Changes in Axial Length After Vitrectomy for Rhegmatogenous Retinal Detachment With Associated Choroidal Detachment

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Abstract

BACKGROUND

The precise pre-operative measurements of axial length (AL) are essential for calculating intraocular lens power in cases undertaking pars plana vitrectomy (PPV) combined with cataract surgery. The changes in AL after PPV for rhegmatogenous retinal detachment (RRD) combined with choroidal detachment (CD) has not been reported. Here, we studied the postoperative AL changes in patients with RRD combined with CD (RRD-CD) and compared the changes in patients with RRD and tractional retinal detachment (TRD).

METHODS

In this retrospective cohort study, medical records of 129 patients who received PPV combined with silicone oil tamponade from January 2015 to December 2018 were reviewed. Patients included were divided into three groups, RRD-CD, RRD, and TRD. All patients had received AL measurements before PPV and before silicone oil removal (SOR). The changes in AL of three groups before PPV and before SOR were compared. The potential factors related to AL changes were analyzed.

RESULTS

The number of patients included in RRD-CD, RRD, TRD groups were 41, 43, and 45, respectively. In RRD-CD group, AL measured before SOR was longer than that measured before PPV with a median of 1.01 [0.37,1.79] mm ($p = 0.02$). There was no such significant difference in RRD group (0.15 [0.04, 0.42] mm, $p = 0.58$) or TRD group (0.07[-0.03,0.15] mm, $p = 0.53$). The amplitude of AL changes in RRD-CD group was greater than that in RRD group ($p < 0.001$) and that in TRD group ($p < 0.001$). AL increased 0.06 mm (0.06, $R^2 = 0.11$, p = 0.03) in RRD-CD group and 0.02 mm (0.02, $R^2 = 0.11$, p = 0.01) in RRD group when the IOP before SOR was 1 mmHg higher than that before PPV. After adjusting the effect of the factors as the presence of pathological myopia ($p = 0.45$), IOP before PPV ($p = 0.86$), sustained elevation of IOP in post-PPV follow up ($p = 0.51$), AL in RRD-CD group was 11.42 times (3.54, 46.80) more likely to increase for more than 1 mm compared to that in RRD group (p < 0.001, AIC = 86.15).

CONCLUSION

Patients with RRD-CD are very likely to have postoperative elongation of AL. The primary IOL implantation using pre-operative AL data may cause significant refractive error in combined surgery in patients with RRD-CD.

Background:

Axial length (AL) and keratometric value measured before surgery are of great importance in calculating the IOL power in patients with rhegmatogenous retinal detachment (RRD) who underwent combined phacoemulsification and pars plana vitrectomy (PPV). The accuracy of the measurement of AL can be affected by several factors. High retinal detachment in the upright position[1], macula-off status[1, 2] and low IOP[3, 4] may cause underestimation of AL.

As the advances emerging in microsurgical instrumentation on small-gauge vitrectomy, combined surgery has, therefore, become a popular procedure in treating RRD[5–7]. A high level of consistency of AL measured before and after PPV has been shown in both macula-sparing RRD cases[8] and macula-off RRD cases [1, 2]. In RRD cases treated by combined surgery, selection of the IOL power using AL data measured before PPV is reported to result in a small biometric error and a small myopic shift that is within the tolerable range in most cases[9].

Rhegmatogenous retinal detachment combined with choroidal detachment (RRD-CD) is a kind of RRD with specific low IOP character and is reported to affect 8.6–19.2% cases with RRD in China[10, 11]. The need of cataract extraction during PPV is present in RRD-CD cases due to difficulties in viewing the fundus or dealing with proliferative vitreoretinopathy. The report on the postoperative changes of AL in patients with RRD-CD is rare. Investigation on AL changes will contribute to the accurate selection of IOL power and ensure the desired postoperative refraction in patients with RRD-CD who are planning to have combined surgeries.

The present study evaluated the postoperative AL changes in patients with RRD-CD, as well as RRD and tractional retinal detachment (TRD) who underwent PPV. AL changes were compared among different types of RD. In addition, the potential factors influencing AL after the PPV surgery were examined.

Methods

This retrospective cohort study was approved by the Ethics Committee of Beijing Tongren Hospital and adhered to the tenets of the Declaration of Helsinki. Medical records of 129 RRD or TRD patients who underwent PPV combined with silicone oil tamponade in our hospital from January 2015 to December 2018 were reviewed.

