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Original Research Article

A comparative study of anatomical and functional outcomes after 20, 23 and 25 gauge pars plana vitrectomy in adult population at a tertiary care center in Rajasthan

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ABSTRACT

Background: Pars plana vitrectomy is the most common technique in vitreoretinal surgery that enables access to the posterior segment for treating conditions such as retinal detachment, vitreous hemorrhage, macular hole, endophthalmitis, dropped nucleus and dropped iol in a controlled closed system.
Materials and Methods: Prospective, comparative study of patients, more than 18 years of age, who underwent pars plana vitrectomy for various vitreoretinal disease at J.L.N. Medical College, Ajmer, from October 2020 to March 2022,with no previous history of any vitreoretinal surgery.
Result: 96 eyes of 96 patients that underwent 20-gauge (n=32), 23-gauge (n=32) and 25-gauge (n=32) Pars plana vitrectomy were included in this study. The mean duration of surgery was significantly higher in the conventional 20-Gauge as compared to the micro incisional vitrectomy system. Mean Best corrected visual acuity (BCVA) improved significantly in all three groups at postoperative 3 months, no significant difference between the 3 groups. Re retinal detachment occurs in 6 eyes(2 eyes in each group). Recurrent vitreous hemorrhage occurs in 1 eye in 25-gauge and postoperative endophthalmitis occurs in 2 eyes(1 eye each in 20-gauge and 23-gauge). There was a similar rate of ocular hypertension in all three groups. Postoperatively 20-gauge showed significantly higher mean conjunctival hyperemia and subconjunctival hemorrhage compared to Sutureless microincisional vitrectomy surgery.
Conclusion: Functional and anatomical outcomes assessed by BCVA and retinal status postoperatively seem to be comparable between 20,23 and 25-gauge vitrectomy systems. Sutureless microincisional vitrectomy surgery showed significantly shorter duration of surgery.

1. Introduction

Traditionally, most vitrectomy surgical systems utilize the 20-gauge instruments. PPV includes multiple incisions including peritomy (opening of the conjunctiva) and sclerotomy. Since the introduction of PPV in 1971, one of the most revolutionary developments in vitreoretinal surgery over the past few years has been Transconjunctival sutureless vitrectomy (TSV).[1] The gauge refers to the size of the instruments with higher numbers corresponding to smaller size instruments (20-gauge = 0.9mm diameter, 23-gauge = 0.6mm diameter, 25-gauge = 0.5mm diameter, 27-gauge = 0.4mm diameter). Sclerotomies created with 20-gauge instruments would need to be sutured. While seldomly used nowadays, there are still indications for which 20-gauge is necessary including removal of retained lens material using the fragmentome and removal of Intraocular foreign bodies (IOFB) using IOFB forceps. In addition, patients with 20-gauge, sutured wounds may

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have a decreased rate of endophthalmitis compared to patients undergoing smaller-gauge vitrectomy surgery; a finding possibly related to hypotony and wound leakage more commonly seen in sutureless surgery. Previous studies have found endophthalmitis rates twelve to twenty-eight times higher with 25-gauge vitrectomy compared to 20-gauge vitrectomy although endophthalmitis rates were low in both groups.[2,3] However, subsequent studies have found similar rates of endophthalmitis with 20-gauge and 25-gauge vitrectomy.[4,5] On the other hand, there are numerous advantages of small-gauge vitrectomy, including ability to use trocar-cannula entry systems which reduce retinal and vitreous incarceration, neovascularization at sclerotomy sites, and iatrogenic breaks and dialysis at the vitreous base,[6] increased patient comfort,[7,8] decreased corneal astigmatism,[9,10] decreased operative times,[7,8] decreased conjunctival scarring.[6]

