Visual field recovery after pars plana vitrectomy procedure for rhegmatogenous retinal detachment.

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Objective: *To evaluate visual field recovery after pars plana vitrectomy procedure for rhegmatogenous retinal detachment.*

Design: *Prospective case series.*

Method: *The series was conducted in 8 patients (8 eyes) with rhegmatogenous retinal detachment at Thammasat eye center. Each patient who was diagnosed rhegmatogenous retinal detachment had to perform visual field test (CTVF 24-2 and CTVF120 degree) on the first visit, and postoperatively at 1st and 3rd month . The number of threshold spots were recorded as visual field scores, then calculated and compared statistically.*

Results: *After successful reattachment surgery, the visual field score increased mostly within the first post-operative month and then gradually raised through the third month in both CTVF 24-2 and CTVF 120 degree strategies. The CTVF 24-2 and CTVF 120 degree visual fields significantly increased ($P < 0.05$) when compared to pre-operation and 1st month-post operation. However, the CTVF 120 degree visual field group did not significantly increase when compared to 1st month and 3rd month-post operation ($P = 0.396$). There was an unexpected observation that in cases of macular-on rhegmatogenous retinal detachment the visual field might not improve, when compared to macular-off rhegmatogenous retinal detachment. This may be due to good baseline visual function including visual field, hence after surgery the visual function tended to see little improvement.*

Conclusion: *Visual field recovery was significantly increased in the first month after successful retinal reattachment surgery and steadily through the third month.*

Keywords: *visual field recovery, rhegmatogenous retinal detachment surgery*

Ethics: *This study was approved for ethical research in human with the human research ethics committee of Thammasat university, Thailand (Research ID : MTU-EC-OP-1-152/58).*

