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# Comparison of Postoperative Topographic Changes Between 23G Transconjunctival Sutureless Vitrectomy and 20G Standard Transconjunctival Vitrectomy

**Mohamad Hosein Ahoor[1], Rana Sorkhabi[1], Amir Reza Pouraligholie Ipchi[1*], Zanyar Yousefi[1]**

## Abstract

**Objectives:** Transconjunctival sutureless vitrectomy (TSV) is a common procedure in eye surgery and is performed with needles 20, 23, and 25. This study compared the 2 methods of 20 and 23 in terms of various parameters.

**Materials and Methods:** A total of 36 patients were admitted to Nikookari hospital, from which 18 patients were operated with the standard 20G vitrectomy and 18 patients with 23G TSV. Intraocular pressure (IOP), corneal anterior surface-based keratometry, corneal anterior surface-based curvature radius, and the corneal thinnest part thickness were evaluated before, a week after, and one month after the surgery. The results were compared through statistical methods using the SPSS software, version 22.

**Results:** Based on the results, IOP, corneal anterior surface-based keratometry, corneal anterior surface-based curvature radius, and corneal thinnest part thickness had no significant difference between the 2 methods at different times ($P > 0.05$). However, IOP significantly reduced in the 20G standard vitrectomy one week after the surgery ($P = 0.023$). However, K1 and K2 in the 20G standard vitrectomy significantly increased one week after the surgery compared to the time before surgery ($P < 0.05$). In addition, the corneal thinnest part thickness in the 23G TSV significantly increased a week after the surgery compared to the period before the surgery ($P = 0.007$).

**Conclusions:** In general, no statistically significant difference was observed between the 2 methods in terms of the studied parameters using one week and one month after the surgery.

**Keywords:** 23G vitrectomy, 20G standard vitrectomy, Intraocular pressure, Cornea

## Introduction

Any surgery which changes the shape of the central part of the cornea may influence image formation in the macula, leading to changes in vision (1). Several studies explored the corneal surface changes after the surgical procedures such as pars plana vitrectomy with 20G tools (2-5). These studies indicated that this method neither causes clinical corneal astigmatism nor changes in visual acuity (6). However, Weinberger et al reported significant changes in corneal curvature following using this method (7). In addition, Fuji introduced the 25G method and created a new perspective in surgical instruments (8). The 23G method recently introduced by Eckardt was found to have successful results in a variety of vitreous retinal surgeries (9,10). Previous studies demonstrated the superiority of 23G method to the 20G method in terms of reduced tissue manipulation, decreased micro-traumas following repeated insertion and device removal, a significant decrease in surgery time, lack of suture-associated complications, reduced time of convalescence, and decreased postoperative inflammatory response (11-13). Although both 23G and 25G methods have the above-mentioned advantages, their characteristics differ from the previous methods due to differences in the instruments.

Therefore, surgically induced corneal changes and astigmatism vary since sclerotomy port is 0.6 mm in 23G method while it is 0.50 mm in the 25G method. Various studies reported non-significant changes in the corneal surface and astigmatism after surgery using 25G method (14).

A recent prospective study conducted by Kim et al indicated that 23G surgically induced astigmatism was insignificant within a month after the surgery although corneal topographic changes were not evaluated one month after the surgery (15).

Further, hypo- or hypertonia is one of the major complications of vitrectomy. However, few studies in this field accurately compared this complication in both 20G and 23G methods and only evaluated the Intraocular

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[1] Department of Ophthalmology, Tabriz University of Medical Sciences, Tabriz, Iran.
***Corresponding Author:** Amir Reza Pouraligholie Ipchi, Tel: +989143141465, Email: amir_ipc@yahoo.com

pressure (IOP) in the first day after the surgery (16, 17). The present study determined and compared postoperative topographic changes, corneal thickness, and IOP between 23G transconjunctival sutureless vitrectomy (TSV) and 20G standard vitrectomy.

