown to be both safe and useful. **Objective:** This study aimed to compare the results of chandelier assisted 23, 25, 27 gauge bimanual vitrectomy in diabetic vitreous hemorrhage and diabetic tractional retinal detachment.

Patients and Methods: There were a total of 30 eyes from 30 diabetic individuals in this prospective research of pars plana vitrectomy. The study was conducted throughout 18 months (January 2018 to June 2019) in two private eye centers in Alexandria (El-Safwa and Ebsar centers). Patients were divided into three groups according to the used vitrectomy system (10 eyes per group): Group (I, II & III), each included 10 patients underwent vitrectomy surgery using 23-gauge system, 25-gauge system and 27-gauge system respectively.

Results: The 27 gauge group took the highest operative duration (40.2 ± 7.5 min). However, at 6 months follow-up, the 27 gauge group had significantly improved Best Corrected Visual Acuity (0.39 ± 0.13 logMAR) compared to the 23 gauge group (0.76 ± 0.37 logMAR), ($p < 0.01$). The 23 gauge group had the highest mean time of exit (9.5 ± 1.3 min.).

Conclusion: When comparing the varied incision sizes associated with the 25-G and 23-G vitrectomy systems, the 27-G system yielded comparable results when done on a variety of conditions. Smaller-gauge vitrectomy systems have several advantages, but they also have some drawbacks, including as weaker instruments and a less effective treatment.

Keywords: Chandlier, 23 Gauge, 25 Gauge, 27 Gauge, Bimanual vitrectomy, Diabetic tractional retinal detachment, Vitreous hemorrhage.

INTRODUCTION

After the introduction of wide-angle viewing equipment, transconjunctival microincision vitrectomy surgery (MIVS) employing 23-, 25-, or 27-gauge instrumentation has become increasingly common [(1)]. Microincision phacoemulsification surgery (with 25- or 23-gauge "25G" or "23G" instruments) has various advantages, including a low rate of intraoperative and postoperative sequelae, such as early postoperative hypotony and endophthalmitis [(2)]. A number of other benefits have also been observed, including expedited wound healing, shorter surgery times, increased patient comfort, decreased postoperative inflammation, reduced medically-induced astigmatism, and stable postoperative intraocular pressure with early visual recovery [(3)]. It has been claimed that postoperative intraocular pressure (IOP) stabilization can be achieved by the use of angled incisions rather than straight ones while performing sclerotomy, and through the use of air or gas exchange rather than fluid exchange [(4)]. The primary focus of technology development is still on patient care and treatment compliance, even though these advancements make surgery safer. The 27G instrumentation system has just been released. First presented by **Oshima and colleagues in 2010** [(5)], the revolutionary 27-G MIVS system has been shown to be feasible and safe in early trials.

Indications for 27-G vitrectomy have broadened to encompass a wider range of conditions, such as proliferative vitreoretinopathy, retinal detachment as well as proliferative diabetic retinopathy [(6, 7)]. Even though 27-G vitrectomy has been around for a while, the quantity of studies on it is still rather low [(8)]. In addition, numerous vitreo-retinal surgical indications, including rhegmatogenous retinal detachment (RRD), have been reported to have positive clinical outcomes with 27G transconjunctival sutureless vitrectomy (TSV), along with a favorable short-term safety profile [(9)]. The aim of the work was to compare the results of chandelier assisted 23, 25, 27 gauge bimanual vitrectomy in diabetic vitreous hemorrhage and diabetic tractional retinal detachment.

PATIENTS AND METHODS

There was a total of 30 eyes from 30 diabetic individuals in this prospective research of pars plana vitrectomy. The research covered 18 months (January 2018 - June 2019) and took place at two Alexandria private Eye Medical Centres (El-Safwa and Ebsar centers). Patients were recruited randomly and were divided into three groups according to the vitrectomy system used (10 eyes in each group): Group (I): Patients in the study had vitrectomies performed with a 23-gauge system, Group (II): Patients were operated on with a 25-gauge vitrectomy system and Group (III): Patients in the study had vitrectomies performed with a 27-gauge system.