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Background

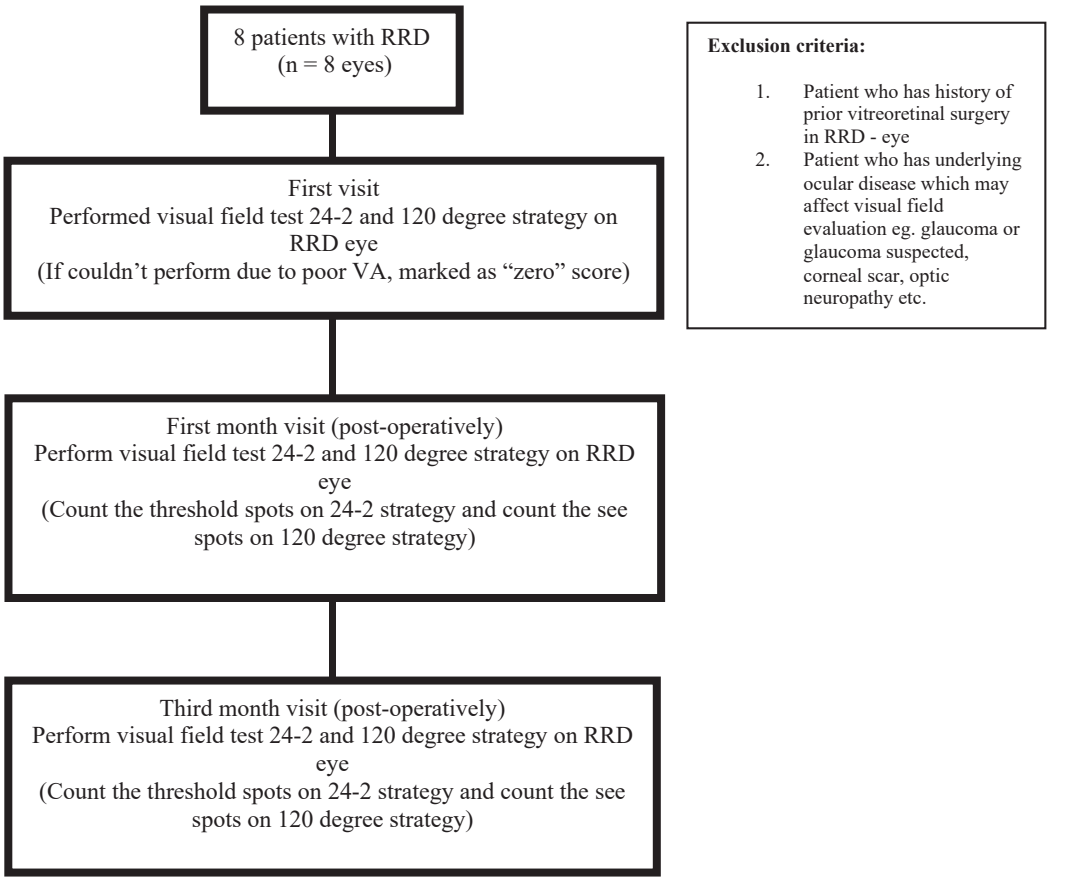
Rhegmatogenous retinal detachment (RRD) is the most common type of retinal detachment. It occurs after the retina was torn by traction force such as from posterior vitreous detachment (PVD) which leads to subretinal fluid accumulation and separation of the neurosensory retina from the underlying retinal pigment epithelium (RPE). The incidence is about 10-15 per 100,000 cases[1] with a prevalence of about 0.3% of the general population and a lifetime risk of 3% by the age of 85[2]. It is more common in males than in females.[3,4] The classic symptom is photopsia (flashing lights) which occurs in about 60% of patients[10]. This tends to be induced by eye movement and is best seen in dim lighting condition, particularly in the temporal, peripheral visual field. It arises as a result of the vitreous traction on the retinal surface from preexisting PVD. Photopsia is commonly associated with floaters which may be described as a solitary opacity, a cobweb-like opacity or a shower of little spots[11]. Patients often describe a black curtain (visual field defect) once the retinal detachment extends posterior to the equator. When the macula becomes detached (i.e. extension of subretinal fluid into the macula), the patient will experience a drop in visual acuity and feel the loss of central vision. On eye examination, a detachment can be seen as a sheet of sensory retina billowing towards the center of the globe, over which the vessels pass like paths over a hill and there may be an associated visible tear. The surgical goals are to identify and close all retinal breaks with minimum iatrogenic damage. Closure of the breaks occurs when the edges of the retinal break are brought into contact with the underlying RPE. This is accomplished either by bringing the eye wall closer to the detached retina (a scleral buckle) or by pushing the detached retina toward the eye wall (by intraocular tamponade with a gas bubble). Sealing of the breaks is accomplished by creating a strong chorioretinal adhesion around the breaks. This may be completed with diathermy, cryotherapy, or laser photocoagulation. Untreated rhegmatogenous retinal detachments (RRD) may lead to blindness. But early and appropriate intervention can do excellent outcome.[5,6] For those requiring surgery, prognosis is related inversely to the degree of macular involvement and the duration of retinal detachment.[7] Recovery depends on the site and extent of the retinal detachment. Most series report an anatomical success rate of 90-95%. Of the eyes that are successfully reattached, about 50% obtain a final visual acuity of 20/50 or better.[8] There are many studies that evaluate the visual recovery after surgical repair in term of visual acuity, contrast sensitivity, electroretinogram and anatomical outcome.[9] In this study we focus on visual field recovery after surgical repair by pars plana vitrectomy technique.

Material and Method

This prospective case series was approved by the human ethics committee of Thammasat university, Thailand (Research ID : MTU-EC-OP-1-152/58) and the study was conducted from 1 August 2015 to 31 May 2016.

Each visual field test was performed by experienced staff at the Out Patient Department (OPD) using CTVF 24-2 and 120 degree strategy. Humphrey automated visual field perimetry was used in this study. On the first visit, if the patients were not able to perform visual field test due to poor visual acuity, this was given a zero score. On the first month and the third month visit, we calculated the score by counting the threshold spots on each strategy.

