

Comparison of Intraoperative Retinal Break Formation during Standard 20-Gauge and 23-Gauge Sutureless Vitrectomy Systems

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Abstract

Purpose: The aim of this study was to compare the rate and location of intraoperatively induced retinal breaks between two techniques of standard 20-gauge vitrectomy and transconjunctival 23-gauge using trocar/cannula

Methods: In this prospective comparative case series patients having attached retina before surgery who were operated for different vitreoretinal or macular conditions by standard 20-gauge trans-pars plana vitrectomy (20G) were compared with another group of patients who were operated by 23-gauge using trocar/cannula system. The peripheral retina was examined before surgery and by the end of surgery using indirect ophthalmoscope and scleral depression. The rate of iatrogenic break formation, number and type of breaks and location of breaks were compared between the two groups.

Results: A total of 115 vitrectomies were studied. Fifty five vitrectomies were done by transconjunctival micro-incision vitrectomy systems (MIVS) and 60 were performed by standard 20G system. The overall rate of iatrogenic break formation was two (3.6%) and seven (11.7%) for 23-gauge and 20-gauge system, respectively. Eleven breaks in 20G group were either dialysis behind or tears within one clock hour from the sclerotomy site, while the two patients in 23-gauge group had tears away from the sclerotomy site ($P < 0.05$). No patient in the 23-gauge group showed iatrogenic dialysis.

Conclusion: Twenty-three gauge vitrectomy may have the potential benefit of lower complication in terms of sclerotomy related breaks and retinal dialysis formation. This benefit should be weighed against the limitations and other potential complications of this technique. Further studies are required to assess their safety and other complications of these systems.

Keywords: Vitrectomy-Adverse Effects, Vitrectomy-Methods, Microincision Vitreous surgery, Retinal Break, Sutureless Vitrectomy

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Introduction

Early in 1970s Machemer and Kloti introduced the idea of shifting to the pars-plana area to access the vitreous cavity. It was the birth of pars-plana vitrectomy.¹⁻⁵ In 2002 Fujii et al, presented the first fully integrated transconjunctival 25 gauge vitrectomy system consisting of micro-cannulas, insertion trocar, small gauge vitreous cutter and infusion cannulas and demonstrated its safety and efficiency, specially in simple vitrectomies.^{6,7} In 2004/2005 Eckardt for the first time introduced a fully integrated 23-gauge vitrectomy system, and demonstrated its safety and efficiency.⁸ Since then these methods are widely used for treatment of different vitreoretinal conditions although debates exist on the benefits and limitations of these new transconjunctival micro-incision vitrectomy systems (MIVS).⁸

Various complications have been reported for vitreous surgery. Potential intraoperative complications include retinal tear, retinal detachment, intraocular and vitreous hemorrhage, lens damage, corneal haziness and macular damage and toxicities. Infection, hemorrhage, wound leak, hypotony, retinal detachment, intraocular pressure (IOP) changes, cataract formation, macular pucker and failed surgery also reported as postoperative complications of vitreous surgery. Retinal break is one of the major complications of vitreous surgery.^{9,10} This complication can lead to retinal detachment, proliferative vitreoretinopathy (PVR) and more additional procedures may ensue. Thus a study on the rate of break formation by various systems of vitreous surgery is valuable.

Methods

This prospective comparative case series was performed after institutional review board (IRB) approval on 116 patients who were candidate for vitreous surgery in two main ophthalmology centers of Shiraz, south of Iran; since September 2008. All patients signed an informed consent before any intervention. Patients were enrolled in this study if they met the inclusion criteria of our study. Complete ophthalmic examination including Snellen visual acuity (VA), slit-lamp and funduscopy examinations and any

appropriate paraclinical test and imaging was done preoperatively.

All patients who had visible peripheral retina in the preoperative examination and good anterior segment media for visualization entered in this study. Patients who preoperatively had cloudy corneas, high myopia, opaque media with no visible peripheral retina, peripheral retinal traction, any retinal detachment or previous vitrectomy surgery in the study eye or those requiring silicone oil injection or intraoperative conversion from 23-gauge to 20-gauge vitrectomy were excluded from the study.

Patients selected for the study according to the above inclusion and exclusion criteria were randomly divided into two groups (23-gauge or 20-gauge). One hundred and fifteen eyes from 115 patients were included in this study. Sixty patients underwent 20G vitrectomy and 55 underwent 23-gauge vitrectomy with the same vitrectomy systems and techniques.