Inclusion criteria: the records of RRD or TRD patients who 1) underwent PPV combined with silicone oil tamponade in our hospital; 2) underwent silicone oil removal (SOR) in our hospital after PPV; 3) had AL measurements by the same machine before PPV and before SOR. Based on the type of retinal detachment, the records of patients were categorized into three groups, RRD-CD, RRD only, and TRD. TRD was caused by retinal vein occlusion or diabetic retinopathy. CD was defined as the detection of peripheral choroidal detachment by either binocular indirect ophthalmoscopy examination or ultrasound scans [12].

Exclusion criteria: 1) the records lacking the AL measurement; 2)the records without the description of pre-surgery choroidal status; 3) the AL measurement severely impacted by dense vitreous hemorrhage or dense fibro-membrane that involved the fovea; 4) macula-on RRD.

All patients had received AL measurement before PPV and before SOR surgery. Keratometry was measured using an auto-refractive-Keratometer (KR-8100, Topcon Crop, Tokyo, Japan). AL was measured before PPV by partial coherence interferometry (IOL Master®, Carl Zeiss, Jena, Germany). It had been ensured that the detected waveform was retinal pigment epithelium instead of the detached retina while AL was measured by IOL-Master. More than ten AL measurements were taken for each eye, and the mean value was used. Simultaneously, AL was measured by the A-scan with confirmation from B-scan of the configuration of the detached retina (Ocuscan RxP®, Alcon Laboratories, Fort Worth, TX, USA). The measurement of A scan was carried out by adjusting the ultrasound gain to detect the signal of the wall of the eyeball based on the configuration obtained from B-scan. The result from A-scan biometry was selected if the result from IOL master was greatly different from that from A-scan biometry. The AL measurement before SOR was carried out using both IOL-master with adjusted formula and A-scan biometry with adjusted ultrasound velocity. The result from IOL-master and A-scan were compared. Whether the result from A-scan or IOL-master was selected was judged by the same ophthalmologist according to the clinical examination of the optical media and status of silicone oil. The changes in AL before PPV and before SOR were compared among the three groups.

Intraocular pressure (IOP) was measured by non-contact air tonometer (Nidek Tonoref 3), no less than three measurements were taken in each eye, and the mean value was recorded. The following information of the patients were included: age, sex, IOP before each surgery, refractive error, presence of pathological myopia (PM), the interval time between two surgeries, IOP after each surgery, and medication for IOP control. PM was diagnosed by the presence of posterior scleral staphyloma through indirect biocular ophthalmoscopy[13] .

The 23-gauge PPV was performed by two surgeons separately. Barrier photocoagulation of tear and lattice degeneration was conducted, followed by silicone oil tamponade. Drainage of suprachoroidal fluid or cryotherapy was performed in some RRD-CD patients.

Statistical analysis was performed using R version 3.20 (http://www. R-project.org). Patient characteristics were retrieved from their medical charts and recorded in Epidata Entry Clientversion2.0.3.15 (http://epidata.dk). Mean and standard deviation (SD) were calculated for continuous data following a normal distribution. Medians with interquartile range (the 3rd quartile- the1st quartile, IQR) were calculated for continuous data not following a non-normal distribution. The independent-samples t-test, paired t-test or Mann-Whitney U test was performed to compare the data from two groups. The Kruskal-Wallis test was performed to compare the data from three groups. The Chi-square test or Fisher's exact test was carried out for discrete data. To explore the potential factors that may influence the changes of AL, we divided the whole patients into two groups: patients with AL changes more than 1 mm and patients with AL changes less than 1 mm. Variables were compared between the two groups. Variables with p-value less than 0.3 were further enrolled in a binary backward stepwise logistic regression model. One variable was included or excluded from the model each time by comparing the Akaike information criterion (AIC) value, and the model that had the lowest AIC was chosen. The linear regression was performed to analyze the changes of AL and IOP. P value less than 0.05 was considered to be a statistically significant difference.

Results

A total of 129 cases were included in this study with 41 in RDD-CD group, 43 in RRD group, and 45 in TRD group. In RRD-CD group, there were 27 males and 14 females, with mean age of 52.24 ± 10.59 years. In RRD group, there were 38 males and 15 females, with mean age of 52.81 ± 13.13 years. In TRD group, there were 24 males and 21 females, with mean age of 53.64 ± 11.48 years. There was no significant difference in gender distribution (p = 0.34) and age (p = 0.56) among the three groups.

1. The baseline characteristics of patients before the PPV surgery

In the affected eyes, the mean of AL in RRD-CD group was 24.46 ± 2.48 mm, which was similar to that in RRD group (25.43 ± 2.82 mm, p = 0.08), but longer than that in TRD group(23.16 ± 0.83 mm, p = 0.001).