In each group five eyes had diabetic vitreous hemorrhage and five eyes had diabetic tractional retinal detachment (RD) were included in our study.

Inclusion criteria: Diabetic tractional RD involving or threatening macula, chronic diabetic vitreous hemorrhage, combined tractional RD and rhegmatogenous RD, sever premacular diabetic hemorrhage, diabetic tractional papilopathy and case of neovascular glaucoma with vitreous hemorrhage.

Received: 22/10/2020
Accepted: 10/12/2020

Exclusion criteria: Single eyed patient, patients with visual acuity less than HM, patients with severe retinal ischemia as diagnosed by F A and recurrent diabetic retinal detachment.

All patients included in this study underwent a complete ocular and systemic assessment. The same preoperative and postoperative measures were done for all patient of the three groups. Full history taking was obtained from all subjects in addition to detailed ocular examination. Laboratory investigations including fasting and random blood glucose, HgA1c, urine analysis, bleeding time and kidney function tests.

Preoperative preparation:

Preoperatively, all patients received topical anesthesia [Benoxinate hydrochloride (Benox eye drops by E.I.P.I. Co.)] and their pupils were dilated by tropicamide 1.0% (Mydriacyl by Alcon). All surgeries were carried out under general anesthesia.

Measurement of the time of operation was taken by stopwatch as well as time of entry, core vitrectomy and exit time. Intraoperative complications were assessed.

Surgical technique:

Each of the study groups was operated upon by a single expert surgeon. Phacoemulsification through corneal incision with foldable IOL implantation was carried out for eyes with significant cataract.

Three routine transconjunctival cannula insertion 23 ,25 and 27gauge system by Alcon Constellation Vision System - Jody Myers Eye Equipment (Alcon Laboratories, Texas, United States).

Insertion of the twin light chandelier endoillumination system (Eckardt TwinLight Chandelier with Photon connector and guidance needle (27 gauge/0.4 mm by dorc) to allow bimanual surgery. Core vitrectomy was carried out with a vacuum 400 mmHg and a cutting rate 2500 cpm and intraocular pressure of 25 mmHg. The vitreous cutter's vacuum was used to produce triamicinolone-assisted posterior vitreous detachment (PVD), with the attachment point at the optic disc and the posterior hyaloid carefully elevated to prevent breakage at the retina's fragile spots. Membrane dissection was carried out by using bimanual dissection in the 25 and 27 gauge groups and combined segmentation delamination using the vitreous cutter in the 23- gauge group. ILM peeling was carried out if there was residual macular traction. Panretinal photocoagulation with endolaser was carried out. Internal tamponade with air, SF6 or silicone oil according to number and location of existing or induced breaks and degree of retinal traction or elevation and persistence or completion of any fibrous traction or membranes. Silicone oil 1300 centistokes was used. The cannulas were removed at the end of surgery.

Postoperative medication:

Topical antibiotic and topical anti-inflammatory. Also, topical anti-glaucoma if indicated. Systemic antibiotic was used in high-risk patients.

Outcome measurement:

The postoperative evaluations for all patients were performed at 1 week, then at 1 month, 3 months, and 6 months. A complete ophthalmic examination using slit-lamp biomicroscopy and 78 Diopter lens was performed at all follow-up visits if possible and by indirect ophthalmoscope. Best-corrected visual acuity was measured by Snellen's chart and converted into log Mar values for statistical analysis in every visit except first visit. Re-detachment was evaluated by slit-lamp biomicroscopy and 78 Diopter lens and confirmed by US. Intraocular pressure was also monitored at each visit using Goldmann applanation tonometry. Any complication was recorded.