Figure 1: Recruitment flow of 8 patients (8 eyes) assigned to perform visual field test from 1 August 2015 to 31 May 2016: Faculty of Medicine, Thammasat University



The patients have the opportunity to ask an investigator (J.C.) questions regarding the study and then signs the participation information and consent forms before starting the study. We excluded patients who had any history of ocular vitreoretinal surgery or has underlying ocular disease which may affect visual field evaluation eg. glaucoma or glaucoma suspected, corneal scar, optic neuropathy. Eight patients (8 eyes) were included in this study.

Intervention and evaluation

Each patient who was diagnosed with rhegmatogenous retinal detachment in their eye was assigned to perform visual field test using Humphrey automated visual field perimetry 24-2 and 120 degree strategy on the first visit and then on the first and third post-operative month. By using 24-2 strategy each threshold spot (white spot) represent 1 mark, each subthreshold spot represents a 0.5 mark and each black spot represents a 0 mark. Total spots should be In a normal person, there should be a total of 52 threshold spots. in normal person. By using 120 degree strategy we used "seen spots" as a score. Total spots should be 120 seen spots in normal person. On the first visit, if the patients could not perform visual field test due to poor visual acuity we marked asgave a zero score.

Statistical analysis

Based on the data provided by previous studies.[12] A sample size of 12 was calculated as being necessary to provide 90% power at the 5% two-sided level to detect a difference in means characterized. Eight participants were allocated. The statistical analysis were performed using STATA version 7 (Stata coop, Texas, USA). The descriptive analysis included mean ± standard deviation depend on the data distribution. A P-value equal to or less than 0.05 was considered statistically significant.

Result

There were 8 patients included in this study (Table 1). The mean age was 52 years and there were 4 (50%) males. The mean onset was 2.88 weeks. 2 patients (25%) had macula-on status and 6 patients (75%) were phakic eye. The visual acuity ranged from hand motion to 20/30.

Table 1: Baseline characteristic

Case (no.)	Sex	Age (yrs)	Eye	Onset (wks)	Macular status	Extension (quadrant)	Lens status	Visual acuity
1	F	59	OD	4 WK	OFF	3 Q	PHAKIC	HM
2	M	24	OD	1 WK	OFF	3 Q	PHAKIC	FC
3	F	49	OS	2 WK	ON	2 Q	PHAKIC	20/30
4	M	40	OD	2 WK	OFF	3 Q	PHAKIC	20/200
5	F	64	OS	8 WK	ON	2 Q	PHAKIC	20/70
6	F	56	OD	1 WK	OFF	3 Q	PHAKIC	10/200
7	M	62	OS	1 WK	OFF	2 Q	PSEUDOPHAKIC	HM
8	M	63	OD	4 WK	OFF	2 Q	PSEUDOPHAKIC	FC

The mean threshold spots in visual field test using Humphrey automated visual field perimetry 24-2 strategy at pre-operative period was 4.13 spots (range from 0-33 spots), at 1-month post-operative period was 23.79 spots (range from 0-44 spots), at 3-months post-operative period was 37.14 spots (range from 22.5-50 spots) (table 2)

Table 2: Clinical data of the patients before and after surgery

case	CTVF 24-2 (0-52 threshold spots)			CTVF 120 degree (0-120 threshold spots)			Vitreous Substitute
No.	**Pre-op**	**1mo**	**3mo**	**Pre-op**	**1mo**	**3mo**	
1	0	MISS	41	0	0	14	C3F8
2	0	44	44	4	75	99	C3F8
3	33	23.5	26	58	55	50	SO
4	0	21.5	40	10	36	33	C3F8
5	0	10.5	OR	0	0	OR	C3F8
6	0	40	50	0	95	MISS	C3F8
7	0	27	36.5	0	5	MISS	C3F8
8	0	0	22.5	0	3	36	SO
Mean	4.13±11.67	23.79±15.43	37.14±9.78	9±20.11	33.63±37.72	46.4±32.08	

MISS ; patient did not perform visual field testing in that visit.
OR ; patient has redetachment of retina at that visit

The mean threshold spots in visual field test using Humphrey automated visual field perimetry 120 degree at pre-operative period was 9 spots (range from 0-58 spots), at 1-month post-operative period was 33.63 spots (range from 0-95 spots), at 3-month post-operative period was 46.4 spots (range from 14-99 spots) (table 2).

