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MACULAR CHANGES FOLLOWING PARSPLANA VITRECTOMY FOR RETINAL DETACHMENT USING OCT

By

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ABSTRACT

Background: Retinal detachment is the separation of the neurosensory retina (NSR) from the underlying retinal pigment epithelium (RPE). These two layers are derived from neuroectoderm that lines the optic vesicle during embryogenesis.

Objective: We compared spectral-domain optical coherence tomography imaging with postoperative visual acuity to evaluate the relationship between morphological changes in the macula and visual outcome after successful repair of RRD with macula off.

Patients and methods: We enrolled 30 patients (30 eyes) 21 eyes were phakic (70%) and 9 eyes were pseudophakic (30%). with successful repair of RRD. the examination had been done 1,2,6-months and one year follow up after surgery in this prospective research. The mean age of the patients was 17 to 73 years with mean age value of 44 ± 13.4 years. The duration of retinal detachment (RD) ranged from 1 to 14 weeks with a mean of 6.8± 4.2 weeks. There was history of trauma in 3 cases (10%). The IS/OS line was evaluated considering its continuity and any disruption in the line was measured by manual caliber. The extent of disruption was evaluated in the 5-lines raster scan. In the scan that showed the largest defect, the extent of the IS/OS disruption was measured along a 1.8 mm-diameter area centered on the fovea.

Results: SD-OCT was done to all patients post-operatively according to OCT findings, the 30 eyes were divided into three groups; A, B, and C. Group A included all cases with residual subretinal fluid, Group B included cases with other finding rather residual subretinal fluids. Group C included eyes with no detectable OCT findings.

There were 8 (26.7%) eyes with retained subretinal fluids (Group A), 18 eyes (60%) with pathology other than Subretinal fluid (Group B), and 4 eyes (13.33%) with no detectable pathology after the operation (Group C)

Conclusion: SD-OCT is an irreplaceable instrument for the postoperative assessment of macula in patients who have undergone surgery for macula-off RRD. It permits detection of the presence of foveal changes that are not visible with ophthalmoscope. Persistent sub-retinal fluid is responsible for the poor prognosis after surgery. Although there was a detectable improvement in vision with decrease of the amount of subretinal fluid, Visual prognosis related to other pathological finding as photoreceptors integrity, and presence or absence of Cystoid macular edema.

INTRODUCTION

Retinal detachment often is a preventable cause of vision loss. It is defined as separation of the neurosensory retina (NSR) from the underlying pigment epithelium in association with accumula-

tion of subretinal fluid **(Reichstein et al., 2013).**

A retinal detachment occurs when the forces of adhesion between the neurosensory retina (NSR) and the retinal pigment epithelium RPE are overwhelmed. This can occur by different mechanisms. Regardless of the mechanism, all types of retinal detachment have one characteristic in common,i.e. the accumulation of subretinal fluid **(Delolme et al., 2012).**

Despite the high level of anatomic success, visual results remain compromised mainly because of permanent functional damage once the macula becomes detached **(Kashani et al., 2015).**

Patients with macula-off rhegmatogenous retinal detachments (RRDs) can have poor visual recovery, specific color vision defects, or metamorphopsia postoperatively despite successful retinal reattachment. In these cases, subtle changes in the foveal structure, which may be causing visual disturbances, can be difficult to identify during standard clinical examinations such as slit-lamp biomicroscopy or binocular indirect ophthalmoscopy.

Wolfensberger and Gonver (2011) reported a possible association between incomplete visual recovery and the presence of residual subretinal fluid (SRF) postoperatively.

Optical coherence tomography is a noninvasive, patient- and operator-friendly technique that has the advantage of imaging and quantitatively analyzing retinal thickness, nerve fiber layer, and optic nerve structures with good reproducibility **(Ricker et al., 2011).** The present work aimed to evaluate the relationship between morphological changes in the macula and visual outcome after successful repair of retiinal detachment.

PATIENTS AND METHODS

This study included some patients suffering from rhegmatogenous retinal detachment with detached macula and Prolirefrative vitroretinopathy(PVR)who attended the outpatient clinic, AL-Azhar University hospitals (AL-Hussein and Sayed Galal) from October 2012 to May 2015.

All patients underwent a comprehensive preoperative ophthalmological examination, including complete medical and ophthalmic history, the measurement of best-corrected visual acuity (BCVA), intraocular pressure, slit-lamp anterior segment examination, indirect ophthalmoscopy,contact lens slit-lamp biomicroscopy and fundus photography.

As all patients were treated with a procedure using silicone oil 1, 000 centistokes which made OCT measurements dificult at the early postoperative period OCT was done at one month for the 1st time Thus, examinations had been done after 1, 2, 6 months and one year.

Inclusion criteria

Patients with rhegmatogenous retinal detachment of intermediate severity of PVR .

Exclusion criteria

- Recurrent-detachment.
- Tractional retinal detachment.
- Strabismus.
- Glaucoma.
- Ambylopia.

- Pre-existing macular disease (e.g. Age related macular degeneration and diabetic retinopathy).
- Vitreous hemorrhages.
- Vascular occlusion.
- Uveitis.
- Opaque media.
- Patients with macular hole.

Patients accepted best-corrected visual acuity examination postoperatively and SD-OCT imaging postoperatively for data analysis and gave written consent. The best-corrected visual acuity was determined from Snellen chart and converted to the logarithm of minimal angle of resolution (log MAR) equivalents to perform the appropriate statistical manipulation The following data collected was age, sex, time from symptom onset to surgery, characteristics of RRD including the number of quadrants involved and proliferative vitreoretinopathy grade. Central 1 mm subfield retinal thickness (CSFT) was also recorded automatically. This measurement represented the mean distance from the internal limiting membrane to the RPE-Bruch membrane at the fovea. After 6 months, silicone oil was removed in all cases. The retinal status was evaluated again, after silicone removal, with binocular indirect slit-lamp biomicroscopy using contact or non contact lens.