Ethical consent:

An approval of the study was obtained from Al-Azhar University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

Statistical tests were run in SPSS 21 running on Windows 7. When dealing with numerical data, results were presented as means ± SD, whereas qualitative findings were reported as numbers or percentages. Parametric data were distinguished from non-parametric data using the Kolmogorov-Smirnov for normality test. Following a one-way analysis of variance (ANOVA) for parametric data and a Kruskal-Wallis test for non-parametric data, we utilised the Duncan test to assess if there was a statistically significant difference between the means. The paired T test was used to determine if there was any statistically significant variation in the intervals between inspections. To compare qualitative groups, we employed the chi-square and fisher exact tests. We regarded a result to be statistically significant if the P-value was equal or less than 0.05, and highly significant if it was equal or less than 0.01. A P-value greater than 0.05 was considered to be non-significant.

RESULTS

The mean age of group (I) was 60.0 ± 6.9 years, group (II) mean age was 57.5 ± 16.0 years and for group (III), it was 60.9 ± 12.2 years with no significant difference among groups (p=0.815). In the first group 6 patients (60%) were males, in the second group 3 patients (30%) were males while, There was no statistically significant difference between the sexes among the third group's patients, of which 4 were males (p = 0.387) (Table 1). Also, no significant difference was noticed among groups regarding medical or neurological diseases (p=0.401) and previous operations (p=0.969).

Table (1): Demographic data

Variable		Groups			P. value (Sig.)
		Group (I) (23 gauge) (n=10)	Group (II) (25 gauge) (n=10)	Group (III) (27 gauge) (n=10)	
Age (year)		60.0 ± 6.9 (49-71)	57.5 ± 16.0 (28-79)	60.9 ± 12.2 (42-80)	0.815^{NS}
Sex	**Male**	6 (60.0%)	3 (30.0%)	4 (40.0%)	0.387^{NS}
	Female	4 (40.0%)	7 (70.0%)	6 (60.0%)	

Vitreous hemorrhage was the main surgical indication in the three groups followed by rhegmatogenous retinal detachment (TRD) with no statistically significant difference among groups regarding surgical indications (p=0.365). Preoperative intraocular pressure (IOP) showed no significant group differences (p=0.183) and postoperatively at the four follow-up intervals (p=0.213, 0.194, 0.231 and 0.140 at 1 week, 1 month, 3 months and 6 months, respectively) **(Table 2)**.

Table (2): Pre and post-operative IOP among studied groups throughout the study period

IOP (mmHg)		Groups			P. value (Sig.)
		Group (I) (23 gauge) (n=10)	Group (II) (25 gauge) (n=10)	Group (III) (27 gauge) (n=10)	
Preoperative		13.60 ± 1.57	12.81 ± 1.39	14.32 ± 2.21	0.183^{NS}
Postop.	**1 week**	11.69* ± 1.35	11.01* ± 1.21	12.30* ± 1.90	0.213^{NS}
	1 month	12.28* ± 1.42	11.56* ± 1.26	12.91* ± 1.99	0.194^{NS}
	3 months	13.01 ± 1.51	12.22 ± 1.35	13.65 ± 2.11	0.231^{NS}
	6 months	13.17 ± 1.48	12.26 ± 1.32	13.72 ± 1.95	0.140^{NS}

One way ANOVA, Duncan and paired T test were used. * Statistically significant difference compared to pre-operative ($p<0.05$).

In the three groups, there was a significant improvement in best corrected visual acuity (BCVA) at 1 month of the follow-up compared to 1 week and preoperative values and it continued to improve markedly ($p< 0.01$) at 3 months and 6 months, respectively **(Figure 1)**. Those in the first, second, and third groups were significantly different. ($p=<0.01$).