In the fellow eyes, the mean of AL in RRD-CD group was 25.89 ± 2.78 mm, which was similar to that in RRD group (24.32 ± 5.43 mm, p = 0.08), but longer than that in TRD group (21.62 ± 5.90 mm, p < 0.001).

The median and IQR of AL difference between the affected eye and fellow eye was − 0.90 (2.15) mm in RRD-CD group, 0.07 (0.73) mm in RRD group, and − 0.04 (0.28) mm in TRD group respectively. The shorter AL of the affected eyes compared to fellow eyes was observed in RRD-CD group (p = 0.01), but not in RRD group (p = 0.17) or TRD group (p = 0.09). The variation of AL between two eyes of the same patient was greater in RRD-CD group than that in TRD group (p < 0.001), and RRD group (p = 0.01).

There were 12 patients (29.3%), 19 patients (35.8%), and none patient with PM in RRD-CD, the RRD, and TRD groups, respectively. The percentage of PM in RRD-CD group and RRD groups showed no significant difference (p = 0.71), but both are significantly higher than that in the TRD group (p < 0.001).

2. The interval from PPV to SOR

The median and IQR of interval time between two surgeries was 154 (89) days in RRD-CD group, 159 (95) days in RRD group, and 201 (166) days in TRD group. There was no significant difference in the interval between two surgeries among the three groups (p = 0.32).

3. The AL characteristics of patients before SOR surgery

In the affected eyes, the mean of AL before SOR in RRD-CD group was 25.72 ± 2.66 mm, which was similar to that in RRD group (25.75 ± 3.00 mm, p = 0.83), but significantly longer than that in TRD group (23.28 ± 0.95 mm, p = 0.001).

Similar to AL before the PPV surgery, in the unaffected eyes, the mean of pre-operative AL in RRD-CD group was 25.91 ± 2.81 mm, which was similar to that in RRD group (24.30 ± 5.47 mm, $p = 0.06$), but significantly longer than that in TRD group (21.59 ± 5.96 mm, $p = 0.003$).

The median and IQR of the difference of AL between the affected eye and fellow eye before SOR was − 0.04 (0.98) mm in RRD-CD group, 0.19 (0.98) mm in RRD group, and − 0.03 (0.29) mm in TRD group, respectively. AL of the affected eyes was shorter than that of the fellow eyes in RRD-CD group ($p = 0.015$). There was no significant difference in AL between the affected eyes and fellow eyes in RRD group ($p = 0.17$) or TRD group ($p = 0.09$). The difference of AL between the affected eye and fellow eye in RRD-CD group was not significantly different from that in RRD group ($p = 0.11$) or that in TRD group ($p = 0.06$). There were no significant changes of AL in the follow eye before PPV and before SOR in neither of the three groups ($p = 0.96$).

4. The changes of AL from PPV to SOR (Fig. 1)

In RRD-CD group, AL measured before SOR was longer than that measured before PPV with a median (IQR) of 1.01 (1.42) mm ($p = 0.02$). There was no such significant difference in RRD group with a median of 0.15(0.38) mm ($p = 0.58$) or TRD group with a median of 0.07 (0.18) mm ($p = 0.53$). The variation of AL between the two surgeries in RRD-CD group was greater than that in RRD group ($p < 0.001$) and that in TRD group ($p < 0.001$).

5. The changes of IOP of the affected eye from PPV to SOR (Fig. 2)

The mean IOP before PPV in RRD-CD group was 8.0 ± 2.7 mmHg, which was lower than that of RRD group (12.5 ± 4.3 mmHg, $p < 0.001$), and that of TRD group (12.7 ± 9.2 mmHg, $p = 0.003$).

There were 26 (73.4%) patients with a history of IOP > 30 mmHg in two consecutive follow-ups in RRD-CD group, similar with those in RRD group (23, 43.4%, $p = 0.23$), but more than those in TRD group (10, 22.2%, $p < 0.001$).

The mean IOP of the affected eye before SOR in RRD-CD group was 17.0 ± 5.7 mmHg, which was similar to both that of RRD group (17.4 ± 5.7 mmHg, $p = 0.73$), and that of TRD group (16.2 ± 6.6 mmHg, $p = 0.58$).