## Materials and Methods

This clinical trial included patients in need of vitrectomy who referred to Nikookari hospital. Inclusion criteria were patients who required vitrectomy for various reasons such as vitreous hemorrhage, idiopathic macular hole, rhegmatogenous retinal detachment, and the like. Finally, they were enrolled if they had no exclusion criteria and expressed their willingness to participate in the study by the informed consent.

Conversely, patients with a history of prior retinal surgery, simultaneous vitrectomy and scleral buckling, eye trauma, and diseases affecting topographic features of the cornea such as dystrophy, degeneration, and wounds were excluded from the study.

### Method

In this study, patients who met the inclusion criteria were selected upon their consent and were assessed. Based on the calculated sample size, those who had all the conditions underwent either 20G standard vitrectomy (n = 18) or 23G TSV (n = 18).

The demographic characteristics of the patients such as age and gender were recorded and all the patients were examined with an ophthalmoscope and their abnormal findings were recorded. Furthermore, the visual acuity was determined using the Snellen chart. The corneal topographic changes were evaluated in all patients before the surgery using Scheimpflug method. Variables K1, K2, IOP, and thin were evaluated before, one week after, and one month after the surgery employing this method. Moreover, surgically induced astigmatism and the astigmatism axis were identified with Jeff and Clayman vector analyzer and its magnitude and direction were determined. Additionally, the corneal thickness was measured in 3 areas including the central part and 3 peripheral parts between the vertex and meridian lines 60, 120, 240 in the right eye, and meridian lines 60, 120, 300 in the left eye in millimeter. In addition, IOP was measured through tonometry and the topographic changes, corneal thickness, IOP, and visual acuity were evaluated a week and a month after the surgery in both groups. Finally, the type of tamponade used (gas or non-gas) and the necessity to use the suture were recorded.

### Statistical Analysis

The collected data were analyzed employing the SPSS software, version 20. The quantitative and qualitative data were represented as the mean and standard deviation, as well as frequency and percentage, respectively. The independent *t* test and paired *t* test were applied to study the effect of the 2 different procedures and to compare the preoperative results with those related to a week and a month after the surgery. In all cases, $P > 0.05$ was considered significant.

## Results

Totally 36 patients underwent 23G (18 cases) and 20G (18 cases) procedures in the current study. Group 23G included 8 females (44.44%) and 10 males (55.56%). Further, 9 patients were females (50.0%) and 9 were male (0.50%) In 20G group. There was no statistically significant difference between the 2 groups in terms of gender distribution ($P = 0.87$). Furthermore, the right and left eyes were examined in 8 (44.44%) and 10 (55.56%) patients in the 23G group, respectively. Moreover, in the 20G group, the right and left eyes were examined in 9 (50.0%) and 9 (50.0%) patients. No statistically significant difference was found between the 2 groups regarding the investigated side distribution ($P = 0.87$). Eventually, based on the results, no significant difference was observed between the patients respecting the age ($P > 0.05$). The mean age was 58.53 ± 3.05 and 50.0 ± 3.38 in 23G and 20G groups, respectively (Table 1).

Comparison of 23G and 20G methods indicated that none of the studied parameters in different time periods had any statistically significant differences ($P > 0.05$) (Table 2).

The results of the study indicated a significant difference in IOP in 20G group before and a week after the surgery ($P < 0.01$) while there was no statistically significant difference in 20G and 23G groups at various times during the study ($P > 0.05$) (Table 3).

A statistically significant difference was found in the 20G group before and a week after the surgery in terms of the corneal anterior surface keratometry ($P = 0.007$) However, there was no statistically significant difference in 23G and 20G groups at various times during the study ($P > 0.05$).

As represented in Table 4, there is a statistically significant difference in the corneal anterior surface curvature radius between the period before and a week after the surgery in 20G group ($P < 0.05$). However, no significant statistical difference is observed in 20G and 23G groups at various times during the study ($P > 0.05$).