2. Material and Methods

A prospective, comparative study was performed in 96 patients undergoing PPV between October 2020 and March 2022. This study was approved by the institutional Review Board of the J.L.N. Medical College, Ajmer, Rajasthan. Patients were taken in this study after informed and written consent. This study included patients with preoperative diagnosis of vitreous hemorrhage(diabetic and non diabetic), rhegmatogenous retinal detachment, tractional retinal detachment, macular hole, endophthalmitis, dropped iol, dropped nucleus and other vitreoretinal pathologies. Patients were randomly allocated to three groups. Group 1 (n=32) was treated with 20- gauge technique, group 2 (n=32) was treated with 23-gauge and group 3 (n=32) was treated with 25-gauge. All cases were operated under local anesthesia facial and peribulbar block with lignocaine 2% and bupivacaine 0.5%. Surgical procedures were basically similar in all three groups, except for the scleral-entry procedure. In the 20-gauge technique, the conjunctiva was opened in a nasal triangle and in a temporal quadrangle 3.5 to 4 mm from the limbus, and scleral incisions were performed. All 23-gauge trocars was inserted in a beveled 2-step manner with a first partial insertion at an oblique angle of 15° to 20° tangential to the scleral surface followed by entry into the vitreous cavity at an angle of 13 Material & Methods 30° to 40°.For the insertion of the 25-gauge trocars, a 1-step insertion technique at about 30° was employed. Core vitrectomy was performed first. Posterior vitreous detachment was induced if not present prior and required. Peripheral vitrectomy was followed after. If required perfluorocarbon liquid (PFCL) was used to flatten the retina and drain the sub retinal fluid. Under the PFCL bubble, endophotocoagulation was performed if needed. Following which air fluid exchange was done. A suitable intraocular tamponade was replaced for air.For tractional retinal detachment cases, a vitreous cutter was used to shave the residual membrane stump after delamination or segmentation with microscissors. When a macular hole was present and in cases of diabetic macular oedema, brilliant blue green dye was used to enhance visualization of the internal limiting membrane. The dropped nucleus was removed using phacofragmentation. In dropped IOL after releasing the adhesions around the IOL, it was delivered into Anterior chamber with the help of intravitreal forceps and removed after cutting the sutures. Conjunctiva was closed with 7-0 vicryl sutures in all eyes treated with 20-gauge technique and wherever required in 23 or 25 gauge techniques. Subconjunctival steroid and antibiotic injection combination was given at the end of surgery. Patients were positioned according to requirement after surgery. Patients' particulars like patient name, age, sex, ocular and systemic history were recorded. After detailed ocular examination preoperative data included like BCVA (using Snellen's visual acuity chart and converted to LogMAR), IOP, fundoscopy (by direct and indirect ophthalmoscope). When needed, B-scan, OCT and color fundus photography performed. During operation, total operative time(from the insertion of the lid speculum at the start to its removal at the end), intraoperative complications and type of intraocular tamponade used were recorded. Postoperative BCVA, IOP, and retinal status by ophthalmoscope or OCT were measured at 1 day, 1 week, 1 month and 3 months after surgery. As a substitute for a patient survey on the postoperative discomfort, degree of postoperative conjunctival and corneal changes were qualitatively graded using an earlier reported standardized scale with some modifications. Briefly, each category of conjunctival hyperemia, subconjunctival hemorrhage and corneal oedema were scored by slit-lamp examination as 0(absent), 0.5(trace), 1(mild), 2(moderate), and 3 (severe).[11,12] Postoperative complications such as sclerotomy site wound leakage, hypotony, IOP elevation, endophthalmitis, vitreous hemorrhage, retinal detachment were all recorde.