The increased IOP before SOR was observed in the three groups. The mean differences of IOP between PPV and SOR were 8.6 ± 6.4 (-3, 24) mmHg, 4.7 ± 6.2 (-6, 26) mmHg, and 3.5 ± 8.2 (-3.5, 13) mmHg in RRD-CD group, RRD group, and TRD group, respectively. The IOP before SOR was significantly higher than that before PPV in each group of patients ($p < 0.001$). The amplitude of the elevation of IOP from PPV to SOR was greater in RRD-CD group than that in RRD group ($p = 0.002$), and TRD group ($p = 0.007$).

6. Factors that may be related to the variation of AL measured between two surgeries

It was reported that a 0.1 mm error in axial length is equivalent to an error of about 0.27D in the spectacle plane[14]. We divided the whole patients into two groups by whether the difference of AL measured before PPV and before SOR was greater than 1 mm in the binary logistic regression analysis. The greatest AIC was achieved in the final model. After adjusting the effect of the factors as the presence of PM (p = 0.45), IOP before PPV (p = 0.86), sustained elevation of IOP in postoperative follow-up (p = 0.51), RRD patients with CD was 11.42 times (3.54, 46.80) more likely to have axial elongation after PPV than patients with RRD ($p < 0.001$, AIC = 86.15). Patients with RRD-CD was 8.50 times (3.59, 24.87), more likely to have axial elongation than other patients without CD in the whole patients who underwent PPV ($p < 0.001$, AIC = 98.58).

We further investigated the relationship between AL changes and IOP changes. In linear regression analysis, the difference of AL measured before PPV and before SOR was related to the difference of IOP measured before PPV and before SOR in the group of RRD and RRD-CD. AL increased 0.06 mm when IOP measured before SOR was 1 mmHg greater than that measured before PPV (0.06, R^2 = 0.11, p = 0.03) in RRD-CD group. AL increased 0.02 mm when IOP measured before SOR was 1 mmHg greater than that measured before PPV (0.02, R^2 = 0.11, p = 0.01) in RRD group. The variation of AL measured between two surgeries was not related to the variation of IOP in the TRD group (p = 0.89)

Discussion:

Sometimes, combined PPV and cataract extraction were required in complicated cases with RD. The best postoperative refractive prediction after the PPV combined with cataract extraction surgery depends on the correct estimation of IOL power using the accurate pre-operative biometric measurements. AL is one of the key parameters required in IOL power calculation formula. RRD-CD is not a rare condition in patients with RRD. The AL changes in patients with RRD-CD before and after PPV were not well addressed. In this study, the AL in patients with RRD-CD before and after PPV surgery were evaluated, and the potential factors related to the changes of AL were investigated. A significant elongation of axial after PPV was identified in the RRD-CD group, but not in the RRD or the TRD group. Patients with RRD-CD were more likely to have axial elongation after PPV than other patients without CD.

The previous studies have shown that no significant changes in AL was detected in patients with RRD[8, 15]. The tolerable myopic shift compared to the predicted spherical equivalent following combined phacovitrectomy was observed as − 0.41 ± 0.67[8] or -0.40 ± 1.07 D[16]. The previous results on RRD patients indicate that the pre-operative AL measurement is reliable data for calculating the IOL power. We found a similar result that no significant AL changes before and after PPV was seen in patients with RRD. But contrary to the previous findings on patients with RRD without CD, we found Axial elongation after PPV in patients with RRD-CD with a median of increment as 1.01[0.37, 1.79]mm, which was also significantly greater than that of patients with RRD. The underestimated IOL power using the pre-operative AL measurement would be expected to be above 3D according to the previous work on the relationship of AL to the IOL power calculation[14]. Our findings indicated that using the underestimated pre-operative AL measurements to calculate IOL power in patients with RRD-CD might result in intolerable refractive errors after combined phacovitrectomy. The separate IOL implantation with accurate AL measurement in patients with RRD-CD may be an option to achieve a better postoperative visual outcome by achieving a more accurate IOL power calculation.

Alternatively, it has been reported intraocular lens calculations using fellow-eye biometry for phacovitrectomy for macula off rhegmatogenous retinal detachments are accurate and better than those from same-eye biometry[2]. It was found in our study, the difference of AL between the affected eye and the fellow eye was greater before PPV than that before SOR in patients with RRD-CD. Even in cases before SOR, the difference of AL between the affected eye and the fellow eye was existed in patients with RRD-CD. It has been shown in our study that there is difference of AL between the two eyes of one patients. Therefore, referencing to AL in the fellow eye before PPV in patients with RRD-CD may lead to inaccurate IOL power calculation. There would be two options to calculate and implant the IOL, one is referencing to the AL in the fellow eye before PPV to implant the IOL primarily, the other is using the AL data of the affected eye before SOR to implant the IOL secondarily. Which one could achieve a better final visual acuity should be investigated in the further study in patients with RRD-CD who undertake phacovitrectomy.