As regards the thickness of cornea at the thinnest part, a statistically significant difference was observed in the 23G group before and a week after the surgery ($P = 0.007$). However, there was no statistically significant difference in 23G and 20G groups at various times during the study ($P > 0.05$) (Table 5).

## Discussion

In recent years, 25-gauge TSV is introduced as a technique with more advantages and less traumatic complications compared to the 20-gauge vitrectomy system (8,11). Various benefits were provided for 25 TSV procedure including non-surgical injury of the conjunctiva,

**Table 1.** Comparison of Both Methods Regarding K1, K2, IOP, and Thickness Before, a Week After, and One Month After the Surgery

| | | Before Surgery | One Week After Surgery | One Month After Surgery |
|---|---|---|---|---|
| Intraocular pressure | 23G | 86.59 ± 13.0 | 60.42 ± 13.0 | 66.39 ± 13.0 |
| | 20G | 60.47 ± 14.0 | 30.36 ± 13.0 | 60.37 ± 13.0 |
| | *P* value | 0.428 | 0.643 | 0.978 |
| Corneal anterior surface keratometry | 23G | 63.47 ± 43.0 | 78.46 ± 43.0 | 54.46 ± 43.0 |
| | 20G | 68.56 ± 42.0 | 91.52 ± 42.0 | 43.0 ± 17.47 |
| | Significance | 0.238 | 0.261 | 0.471 |
| Corneal anterior surface curvature radius | 23G | 81.50 ± 44.0 | 78.48 ± 44.0 | 76.49 ± 44.0 |
| | 20G | 43.0 ± 35.62 | 94.60 ± 43.0 | 87.56 ± 43.0 |
| | *P* value | 0.160 | 0.311 | 0.471 |
| Corneal thinnest part thickness | 23G | 80.04 ± 524.8 | 542.11 ± 93.91 | 539.13 ± 15.69 |
| | 20G | 522.9 ± 50.12 | 534.11 ± 80.61 | 528.12 ± 22.23 |
| | *P* value | 0.849 | 0.892 | 1.000 |

**Table 2.** Comparison of Both Groups Regarding IOP at Different Times

| | | 23G Group | 20G Group |
|---|---|---|---|
| Corneal anterior surface keratometry | Before surgery | 86.59 ± 13.0 | 60.47 ± 14.0 |
| | One week after surgery | 60.42 ± 13.0 | 30.36 ± 13.0 |
| | *P* value | 0.391 | 0.023 |
| Corneal anterior surface keratometry | Before surgery | 86.59 ± 13.0 | 60.47 ± 14.0 |
| | One week after surgery | 66.39 ± 13.0 | 13 |
| | *P* value | 0.563 | 60.37 ± 0.0 |
| Corneal anterior surface keratometry | Before surgery | 60.42 ± 13.0 | 0.079 |
| | One week after surgery | 66.39 ± 13.0 | 30.36 ± 13.0 |
| | *P* value | 0.862 | 60.37 ± 13.0 |

**Table 3**. Comparison of Both Groups Regarding Anterior Corneal Surface Keratometry at Different Times

| | | 23G Group | 20G Group |
|---|---|---|---|
| Corneal anterior surface keratometry | Before surgery | 63.47 ± 43.0 | 68.56 ± 42.0 |
| | One week after surgery | 78.46 ± 43.0 | 91.52 ± 42.0 |
| | *P* value | 0.15 | 0.012 |
| Corneal anterior surface keratometry | Before surgery | 53.54 ± 43.0 | 87.58 ± 42.0 |
| | One week after surgery | 54.46 ± 43.0 | 43.0 ± 17.47 |
| | *P* value | 0.844 | 0.206 |
| Corneal anterior surface keratometry | Before surgery | 63.51 ± 43.0 | 43.0 ± 12.3 |
| | One week after surgery | 54.46 ± 43.0 | 43.0 ± 17.47 |
| | *P* value | 0.483 | 0.888 |