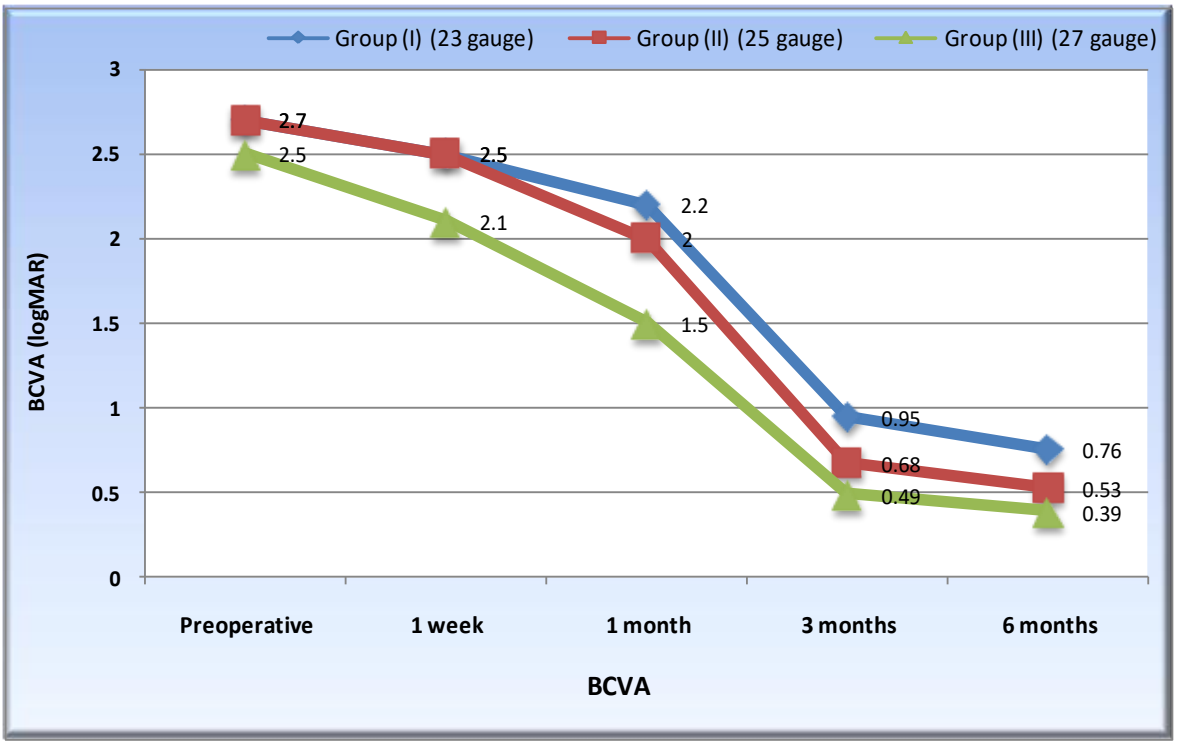

Figure (1): Pre and post-operative BCVA among groups

The research group and the control group did not differ significantly in terms of intraoperative complications **(Table 3).**

Table (3): Intraoperative complications in the study groups

Complication		Groups			P. value (Sig.)
		Group (I) (23 gauge) (n=10)	Group (II) (25 gauge) (n=10)	Group (III) (27 gauge) (n=10)	
No		7 (70.0%)	8 (80.0%)	9 (90.0%)	0.782^{NS}
Yes	**Bleeding**	2 (20.0%)	1 (10.0%)	1 (10.0%)	
	Ret. Breaks	1 (10.0%)	1 (10.0%)	0	

Chi-square test was used. NS Not significant.

Neither group showed a significantly different rate of postoperative complications as compared to the other (**Table 4).**

Table (4): Postoperative complications experienced by patients in the groups

Complication		Groups			P. value (Sig.)
		Group (I) (23 gauge) (n=10)	Group (II) (25 gauge) (n=10)	Group (III) (27 gauge) (n=10)	
No		6 (60.0%)	9 (90.0%)	9 (90.0%)	0.344^{NS}
Yes	**Pupillary block glaucoma**	1 (10.0%)	0	1 (10.0%)	
	Recurrent RD	1 (10.0%)	1 (10.0%)	0	
	Vitreous hemorrhage	2 (20.0%)	0	0	

Chi-square test was used. NS Not significant.