3. Result

As shown in Table 1, There were 96 eyes of 96 patients that underwent 20-gauge (n=32), 23-Gauge (n=32) and 25-Gauge (n=32) Pars plana vitrectomy were included in this study. There were no statistical significant differences in patients demographic characteristics or indications of surgery between all three groups. The most common indication of Pars plana vitrectomy in 20 and 23-gauge groups was retinal detachment (28.01%), and in 25-gauge group vitreous hemorrhage (28.10%). The mean duration of surgery was significantly higher in the 20-gauge group (30.28min) as compared to the 23 and 25-gauge micro incisional vitrectomy system (28.7min). Figure 1 shows a comparison of preoperative and postoperative best corrected visual acuity between all patients of three groups. Mean BCVA (Log MAR) improved significantly

in all three groups at postoperative 3 months, but there was no significant difference between the 3 groups. The patterns of visual acuity changes were similar in all groups when we categorized into subgroups according to diagnosis (Figure 2). Table 2 shows comparison of conjunctival and corneal changes on postoperative day 1 and 1 week between three groups. Postoperatively 20-gauge showed significantly higher mean conjunctival hyperemia and subconjunctival hemorrhage compared to 23 and 25-gauge groups. As shown in Table 3, intraoperative suturing of sclerotomy sites was done in all patients in conventional 20-gauge vitrectomy groups, and also required in 3(9.4%) eyes in 23-gauge group and 5(15.6%) eyes in 25-gauge group. Majority of the subjects (90.6%) had retina on at last follow up visit in all groups. Postoperatively retinal detachment occurs in 6 eyes(2 eyes 6.25% in each group). Recurrent vitreous hemorrhage occurs in 1(3.1%) eye in 25-gauge and postoperative endophthalmitis occurs in 2 eyes (1 eye 3.1% each in 20-gauge and 23-gauge). Rate of intraoperative sclerotomy suturing was more in 25-gauge compared to 23-gauge. There was a similar rate of ocular hypertension in all three groups.

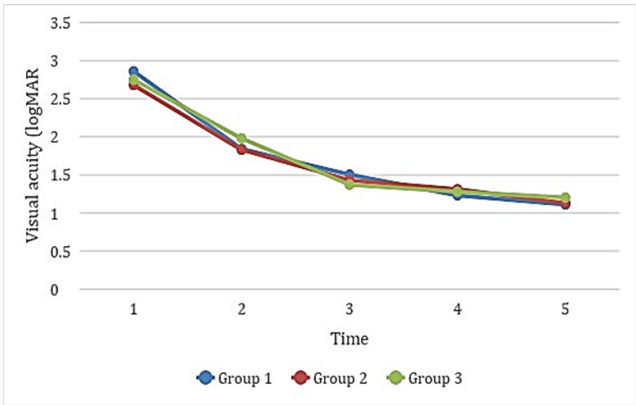

Fig. 1: Comparison of visual acuity

4. Discussion

Sutureless MIVS has increased in popularity owing to short duration of surgery, quicker patient rehabilitation due to lower level of suture related discomfort and inflammation. In this comparative study we compare the anatomical and functional outcomes after 20-, 23- and 25-gauge PPV. Group 2(23-gauge) and 3(25-gauge) was vitrectomy MIVS, while group 1(20-gauge) was conventional vitrectomy surgery which required suturing sclerotomy. The analysis of the functional outcome was done by assessing improvement in visual acuity and the anatomical outcome by assessing the status of the retina. In the current study, the mean duration of surgery for the group 1 subjects was longer (Mean ±S.D. of 30.28±1.689) than groups 2 (Mean ±S.D. of 28.78±1.157) and group 3 (Mean ±S.D. of 28.75±1.391).[13] The results were statistically significant. In Sedova et al[14] 25 gauge PPV(Mean±S.D. of 45.02±20.53) takes more time compared to 23-gauge PPV (Mean ±S.D. of 39.66±21.24). In our study silicone oil tamponade was used in 71.9% subjects in group 1, 68.2% in group 2 and 56.2% in group 3. SF6 gas tamponade was used in 9.4% subjects in group 1 and group 2, and 15.6% subjects in group 3. Misra et al[6] reported that in 20 gauge group 50% subjects not required intraocular tamponade, another 50% subjects required tamponade either silicon oil, SF6 gas, perfluoropropane(C3F8), while in 23 gauge group, only 4 subjects had no tamponade, 20 subjects had air, and a total of 25 subjects required either SF6, C2F6, or C3F8 gas tamponade.