All operations were done by one vitreoretinal surgeon. Before vitrectomy peripheral retina was examined by an experienced vitreoretinal surgeon using binocular indirect ophthalmoscope and scleral depression and/or biomicroscopy of the fundus using three mirror fundus lens. In the 20G group standard three port non-trocar/cannula pars plana vitrectomy was done using corneal contact lenses. 23-gauge was done using Alcon® trocar/cannula and stereoscopic diagonal inverter and BIOM® mounted on Topcon operating microscope or corneal contact lenses. High speed vitrectomy with cutting rates of more than 1,500 cuts/min was done and all vitrectomies completed with induction and/or removal of posterior vitreous cortex and scleral depression was used to remove the peripheral vitreous skirt. Maximum suction of 200 mmHg in 20-gauge and 400 mmHg in 23-gauge group was used. The phacoemulsification was combined with vitrectomy if clinically indicated for simultaneous treatment of cataract. New break was defined as any intraoperatively induced retinal break or any break observed intraoperatively with fresh or bleeding borders not present preoperatively. Sclerotomy site break was defined as any new break (including retinal dialysis) behind or within one

clock hour meridian of sclerotomy site port. At the end of vitrectomy (before wound closure and before any gas injection if it was required), extensive peripheral retinal examination using indirect ophthalmoscope and 2.2 lens was done in all patients. Number, type and location of new breaks were recorded. The patients were followed for at least three months after operation and the final best corrected visual acuity (BCVA) was measured with Snellen chart. All data recorded and analyzed using SPSS software version 11 for statistical analysis. The χ^2 test was used for comparison of ratios between the two groups. Paired t-test and student t-test were used for comparison of means in each group and among the two groups respectively and any P value below 0.05 was considered statistically significant.

Results

One hundred and fifteen eyes from 115 patients were included in this study. Sixty

patients underwent 20G vitrectomy and 55 underwent 23-gauge vitrectomy. One patient was excluded from study due to intraoperative conversion from 23-gauge to 20-gauge vitrectomy. The main characteristics of patients in the two groups are summarized in Table 1.

In the 20-gauge group mean (\pm Standard Deviation) preoperative logMAR of BCVA was 1.04 (\pm 0.32) and mean postoperative logMAR of BCVA was 0.42 (\pm 0.23) ($P=0.01$). Mean preoperative and postoperative logMAR VAs were 0.97 (\pm 0.29) and 0.32 (\pm 0.17), respectively in 23-gauge groups ($P=0.01$). All recorded visions are BCVAs.

In both groups the most common preoperative clinical diagnoses and indications for vitrectomy were idiopathic macular epiretinal membrane, macular hole, vitreo-macular traction syndrome (VMT) and diabetic macular edema with premacular fibrosis (Table 2).

Table 1. Preoperative patients' characteristics in the two groups

	20-gauge vitrectomy group (n=60)	23-gauge vitrectomy group (n=55)
Mean Age (Range)*	59 (24-79)	54 (5-82)
Sex	Male=25 Female=35	Male=23 Female=32
Laterality	OD=28 OS=32	OD=19 OS=36
Lens Status	Phakic=44 Pseudophakic=16	Phakic=45 Pseudophakic=10

* Years of age

Table 2. Preoperative clinical diagnoses and indications for vitrectomy in the two groups

	20-gauge vitrectomy group	23-gauge vitrectomy
Idiopathic macular epiretinal membrane	22	14
Macular hole	15	21
Diabetic macular edema with premacular fibrosis*	8	7
Vitreomacular traction syndrome	5	5
Trauma related conditions (terson, epiretinal membrane)	5	2
Uveitis related conditions	5	4
Post-endophthalmitis related conditions	0	1
Progressive deep lamellar hole	0	1
Total	60	55

* Thick taught posterior hyaloids visible in clinical exam and proved by optical coherence tomography

Phakic vitrectomy was done in 12 and 15 patients in 20-gauge and 23-gauge groups, respectively. Pseudophakic vitrectomy was done in 16 and 10 patients and combined phacoemulsification and vitrectomy was done for 32 and 30 patients in the 20-gauge and 23-gauge groups, respectively.