**Table 4.** Comparison of Both Groups Regarding the Corneal Anterior Surface-based Curvature Radius at Different Times

| | | 23G Group | 20G Group |
|---|---|---|---|
| Corneal anterior surface keratometry | Before surgery | 81.50 ± 44.0 | 43.0 ± 35.62 |
| | One week after surgery | 78.48 ± 44.0 | 94.60 ± 43.0 |
| | *P* value | 0.909 | 0.027 |
| Corneal anterior surface keratometry | Before surgery | 73.57 ± 44.0 | 58.64 ± 43.0 |
| | One week after surgery | 76.49 ± 44.0 | 87.56 ± 43.0 |
| | *P* value | 0.969 | 0.084 |
| Corneal anterior surface keratometry | Before surgery | 72.55 ± 44.0 | 44.0 ± 22.59 |
| | One week after surgery | 76.49 ± 44.0 | 87.56 ± 43.0 |
| | *P* value | 0.683 | 0.161 |

**Table 5.** Comparison of Both Groups Regarding the Corneal Thinnest Part Thickness at Different Times

| | | 23G Group | 20G Group |
|---|---|---|---|
| Corneal anterior surface keratometry | Before surgery | 524.8 ± 80.04 | 522.9 ± 0.12 |
| | One week after surgery | 542.11 ± 93.91 | 534.11 ± 80.6 |
| | *P* value | 0.007 | 0.074 |
| Corneal anterior surface keratometry | Before surgery | 527.8 ± 61.27 | 522.12 ± 11.19 |
| | One week after surgery | 539.13 ± 15.69 | 528.12 ± 22.23 |
| | *P* value | 0.346 | 0.346 |
| Corneal anterior surface keratometry | Before surgery | 547.13 ± 15.69 | 535.12 ± 22.9 |
| | One week after surgery | 539.13 ± 15.69 | 528.12 ± 22.23 |
| | *P* value | 0.13 | 0.086 |

not suturing the sclera, reduced operation time, less discomfort after the surgery, and most importantly reduced the recovery time of vision (13,18).

However, several problems were reported regarding the TSV approach arising from the great flexibility of 25-gauge in complex cases of the retina and postoperative complications including hypotonia, choroidal detachment, and leakage tamponade (13,19,20). This is apparently due to the prolonged surgery and complications arisen from more manipulation with surgical instruments at the sclerotomy site. Therefore, the instrument is stronger and more stable in 23-gauge TSV which overcomes the mentioned disadvantages (9). Researchers highlighted that eye surgeons are widely using TSV or the small incision vitrectomy (23G & 25G) since it reduces the surgical time, the patient is more comfortable, and postoperative recovery is short compared to the 20-gauge procedure (21).

Given the disadvantages of the 25-gauge procedure, the 23-gauge method was introduced by the researchers (9) as a method having the benefits of both 20-gauge and 25-gauge procedures (22). Several studies suggested that surgery-induced astigmatism is temporary if only the vitrectomy is performed (1,23,24). Although vitrectomy alone may increase central cornea a week after the surgery by 1.2 to 1.6 diopters, this change is temporary and returns to normal after 12 weeks (1). Additionally, studies demonstrated that 23-gauge system creates a trans-conjunctival scleral tunnel while sclerotomies are vertical in 20 and 25 methods. Accordingly, 23-gauge tunnel incision is considered a more suitable method due to low postoperative complications and reduced postoperative astigmatism (9).

It is found that 25-gauge TSV has no significant effect on the corneal surface astigmatic changes in the limited time after the surgery (11). Some researchers compared the regular and irregular astigmatic changed after the standard 20 and 25 vitrectomies and found significant changes in corneal topography in the 20-gauge group while these changes were not observed in the 25-gauge group (23). The sclerotomy is 0.7 mm in the 23-gauge method and has a high potential for creating surgically induced astigmatism compared to 25-gauge which is 0.5 mm (15).

Post-vitrectomy hypotonia and hypertonia are reported in some cases (21). Wound leakage and hypotonia are normally higher in low-gauge sutureless systems compared to the 20-gauge traditional vitrectomy (21).