Assessment of visual acuity was one of the primary aims of this study to determine the functional outcome of PPV in the current study. In Group 1, BCVA improves from 2.81±7.308 preoperative to 01±0 58 at postoperative 3 months In Group 2, BCVA improves from 2 72±1 32 preoperative to 92±0 4046 at postoperative 3 months In Group 3, BCVA improves from 2 73±1 25 preoperative to 09±0 305 at postoperative 3 months all 3 groups showed a significant improvement in postoperative visual recovery at every follow up, but there was no statistically significant difference between the 3 groups at any follow up time. Interestingly, the patterns of visual recovery were similar in all groups, when we categorized total eyes into sub groups according to preoperative diagnosis. Similar reports were given by Sedova et al.[14] The course of the IOP measurements over the time shows a parallel shape in all three groups with a peak at the postoperative day 1 visit and decreasing trend in the following months. The intraocular pressure was within normal levels all through the follow-up period. There is no statistically significant difference between three groups. It is observed that changes in IOP do not depend on gauge of trocar, it probably depends on intraocular tamponade used during surgery. In subjects undergoing PPV using BSS as intraocular tamponade do not show elevation in IOP on postoperative day 1, but in subjects undergoing PPV using silicon oil and SF6gas as intraocular tamponade IOP elevation observed on postoperative day 1.

In the current study 3 eyes (9.4%), (2 silicon oil filled eyes and 1 SF6 gas filled eye) in the 23-gauge group and 5 eyes (15.6%), (2 silicon oil filled eyes, 2 SF6 gas filled eyes and 1 BSS filled eye) in the gauge group reported intraoperative hypotony and required suturing all 3 sclerotomy ports with 7-0 vicryl suture after removal of trocar. In Sedova et al14 30% eyes in 23 gauge group and 31% eyes in 25 gauge required suturing sclerotomy, which were statistically not significant. Y Nam et al13 reported a higher rate of sclerotomy suturing in the 23 gauge group (14.89% eyes) compared to the 25 gauge group (7.89% eyes). In the current study postoperative wound leakage and hypotony was not observed in any