Regarding time of exit among studied groups (in vitreous hemorrhage cases). Group (I) had the highest time of exit mean (9.4 ± 1.5 min.) followed by group (II) (5.2 ± 1.1 min.), while group (III) had the lowest mean time of exit (3.6 ± 1.7 min.), There was statistically significant variation between the three groups. In TRD cases, the duration of surgery + time of exit was significantly higher in 27 gauge group (49.6 ± 3.5 min) compared to 23 gauge group (43.8 ± 1.8) (p=0.045).

DISCUSSION

Findings from the current investigation showed no statistically significant differences between groups with respect to age (p=0.815) or sex distribution (p=0.387). Also, no significant difference was noticed among groups regarding medical or neurological diseases (p=0.401) and previous operations (p=0.969).

The short-term outcomes of complex diabetic retinal detachment repair using a hybrid 23-gauge or 25-gauge vitrectomy tool with a 27-gauge vitrectomy system are comparable to those obtained in a study by **Khan *et al.* [10].** Distributions of age and gender were similar across all groups. Also, one study by **Naruse *et al.* [1]** examined the effectiveness of vitrectomies performed using 27-G and 25-G instruments. Patients' ages, sexes, and disease histories did not significantly differ from one another**.** Also, **Otsuka *et al.* [11]** found similar results. Additionally, **Sborgia *et al.* [12]** recently evaluated 27G and 25G TSV for the treatment of uncomplicated RRD over a 1-year follow-up and found that 27G was safer and more effective. They discovered no statistically significant distinction between the two groups' initial characteristics.

In the present study, vitreous hemorrhage was the main surgical indication accounting for 50% of cases in each group followed by tractional retinal detachment (50% in group I and II). When comparing surgical indications between groups, there was no statistically significant difference (p=0.365). Similarly, **Naruse *et al.* [1]** analyzed the differences in success rates between 25- and 27-gauge vitrectomies. No statistically significant variations in surgical indications were seen between groups.

Our current results revealed that There were no statistically significant variations in preoperative IOP across groups (p=0.183) and after surgery at each of the four time points (p=0.213, 0.194, 0.231, and 0.140 at 1 week, 1 month, 3 months, and 6 months, respectively). In the three groups, IOP decreased significantly at 1 week and 1 month postoperatively (routine \use of antiglaucoma drops post-operative) then it returned to increase slightly at the last two follow-ups (3 and 6 months). Similarly, **Khan *et al.* [7]** compared IOP before and after surgery and found no significant variations between groups. Also, **Otsuka *et al.* [11]** examined the differences between Pars Plana vitrectomies performed with 25 and 27 gauge instruments. They discovered that preoperative IOP (mmHg) was 13.0 ± 3.5 in 25G TSV and 14.3 ± 2.8 in 27G TSV (p=0.11). While being monitored, neither group experienced a statistically significant shift in IOP (p=0.63 and p=0.21, respectively).

Khan *et al.* [10] short-term outcomes of difficult diabetic retinal detachment surgery using hybrid 23-gauge or 25-gauge, vitrectomy devices were compared using a 27-gauge vitrectomy system. Mean intraocular pressure was observed to have stayed unchanged from preoperative levels of 13 ± 3.4 mmHg to postoperative levels of 13.6 5 ± 0.4 mmHg (P = 0.76).