In addition, Ahn et al reported that IOP was significantly higher than the 20-gauge method one day after the surgery and in contrast to the 23-gauge method, the pattern of IOP increased in the early postoperative period in the 20-gauge vitrectomy technique. Further, IOP increased 3.7 mmHg in the 20-gauge vitrectomy a day after the surgery. Given the increasing and high fluctuation of IOP rate after the surgery, the researchers claimed that 20-gauge vitrectomy should not be performed in eyes at high risk of injury from high or fluctuating IOP such as glaucoma or in eyes with retinal ischemia or ischemic optic neuropathy (21).

Further, the other results demonstrated that there was no significant difference in IOP before or a week after the surgery, as well as the next time in the 23-gauge while a significant difference was detected between the period before and a week after the surgery in the 20-gauge method in terms of IOP, and the IOP significantly reduced a week after post-surgery ($P$ = 0.023). Comparing both 20-gauge and 23-gauge methods indicated that one day after surgery, IOP was significantly higher in 20-gauge than 23-gauge methods. However, the subsequent measurements revealed no difference in IOP between the 2 methods (21).

The results of this study indicated that IOP in both studied methods (20G & 23G) had no significant difference before, one week after, and a month after the surgery ($P$ > 0.05) although IOP was lower in the 20-gauge group compared to 23-gauge of sclera and the suture group a week and a month after the surgery. Based on previous studies, hypotonia was 3% after the 23-gauge method (21) and 8.2% in another study (10). This was reported zero in the 20-gauge method by Haas et al (17). Furthermore, based on the results of the current study, no significant difference was observed between the 2 methods in terms of corneal anterior surface keratometry, corneal anterior surface curvature radius, and corneal thinnest part thickness before, one week after, and one month after the surgery ($P > 0.05$).

Additionally, a number of studies reported that the cornea periphery significantly changes after the 20-gauge standard vitrectomy and results in postoperative astigmatism (25-27). However, the created astigmatism is temporary and returns to normal 1-4 months after the surgery (26,27). The resulted astigmatism may be due to cauterization of the sclera and the suture of the entry point. However, some research indicated that there was no change regarding regular and irregular corneal astigmatism in the 25-gauge TSV method (14). According to a report, the 25-gauge method creates no significant changes in corneal topography compared to the 20-gauge standard vitrectomy (23). In addition, researchers demonstrated that the rate of surgically induced astigmatism was significantly lower in the 23-gauge group compared to the 20-gauge standard method at time intervals of 1, 4, 8, and 12 weeks after the surgery (28).

Further, results of the current study revealed no significant difference between the period before and one week after the surgery and other times in the 23-gauge group in terms of K1 and K2. However, K1 and K2 differed significantly before and one week after the surgery in the 20-gauge method ($P < 0.05$). The rate of K1 significantly increased a week after the surgery compared to the period before surgery ($P = 0.012$). Furthermore, the rate of K2 increased significantly a week after the surgery compared to the period before the surgery ($P = 0.027$). Finally, the amount of the thinnest site had no significant difference at different times in the 20-gauge group ($P > 0.05$) However, its increase was very significant in the 23-gauge method a week after the surgery compared to the period before the surgery ($P = 0.007$).

## Conclusions

Generally, the results of the current study indicated that the IOP, K1, K2, and thinnest local between the 2 studied methods had no significant difference and the results were similar. However, the IOP significantly reduced in the 20-gauge method a week after the surgery ($P = 0.023$). Moreover, K1 and K2 increased significantly in the 20-gauge method a week after the surgery compared to the time before the surgery. Eventually, the thinnest local in the 23-gauge method significantly increased a week after surgery ($P = 0.007$). Regarding infection, no cases of postoperative endophthalmitis were observed in the patients of both groups.

## Conflict of Interests

Authors have no conflict of interests.

## Ethical Issues

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences under the ethical code of TBZMED.REC.1394.1162 at 2016.2.1.


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