We further investigated the potential factors that were likely related to the changes of postoperative AL in RRD-CD. Changes of IOP can affect the measurement of AL. After medical normalization of IOP from elevated level, the decrease of AL was reported to be 0.06 mm per 10 mmHg decrease of IOP[4]. The trabeculectomy or glaucoma drainage device (GDD) surgery was reported to cause 0.006[17]-0.01[18]mm decrease of AL per 1 mmHg decrease of IOP. In surgery combined with cataract extraction, the − 0.08 D myopic shift was expected when IOP changes 1 mmHg in patients underwent trabeculectomy or glaucoma drainage surgery for glaucoma[19], -0.11 D in patients underwent PPV for RRD[3]. We wanted to investigate the influence of IOP changes on the changes of AL. There are several factors in RRD-CD which may influence the changes of IOP. It is noted that RRD-CD patients tend to have low IOP[10]. What's more, the presence of PM or postoperative glaucoma are factors known to be able to cause significant IOP variations before and after PPV surgery. The presence of PM and postoperative sustained IOP elevation was similar in RRD-CD group and RRD group. In logistic regression, neither the presence of PM nor postoperative sustained IOP elevation was related to AL increase, the presence of CD was the only related factor to AL increase. We further investigated the relationship of the variation of IOP and the variation of AL. In our study, the positive linear relationship of IOP to AL was found in both RRD-CD and the RRD groups. Compared to AL measured prior to PPV, AL increased 0.06 mm per 1 mmHg IOP increase in patients with RRD-CD, which is greater than 0.02 mm in patients with RRD. The axial elongation in RRD-CD patients in our study was larger than previously reported 0.104 mm in RRD patients[3, 8]. Our linear regression results (R^2 = 0.09) showed that low IOP might not be the only risk factor. Other unknown causes for the changes of AL needed to be further investigated.

It has been reported the macula-off status may influence the measurement of AL[1, 2]. We ruled out macular-on cases to lessen the impact of macular-on status on AL measurement. Our study only included cases with macula-off RRD in both groups with RRD. A-scan biometry in the supine position was carried out in all cases to make sure the results from IOL-master with adjustment to identify the retinal pigment epithelium band were reliable. The consistency of AL in the fellow eye showed high reproducibility of the biometric data. The postoperative changes of AL were observed in RRD-CD patients but not in RRD patients. It may indicate that it is not the measurement bias in macular-off status to cause the changes of AL after PPV surgery in patients with RRD-CD.

All cases in our series had postoperative AL measurements before SOR. It has been reported that the accuracy and reproducibility of AL measurement has been improved using both partial coherence interferometry with adjusted formula and ultrasound biometry with adjusted ultrasound velocity in patients with silicone oil tamponade[20]. In our study, we used IOL master with adjusted formula and A scan with adjusted ultrasound velocity to measure AL in three groups of patients with silicone oil tamponade. The unchanged pre-operative and postoperative AL in patients from TRD group may indicate the minimal effect of silicone oil on the measurements of AL.

A limitation of this study is that the final visual acuity and refractive status were not evaluated. The combined PPV and cataract extraction was not carried out in most of the patients in our study. We can not show the variation of actual refractive error compared to the predicted refractive error in IOL power calculation. We can not show the influence of changes of AL on the predicted error after combined phacovitrectomy either. The selected bias was also presented due to the patients enrolled in this study were in a tertiary hospital. Most of the patients included in our study showed poor postoperative visual acuity, which could not be corrected by refraction. It was due to either the pre-operative macular-off status or the development of secondary glaucoma or secondary cataract. We can not show the refractive status changes before PPV surgery and before SOR surgery. Further studies with macular-on RRD-CD may be carried out to confirm the result of the axial elongation of RRD-CD after PPV from our study. A non-contact technique may be useful for measuring the axial length and eliminating corneal indentation bias in patients with RRD with hypotony. Furthermore, a comparison of the pre-SOR and post-SOR axial lengths was not performed.

In conclusion, this study offers valuable insight into the significant increase of AL after PPV in patients with RRD combined with CD, which has not been well investigated previously. A significant refractive error may be predicted if primary IOL implantation is performed in PPV using the pre-operative AL data in patients with RRD- CD. The secondary IOL implantation is an option to achieving better visual acuity by more accurate IOL power calculation using AL data measured after PPV.