Iatrogenic new break was found in seven (11.7%) and two (3.6%) eyes of 20-gauge and 23-gauge group, respectively ($P=0.16$). A total of eighteen breaks were found in 20-gauge group and a total of four breaks were found in the 23-gauge group. Five patients with retinal dialyses were found in 20-gauge group while no dialysis was found in 23-gauge group ($P=0.01$). Eleven sclerotomy related breaks were found in 20-gauge group but no sclerotomy related break was found in 23-gauge group. Four breaks in 20-gauge patients and 3 breaks in 23-gauge group were induced during induction and/or removal of posterior vitreous detachment (PVD). One round hole was induced in 23-gauge group due to cutting action of vitrectomy probe.

Discussion

Safety and efficacy of small gauge vitrectomy systems have been evaluated in different studies. Shorter operation time, reduced postoperative discomfort and intraocular inflammation, and a more rapid improvement in VA have been reported, as the benefits of these systems.^{6-8,16}

Postoperatively the rate of wound leakage, hypotony and choroidal detachment may be higher with 23-gauge compared with traditional 20-gauge systems.^{10,17,18} Wound leakage is not a benign condition and may increase the risk of complications including supra-choroidal hemorrhage, and endophthalmitis.^{17,18}

Retinal breaks are among the major complications of vitreoretinal surgical treatments.^{6,11} They potentially can lead to retinal detachment and PVRs. Several reports have documented the risk of intraoperative and postoperative retinal tears and detachment.^{6,11} Excessive vitreoretinal traction at the sclerotomy sites, lack of adequate peripheral vitrectomy with more flexible instruments and intraoperative traction over the vitreoretinal adhesions can induce retinal tears.^{6,11}

Preoperative diagnosis may be an important factor in the selection of appropriate surgical technique. In our study the preoperative diagnosis were similar to those of previous series with 23-gauge systems.^{6,7,9}

We had 7 (11.7%) eyes with new iatrogenic breaks in 20-gauge and 2 (3.6%) in 23-gauge group ($P>0.05$). We found 18 breaks in 20-gauge group compared to only 4 breaks in 23-gauge group. No patient with retinal dialysis was found in 23-gauge group but 5 retinal dialyses were found in 20-gauge group ($P<0.05$). Eleven breaks were found at the site of sclerotomy in 20-gauge group while no break was found at the site of sclerotomy in 23-gauge systems in this study.

Although we found a trend for lower break formation in the 23-gauge compared with 20G vitrectomy, but it was not statistically significant. Our findings showed that the rate of new breaks specially at the site of sclerotomy and retinal dialysis formation are lower in 23-gauge systems.

Theoretically vitreous incarceration at the sclerotomy site might result in peripheral vitreous and retinal traction and the incidence of retinal detachment following small gauge sutureless vitrectomy might be increased compared to that of standard 20-gauge surgery.¹⁹ The results of our study showed that the rate of retinal break is lower in 23-gauge systems as compared to 20-gauge system. This finding is compatible with the results of some other studies.^{8,10,11}

Lakhanpal et al reported no retinal detachment in their 140 consecutive cases of small gauge vitrectomy.¹⁰ Ibarra et al documented postoperative retinal detachment in one out of 45 consecutive eyes after 25 gauge vitrectomy.¹¹ These studies stated that the incidence of retinal detachment after small gauge vitrectomy does not appear to be increased compared to that of standard 20-gauge surgery.

No intraoperative tears were noted by Fine et al among 77 consecutive cases of 23-gauge vitrectomy surgery.²⁰ The findings of our study are compatible with findings of above studies. In the present study we prospectively checked the patients for any intraoperatively induced retinal breaks or dialyses in 23-gauge using trocar cannula and compared them with another group of non-trocar 20G vitrectomy. The 23-gauge

group comprised of 23-gauge technique performed in the same setting as 20G vitrectomy system. This study is focused on the phenomenon of surgically induced retinal breaks in 23-gauge using trocar cannulas prospectively and compares it with a similar group of 20G non-trocar vitrectomised patients.

Mean VA after vitrectomy with 23-gauge improved significantly a finding compatible with other studies.^{19,20} Safety and efficacy of small gauge vitrectomy systems have been evaluated in different studies and the incidence of retinal break formation was up to 24% in some reports.²¹ In our study the incidence of retinal break formation was lower, but our study was a small study with limited cases and for better evaluation of this finding larger studies with more cases is required. The experience of surgeons and case

selection is also different between various studies.

Conclusion

In conclusion in our study 23-gauge trans-conjunctival vitrectomy systems appears to be safe and effective as compared with standard 20-gauge vitrectomy system in terms of retinal break formation and improvement of VA in some of the vitreoretinal diseases, although further large scale studies are required to assess the outcomes and safety of the new small gauge vitrectomy systems.