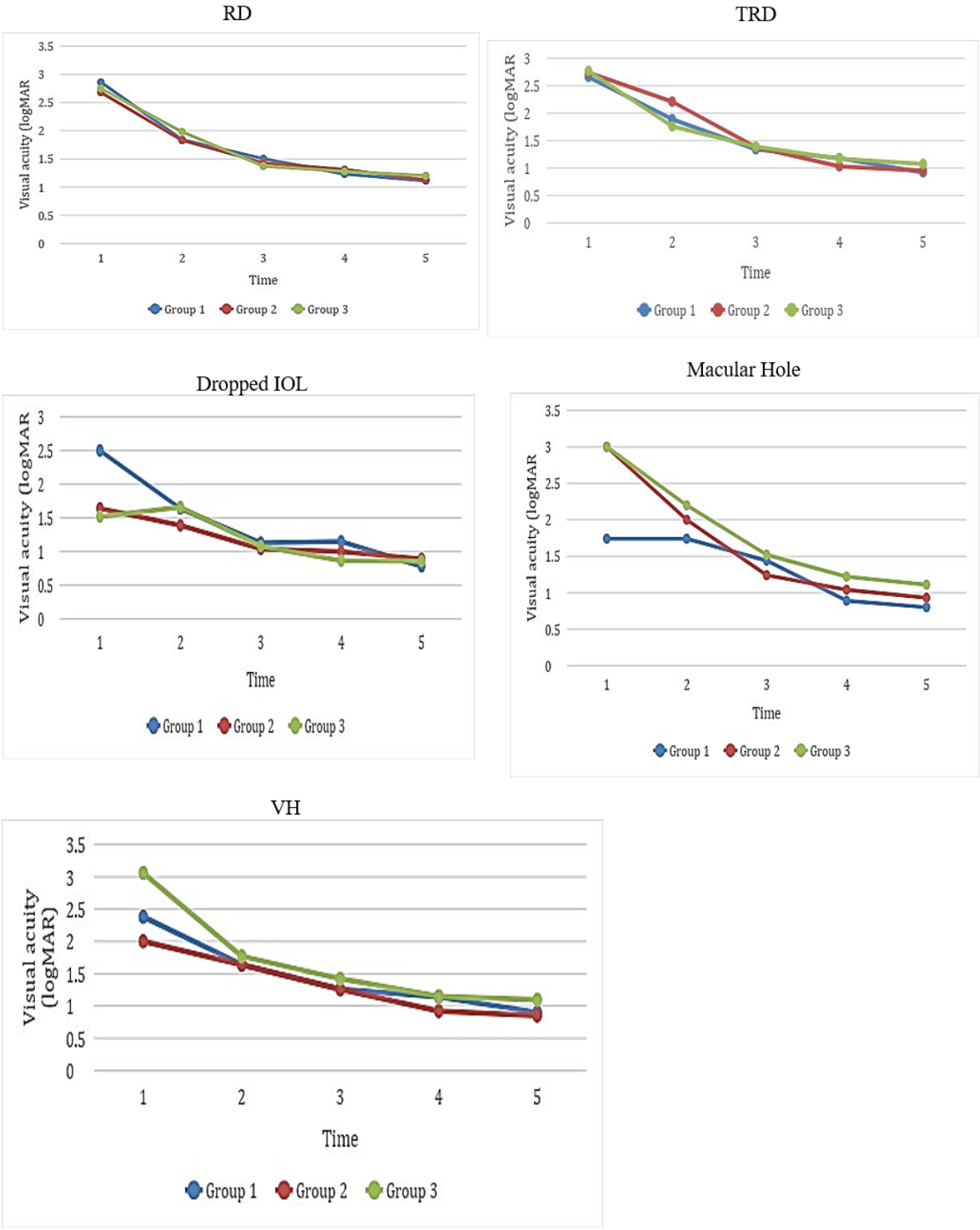
RD
Visual acuity (logMAR
Time
Group 1
Group 2
Group 3
TRD
Visual acuity (logMAR
Time
Group 1
Group 2
Group 3
Dropped IOL
Visual acuity (logMAR
Time
Group 1
Group 2
Group 3
Macular Hole
Visual acuity (logMAR
Time
Group 1
Group 2
Group 3
VH
Visual acuity (logMAR)
Time
Group 1
Group 2
Group 3

Fig. 2:

Table 1: Demographic characteristics

Characteristics	Group 1 (20 Gauge)	Group 2 (23 Gauge)	Group 3 (23 Gauge)
No. of eyes	32	32	32
Gender (Male: Female)	13:19	15:17	14:18
Mean age (Years)	49.91±13.77	53.22±13.26	54.59±14.12
Duration of surgery (minutes) Avg	30.28±1.68	28.78±1.15	228.75±1.39
Indications			
TRD	6(18.8%)	6(18.8%)	7(21.9%)
RD	9(28.1%)	9(28.1%)	8(25%)
VH	7(21.9%)	8(25%)	9(28.1%)
MH	2(6.2%)	2(6.2%)	3(9.4%)
Endophthalmitis	2(6.2%)	3(9.4%)	0
Subhyaloid Hemorrhage	1(3.1%)	0	2(6.2%)
Dropped IOL	2(6.2%)	2(6.2%)	3(9.4%)
Dropped Nucleus	3(9.4%)	2(6.2%)	0
Intraocular Tamponade			
Silicon oil/SF6 gas/BSS	23/3/6	22/3/7	18/5/9
Preoperative Lens Status			
Phakic/ Pseudophakic/ Aphakic	20/7/5	19/9/4	20/9/3

TRD: Tractional retinal detachment, RD: Retinal detachment, VH: Vitreoushe morrhage; MH: Macular hole, BSS: Balanced salt solution, IOL: Intraocular lens