Visual field threshold spots in 24-2 strategy were improved from pre-operative period to 1-month post-operative period significantly (P value =0.001) and continued improvement at 3-month post-operative period (P-value =0.026) (table 3).

Table 3: Summaries of outcomes for CTVF 24-2

	CTVF 24-2 (threshold spots)		
	Mean	**Mean change from pre-op**	**Mean change from 1 month**
Pre-operative	37.14±9.78		
1 month	37.14±9.78	19.66 (P value = 0.001)	
3 month	37.14±9.78		13.35 (P value = 0.026)

Visual field threshold spots in 120 degree strategy were improved from pre-operative period to 1-month post-operative period significantly (P value =0.03) but not be significant improved at 3-month post-operative period (P value = 0.396) (table 4).

Table 4: Summaries of outcomes for CTVF 120 degree

	CTVF 120 degree (threshold spots)		
	Mean	**Mean change from pre-op**	**Mean change from 1 month**
Pre-operative	9±20.11		
1 month	33.63±37.72	24.63 (P value =0.03)	
3 month	46.4±32.08		12.77 (P value = 0.396)

Discussion

Rhegmatogenous retinal detachment (RRD) occurs when the retina was torn by traction force such as from posterior vitreous detachment (PVD) which leads to fluid accumulation and separation of the neurosensory retina from the underlying retinal pigment epithelium (RPE). Patients often describe a black curtain (visual field defect) once the subretinal fluid extends posterior to the equator. When the macula becomes detached (ie, extension of subretinal fluid into the macula), the patient experiences a drop in visual acuity and loss of central vision. There are many studies that evaluate the visual recovery after surgical repair in term of visual acuity, contrast sensitivity, electroretinogram and anatomical outcome.

In the current study we focus on visual field recovery. After successful reattachment surgery, the visual field score mostly increased within the first post-operative month and then slowly raised through the third month in both CTVF 24-2 and 120 degree strategy. The 1-month post-operative visual field were significantly increase in both 24-2 and 120 degree strategy ($p = 0.01$ and 0.03). However the 120 degree visual field doesn't show significant increases when compared to 1st month and 3rd month-post operatively ($P = 0.396$). The 24-2 visual field test strategy may represent central visual field and 120 degree strategy visual field test may represent periphery visual fields. These findings were comparable with previous studies[12,13] which show the improvement of visual acuity and other visual function within three months. There was an unexpected observation that in cases of macular-on rhegmatogenous retinal detachment the visual field may not improve when compared with macular-off cases. This may be from the good baseline visual function include visual field so when after surgery the visual function tend to be a little improvement.

Some experimental studies have shown that there may have been some defects in the outer segment, especially in the outer segment of cone cells after retinal reattachment surgery. In cases with detachment of short duration (less than 1 week), morphological recovery in the reattached retina is complete while with detachments longer than 1 month in duration, recovery is usually incomplete[14,15]. This may explain why visual function including visual fields are not full recovered despite anatomical reattachment.

This study has several limitations. First, the lens status may be the confounding factors for this study. After vitreoretinal surgery the cataract may come faster than usual and disturb the visual field test result. Second, the vitreous substitute (eg. C3F8 and silicone oil) may affected the visual field results especially at 1-month post operative period due to the gas level may confound the visual field test. Further studies should separate lens status and enroll more sample size to find the correlation between visual field recovery correctly.

Conclusion

Visual field recovery in primary rhegmatogenous retinal detachment surgery can be found as early in the first month through the third month after

surgery. Both central and periphery visual field were recovered. Incomplete recovery of visual field indicated the incomplete recovery of photoreceptor cell.

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