It has been reported that the 27-G instrument was superior to the 25-G device at maintaining steady intraocular pressure [6]. **Sandali *et al.* [13]** found that intraocular pressure (IOP) on the first postoperative day was substantially higher in the 20-G group (P0.001), lower in the 23-G group (P=0.073), and unaltered in the 25-G group (P=0.807). **Kim *et al.*[7]** found that 11.3% of eyes in the 23-G group required intraoperative suturing of sclerotomy sites, while no eyes in the 25-G group required suturing of sclerotomy (P<0.002). 1% of the 23-G group and 0% of the 25-G group experienced hypotony or intraocular pressure increase exceeding 30 mmHg on postoperative day 1. According to the research by **Naruse *et al.* [1]** using a narrower gauge stabilises intraocular pressure (IOP) following vitrectomy, resulting in fewer cases of postoperative hypotony and ocular hypertension**.** On the other hand, **Sborgia *et al.* [12]** observed no statistically significant difference in intraocular pressure (IOP) between 27G and 25G TSV in the treatment of uncomplicated RRD over a 12-month follow-up period. Also, **Oshima *et al.* [5]** employing the 27-G system did not find statistically significant variations between baseline and postoperative mean IOP (i.e., 1, 7, and 30 days postoperatively).

The present study demonstrated that there was no significant difference among groups regarding preoperative BCVA (p=0.590) and at 1 week postoperative (p=0.181). However, at 1 month, 3 months and 6 months postoperatively, 27 gauge group had significantly improved BCVA followed by 25 gauge group and the lowest BCVA was noticed in 23 gauge group. Generally, in the three groups, At 1 month of follow-up, BCVA was significantly better than at 1 week and preoperative values, and it remained significantly better at 3 months and 6 months (p 0.01). **In Khan *et al.* [10]** study the 27-gauge vitrectomy instrument was evaluated against the 23- and 25-gauge alternatives. Post-op, patients' average visual acuity improved from 20/822) to 20/566) (P = 0.55). Also, in a recent study by **Sborgia *et al.* [12]** over the course of a year, they looked at how 27G TSV compared to 25G TSV for treating RRD without complications. There was no statistically significant difference in visual acuity improvement between the two groups (p > 0.05), with Group 1 seeing a decrease from 1.5 ±1.09 LogMar to 0.38 ±0.55 LogMar (p0.001) and Group 2 from 1.2± 0.9 LogMar to 0.49± 0.53 LogMar (p<0.001). In addition, **Naruse *et al.* [1]** analyzed the differences in success rates between 25- and 27-gauge vitrectomies. Users of the 27-G system claimed benefits including faster restoration of visual acuity, enhanced CRT, and maintained ocular pressure. In a study conducted by **Yoneda *et al.* [9],** who evaluated the results of vitrectomy using a 27-gauge surgical needle to treat different types of vitreous disorders. Their research

revealed that while the average preoperative BCVA was 20/270 (logMAR, 1.13 ±1.10), it dramatically improved to 20/83 (logMAR, 0.62± 0.74) after surgery (P = 0.02).

Regarding intraoperative complications, our study revealed that 3 cases (30.0%) in 23 gauge group suffered from complications (2 cases with bleeding and 1 case had ret. breaks) versus 2 cases (20.0%) in 25 gauge group (1 case with bleeding and 1 case had ret. breaks) however, only 1 case had bleeding in 27 gauge group with no significant difference among groups (p=0.782). Similar to our findings, **Naruse *et al.*** [(1)] analysed the differences in success rates between 25- and 27-gauge vitrectomies. There was no statistically significant variation in the occurrence of intraoperative complications between the two study groups. **Khan *et al.*** [(10)] using 23-gauge or 25-gauge vitrectomy instruments with a 27-gauge vitrectomy system. They reported no intraoperative or postoperative complications.

Our current results showed that 23-gauge group had high occurrence of postoperative complications "4 cases, 40.0%" (2 cases with vitreous hemorrhage, 1 case with recurrent RD and 1 case with pupillary block glaucoma) compared to the other two groups, only 1 case suffered from recurrent RD in 25 gauge group and one case suffered from pupillary block glaucoma in 27 gauge group with no significant difference among groups (p=0.344). These findings corroborate those of **Rizzo *et al.*** [(6)] who discovered that 27-G and 25-G groups experienced similar rates of intra- and post-operative problems. During surgery, no eyes had to be converted to use larger-gauge instruments. They went on to say that both surgeons felt confident using 27-G instruments for all procedures on both eyes. Similar results were also found by **Khan *et al.*** [(7)]