Table 1 Demographic and ocular characteristics of patients included in this study

Table 1
Demographic and ocular characteristics of patients included in this study

	RRD-CD group (n = 41)	RRD group (n = 53)	*p* value compared with RRD-CD	TRD group (n = 45)	*p* value compared with RRD-CD
Gender (male, %)	27, 65.9%	38, 71.7%	0.7	24, 53.3%	0.34
Age (mean ± SD, years)	52.24 ± 10.59	52.81 ± 13.13	0.81	53.64 ± 11.48	0.56
PM (n, %)	12, 29.3%	19, 35.8%	0.71	0, 0%	< 0.001
Before PPV					
IOP(mean ± SD, mmHg)	8.0 ± 2.7	12.5 ± 4.3	< 0.001	12.7 ± 9.2	0.003
AL of affected eye (mean ± SD, mm)	24.46 ± 2.48	25.43 ± 2.82	0.084	23.16 ± 0.83	0.001
AL of fellow eye (mean ± SD, mm)	25.89 ± 2.78	24.32 ± 5.43	0.082	21.62 ± 5.90	< 0.001
Difference of AL between two eyes (median (IQR), mm)	-0.90 (2.15)	0.07 (0.73)	0.01	-0.04 (0.28)	0.004
Before SOR					
Interval from PPV to SOR (median (IQR), d)	154 (89)	159 (95)	0.42	201 (166)	0.31
Elevated IOP (n, %)	26, 61.9%	23, 41.8%	0.15	10, 22.2%	< 0.001
IOP under the control with medication	20, 47.6%	17, 30.9%	0.23	7, 15.6%	0.002
Elevated IOP without medication	2, 4.8%	3, 5.5%		1, 2.2%	
Elevated IOP out of control even with medication	4, 9.5%	3, 5.5%		2, 4.4%	

RRD-CD: rhegmatogenous retinal detachment combined with choroidal detachment;

TRD: tractional retinal detachment

PPV: pars plana vitrectomy

SOR: silicon oil removal

IQR: interquartile range

	RRD-CD group (n = 41)	RRD group (n = 53)	*p* value compared with RRD-CD	TRD group (n = 45)	*p* value compared with RRD-CD
IOP(mean ± SD, mmHg)	17.0 ± 5.7	17.4 ± 5.7	0.73	16.2 ± 6.6	0.58
AL of affected eye (mean ± SD, mm)	25.72 ± 2.66	25.75 ± 3.00	0.83	23.28 ± 0.95	0.003
AL of fellow eye (mean ± SD, mm)	25.91 ± 2.81	24.30 ± 5.47	0.06	21.59 ± 5.96	0.03
Difference of AL between two eyes (median (IQR), mm)	-0.04 (0.98)	0.19 (0.98)	0.11	0.03 (0.29),	0.066
Difference of AL before PPV and before SOR in affected eye (median (IQR), mm)	1.01 (1.42)	0.15 (0.38)	< 0.001	0.07 (0.18)	< 0.001
Difference of AL before PPV and before SOR in fellow eye (median (IQR), mm)	0.01(-0.04)	0.02 (0.06)	0.37	0.01(0.05)	0.44
p value of the comparison between AL before PPV and before SOR in affected eye	0.02	0.58		0.53	
p value of the comparison between AL before PPV and before SOR in follow eye	0.96	0.97		0.97	
RRD-CD: rhegmatogenous retinal detachment combined with choroidal detachment;					
TRD: tractional retinal detachment					
PPV: pars plana vitrectomy					
SOR: silicon oil removal					
IQR: interquartile range					

In the group of RRD-CD, the AL of affected eye measured before SOR was longer than that measured before PPV with a median of 1.01 [0.37,1.79]mm ($p = 0.02$). There was no such significant difference in the group of RRD (0.15 [0.04, 0.42]mm, $p = 0.58$) or the group of TRD (0.07[-0.03,0.15]mm, $p = 0.53$). The AL of follow eye measured before SOR did not different significantly from that measured before PPV, as 0.01[0.02, -0.02] mm (p = 0.96), 0.02[-0.01,0.05] (p = 0.97), 0.01[-0.01,0.04] (p = 0.97) respectively.

The increased IOP before PPV and before SOR was observed in the three groups. The mean differences of IOP between PPV and SOR were 8.6 ± 6.4 (-3, 24) mmHg, 4.7 ± 6.2 (-6, 26) mmHg, and 3.5 ± 8.2 (-3.5, 13) mmHg in the group of RRD-CD, RRD and TRD respectively. The IOP before SOR was significantly higher than IOP before PPV in each group of patients ($p < 0.001$). The amplitude of the elevation of IOP from PPV to SOR was greater in the group of RRD-CD than the group of RRD ($p = 0.002$) and the group of TRD ($p = 0.007$).