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References

1. Machemer R. The development of pars plana vitrectomy: a personal account. *Graefes Arch Clin Exp Ophthalmol* 1995;233(8):453-68.
2. Machemer R. Pars plana vitrectomy. Summary. *Trans Sect Ophthalmol Am Acad Ophthalmol Otolaryngol* 1976;81(3 Pt 1):431.
3. Machemer R. Pars plana vitrectomy. Introduction. *Trans Sect Ophthalmol Am Acad Ophthalmol Otolaryngol* 1976;81(3 pt 1):350-1
4. Machemer R. A new concept for vitreous surgery. 7. Two instrument techniques in pars plana vitrectomy. *Arch Ophthalmol* 1974;92(5):407-12.
5. Machemer R. Subtotal vitrectomy through the pars plana. *Trans Am Acad Ophthalmol Otolaryngol* 1973;77(2):OP198-201.
6. Fujii GY, De Juan E Jr, Humayun MS, et al. Initial experience using the transconjunctival sutureless vitrectomy system for vitreoretinal surgery. *Ophthalmology* 2002;109(10):1814-20.
7. Fujii Gy, De Juan E Jr, Humayun MS, et al. A new 25-gauge instrument system for transconjunctival sutureless vitrectomy surgery. *Ophthalmology* 2002;109(10):1807-12.
8. Eckardt C. Transconjunctival sutureless 23-gauge vitrectomy. *Retina* 2005;25(2):208-11.
9. Cho Yj, Lee JM, Kim SS. Vitreoretinal surgery using transconjunctival sutureless vitrectomy. *Yonsei Med J* 2004;45(4):615-20.
10. Lakhanpal RR, Humayun MS, De Juan E Jr, et al. Outcomes of 140 consecutive cases of 25-gauge transconjunctival surgery for posterior segment disease. *Ophthalmology* 2005;112(5):817-24.
11. Ibarra MS, Hermel M, Prenner JL, Hassan TS. Longer-term outcomes of transconjunctival sutureless 25-gauge vitrectomy. *Am J Ophthalmol* 2005;139(5):831-6.
12. Yanayali A, Celik E, Horozoglu F, et al. 25-Gauge transconjunctival sutureless pars plana vitrectomy. *Eur J Ophthalmol* 2006;16(1):141-7.
13. Yoon YH, Kim DS, Kim JG, Hwang JU. Sutureless vitreoretinal surgery using a new 25-gauge transconjunctival system. *Ophthalmic Surg Lasers Imaging* 2006;37(1):12-9.
14. Rizzo S, Genovesi-Ebert F, Murri S, et al. 25-gauge sutureless vitrectomy and standard 20-gauge pars plana vitrectomy in idiopathic epiretinal membrane surgery: a comparative pilot study. *Graefes Arch Clin Exp Ophthalmol* 2006;244(4):472-9.

15. Kadonosona K, Yamakawa T, Uchio E, et al. Comparison of visual function after epiretinal membrane removal by 20-gauge and 25-gauge vitrectomy. *Am J Ophthalmol* 2006;142(3):513-5.
16. Kellner L, Wimpissinger B, Stolba U, et al. 25-gauge vs. 20-gauge system for pars plana vitrectomy: a prospective randomised clinical trial. *Br J Ophthalmol* 2007;91(7):945-8.
17. Meyer CH, Rodrigues EB, Schmidt JC, et al. Sutureless vitrectomy surgery. *Ophthalmology* 2003;110(12):2427-8.
18. Lam Ds, Yuen CY, Tam Bs, et al. Sutureless vitrectomy surgery. *Ophthalmology* 2003;110(12):2428-9.
19. Kim MJ, Park KH, Hwang JM, et al. The safety and efficacy of transconjunctival sutureless 23-gauge vitrectomy. *Korean J Ophthalmol* 2007;21(4):201-7.
20. Fine HF, Iranmanesh R, Iturralde D, Spaide RF. Outcomes of 77 consecutive cases of 23-gauge transconjunctival vitrectomy surgery for posterior segment disease. *Ophthalmology* 2007;114(6):1197-200.
21. Recchia FM, Scott IU, Brown GC, et al. Small-gauge pars plana vitrectomy: a report by the American Academy of Ophthalmology. *Ophthalmology* 2010;117(9):1851-7.