Table 2: Comparison of conjunctival and corneal changes (severity score)

		Group 1 Std		Group 2 Std		Group 3 Std		P Value
		Mean	Deviation	Mean	Deviation	Mean	Deviation	
Post-op day 1	Conjunctival Hyperemia	1.31	0.56	0.92	0.42	0.906	0.42	0.001 (S)
	Subconjunctival Haemorrhage	1.34	0.78	0.92	0.47	0.906	0.42	0.004 (S)
	Corneal edema	0.62	0.76	0.609	0.605	0.609	0.61	0.99
Post-op 1 week	Conjunctival Hyperemia	0.609	0.37	0.32	0.35	0.31	0.32	0.001 (S)
	Subconjunctival Haemorrhage	0.65	0.57	0.39	0.37	0.34	0.29	0.01 (S)
	Corneal edema	0.26	0.31	0.28	0.25	0.25	0.28	0.93

Grading: none, 0; trace, +0.5; mild, +1; moderate, +2; severe, +3

Table 3: Complications

	Group 1 (20 Gauge)	Group 2 (23 Gauge)	Group 3 (25 Gauge)
Intraoperative			
Suture of sclerotomy	32	3(9.4%)	5(15.6%)
Retinal tear	0	0	0
Postoperative			
Ocular Hypertension (IOP>24mmHg)	2(6.2%)	1(3.12%)	1(3.12%)
RD	2(6.2%)	2(6.2%)	2(6.2%)
VH	0	0	1(3.12%)
Endophthalmitis	1(3.12%)	1(3.12%)	0

IOP: Intraocular pressure, RD: Retinal detachment, VH: Vitreous hemorrhage

group, which has previously been described as a common complication. Intraoperative retinal tears were not reported in any group in the current study. Majority of subjects in the current study did not have any early complications. 6 eyes (18.75%) in each group presented with IOP elevation over 24mmHg in the first postoperative day. Ocular hypertension (IOP>24mmHg) was reported in 5 eyes(15.6%) in group 1, 3 eyes(9.4%) each in group 2 and group 3 at 1 week. After subsiding inflammation only 2 eyes(6.25%) in group 1, 1 eye (3.1%) each in group 2 and 3 remain with elevated IOP, which was managed by application of pressure-lowering drops. No significant difference between all 3 groups. Postoperative hypotony was not reported in any group. Endophthalmitis was reported in 1 eye (3.12%) in group 1. In group 2, one subject, which was a case of endophthalmitis preoperatively, remained untreated and IOP also elevated postoperatively. 2 eyes (6.25%) had recurrent retinal detachment in each group. Vitreous hemorrhage in 1 eye(3.125) reported in group 3. Assessment of retinal status was carried out to determine the anatomical outcome of PPV with different gauge trocar systems. At final follow-up 29 eyes (90.6%) in each group had retina on, which shows similar anatomical success rate in all three groups. Similar results were reported by Sedova et al[14] and Y Nam et al.[15]

In the current study, Group 1 subjects showed higher mean conjunctival hyperemia and subconjunctival hemorrhage compared to group 2 and 3 subjects at post-op day 1 and I week after surgery. The results were statistically significant. Y Nam et al[15] reported similar conjunctival and corneal changes, only conjunctival edema at 1 week post op was significant.

5. Conclusion

To conclude, the findings of this interventional study of three groups for PPV with 20-23- and 25-gauges show that all the three systems are comparable in terms of functional and anatomical outcomes, assessed by Best corrected visual acuity (BCVA) and retinal status post-operatively. The size difference between 20,23 and 25-gauge cutters do not affect the speed of postoperative visual recovery, final visual acuity and retinal status. In this study, sutureless microincisional vitrectomy surgery with 23 and 25 gauge showed significantly shorter duration of surgery and quicker patient rehabilitation due to lower level of suture related discomfort and inflammation.

6. Source of Funding

None.

7. Conflict of Interest

Nil.

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