List Of Abbreviations

Akaike information criterion AIC

best-corrected visual acuity BCVA

intraocular pressure IOP

intraocular lens IOL

interquartile range IQR

optical coherence tomography OCT

pars plana vitrectomy PPV

posterior vitreous detachment PVD

receiver operating characteristic curve ROC curve

rhegmatogenous retinal detachment combined with choroidal detachment RRD-CD

standard deviation SD

silicon oil removal SOR

tractional retinal detachment TRD

Declarations

Ethics approval and consent to participate:

Ethical approval was given by the medical ethics committee of Beijing Tongren Hospital. It does not have reference number as a retrospective case series study.

Consent for publication: Not applicable

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors read and approved the final manuscript. MZ collected and analyzed the data, she was the one major contributor in writing the manuscript. XJ interpreted the data and performed the vitrectomy surgeries, he was one major contributor in writing and reviewing the manuscript. JPL performed the vitrectomy surgeries and reviewed the manuscript.

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Figures

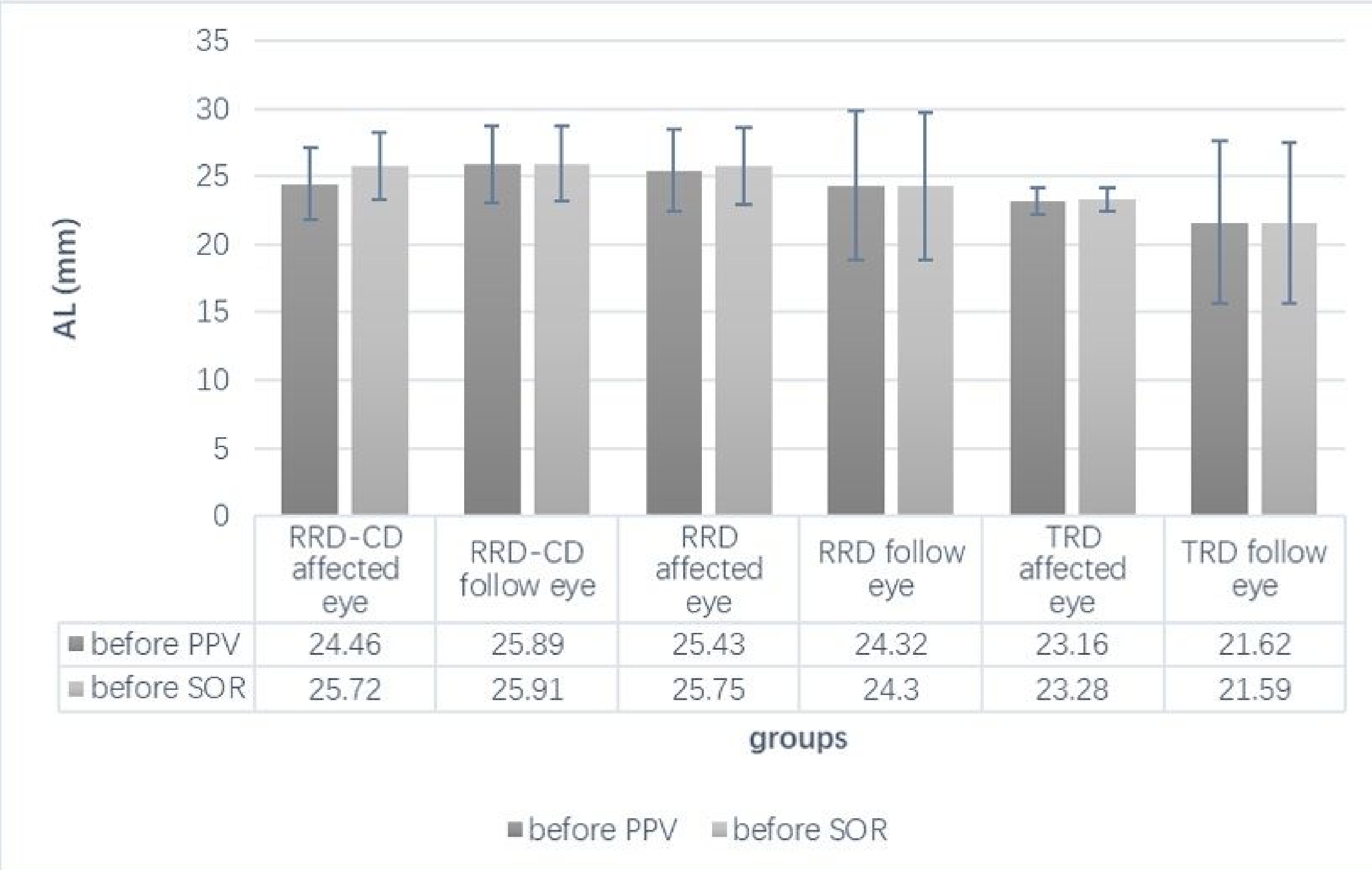

Figure 1

the AL changes in both eyes in three groups of patients

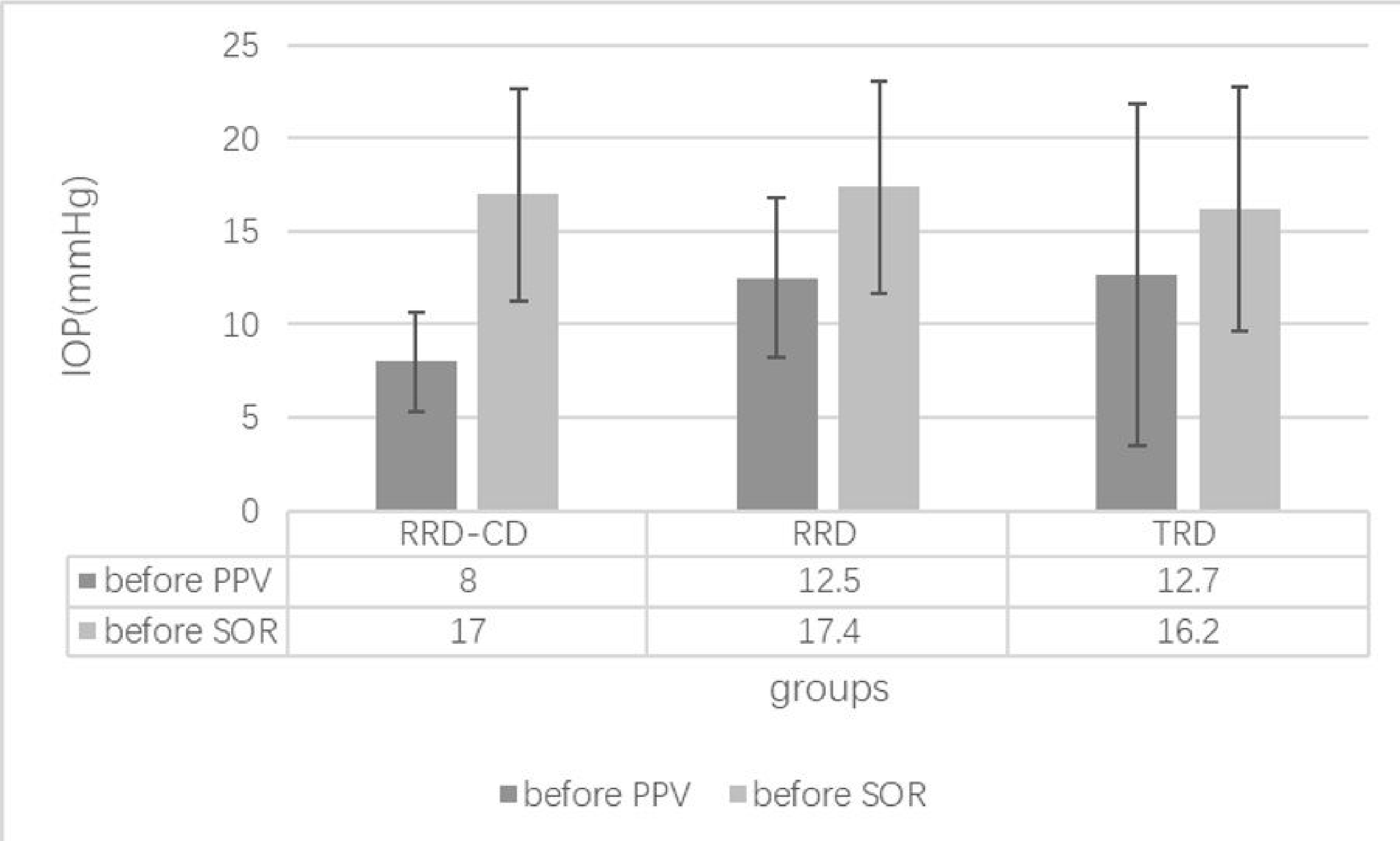

Figure 2

IOP changes of affected eye