CONCLUSION

The 27-G vitrectomy system has been shown to be less traumatic to the eye than its predecessors, the 25-G and 23-G systems, and to have the potential to lessen the patient's inflammatory reaction and hasten their recovery time. When the 27-G vitrectomy system was compared to the 25-G and 23-G systems, it was shown to be equal in terms of efficacy across a range of situations, although requiring smaller incisions. There are benefits to using a smaller-gauge vitrectomy device, but these systems also have downsides, such as weaker tools and a less successful therapy. The trocars used in TRD repair are handled more extensively than those used in regular vitrectomy, therefore suturing may be necessary to guarantee full-fill tamponade. Silicone oil tamponade is often used to prevent escape via wounds, and in these cases, sutures are highly suggested.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

REFERENCES

1. **Naruse S, Shimada H, Mori R (2017):** 27-gauge and 25-gauge vitrectomy day surgery for idiopathic epiretinal membrane. BMC Ophthalmology, 17: 188-163.
2. **Arichika S, Uji A, Murakami T *et al.* (2014):** Retinal hemorheologic characterization of early-stage diabetic retinopathy using adaptive optics scanning laser ophthalmoscopy. Invest Ophthalmol Vis Sci., 55: 8513–22.
3. **Recchia F, Scott I, Brown G *et al.* (2010):** Small-gauge pars plana vitrectomy: a report by the American Academy of Ophthalmology. Ophthalmology, 117: 1851–7.
4. **Kim M, Park Y, Lee D *et al.* (2015):** Comparison of surgical outcome of 23-gauge and 25-gauge microincision vitrectomy surgery for management of idiopathic epiretinal membrane in pseudophakic eyes. Retina, 35: 2115-20.
5. **Oshima Y, Wakabayashi T, Sato T *et al.* (2010):** A 27-gauge instrument system for transconjunctival sutureless microincision vitrectomy surgery. Ophthalmology, 117: 93-102.
6. **Rizzo S, Barca F, Caporossi T *et al.* (2015):** Twenty seven gauge vitrectomy for various vitreoretinal diseases. Retina, 35: 1273-8.
7. **Khan M, Shahlaee A, Toussaint B *et al.* (2015):** Outcomes of 27-gauge microincision vitrectomy surgery for posterior segment disease. Am J Ophthalmol., 161: 36-43.
8. **Mitsui K, Kogo J, Takeda H *et al.* (2016):** Comparative study of 27-gauge vs 25-gauge vitrectomy for epiretinal membrane. Eye, 30: 538-44.
9. **Yoneda M, Sato T, Humayun M *et al.* (2016):** Twenty Seven gauge vitrectomy for advanced diabetic retinopathy. Am J Ophthalmol., 131: 26-34.
10. **Khan M, Samara W, Hsu J *et al.* (2019):** Short-term outcomes of hybrid 23-, 25-, and 27-gauge vitrectomy for complex diabetic tractional retinal detachment repair. Retin Cases Brief Rep., 13: 244-7.
11. **Otsuka K, Hisanori I, Ayaka F *et al.* (2018):** Comparison of 25- and 27-Gauge Pars Plana Vitrectomy in Repairing Primary Rhegmatogenous Retinal Detachment. J Ophthalmol., 7643174: 1-5.
12. **Sborgia G, Alfredo N, Luigi S *et al.* (2019):** One-year outcomes of 27-gauge versus 25-gauge pars plana vitrectomy for uncomplicated rhegmatogenous retinal detachment repair. Int J Retin Vitr., 5: 13-19.
13. **Sandali O, El Sanharawi M, Lecuen N *et al.* (2011):** 25-, 23-, and 20-gauge vitrectomy in epiretinal membrane surgery: a comparative study of 553 cases. Graefes Arch Clin Exp Ophthalmol., 249: 1811-9.