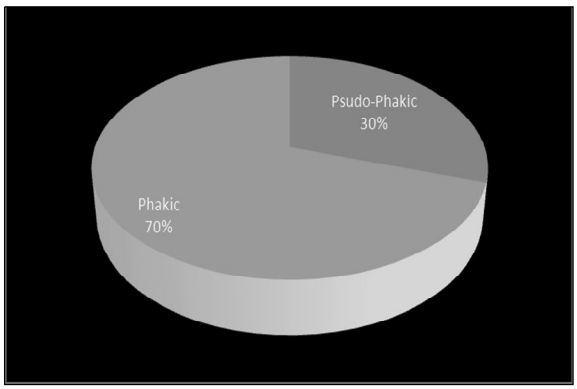


Figure (1): Lens status.

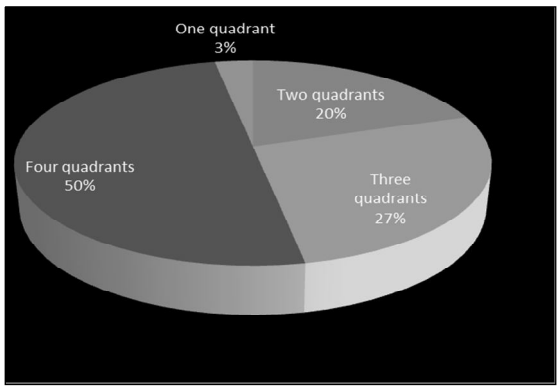


Figure (2): No. of quadrants affected.

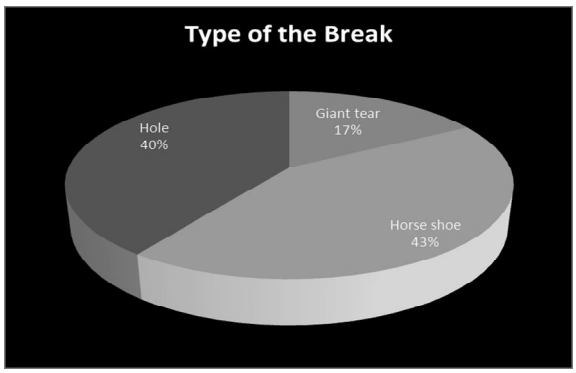


Figure (3): Type of the Breaks.

RESULTS

Thirty eyes of 30 patients were included in this study. The patients were 18 males and 12 females. The male to female ratio was 1.5: 1. The patients' age ranged from 17 to 73 years with mean age value of 44 ± 13.4 years.

Table (1): Age and Sex represent percentage.

Age	Sex		Total
	Male	Female	
≤ 20	1	1	2 (6.67%)
21-30	2	3	5 (16.67%)
31-40	3	3	6 (20%)
41-50	2	1	3 (10%)
51-60	7	1	8 (26.67%)
> 60	3	3	6 (20%)
Total	18 (60%)	12 (40%)	30 (100%)

Twenty one eyes were phakic (70%) and 9 eyes were pseudophakic (30%). The extent of RD, types of tears, state of the macula and the grades of PVR were shown in **table (2**).

Table (2): Clinical data of patients with primary rhegmatogenous retinal detachment.

Extent of retinal detachment	**No. of eyes (%)**
1 Quadrant	1 (3.33%)
2 Quadrants	6 (20%)
3 Quadrants	8 (26.66%)
4 Quadrants	15 (50%)
Preoperative macular status	
On	0
Off	30 (100%)
Type of the break	
Horse shoe	13 (43%)
Rounded hole	12 (40%)
Giant tear	5 (16.66%)
Proliferative Vitreo-Retinopathy (PVR)	
Grade A	16 (53.33%)
Grade B	14 (46.66%)

SD-OCT was done to all patients post-operatively. According to OCT findings, the 30 eyes were divided into three groups; A, B, and C. Group A included all cases with residual subretinal fluid, Group B included cases with other finding rather residual subretinal fluids, and Group C included eyes with no detectable OCT findings. There were 8 (26.7%) eyes with retained subretinal fluids (Group A), 18 eyes (60%) with pathology other than subretinal fluid (Group B), and 4 eyes (13.33%) with no detectable pathology after the operation (Group C)

SD-OCT was used (Group A) to measure the vertical distance between the center of the fovea and the underlying RPE and considered as the height of the subretinal fluid. Another two perpendicular measurements were done to the maximum extent of the elevated fovea. From those two measurements an estimation of the persistence fluid volume was calculated using the ellipse volume formula (Volume = 4/3 π).

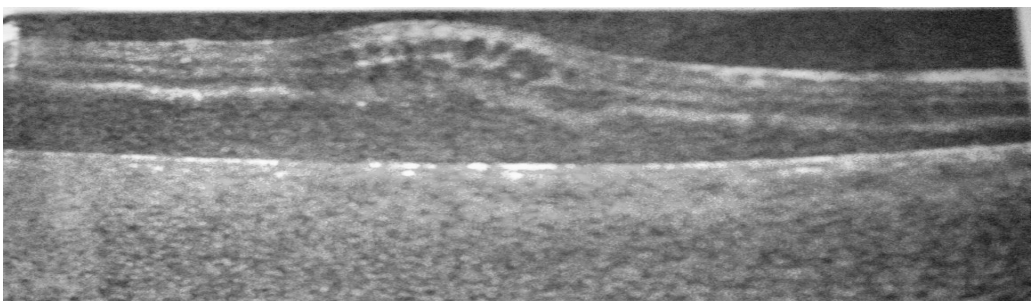
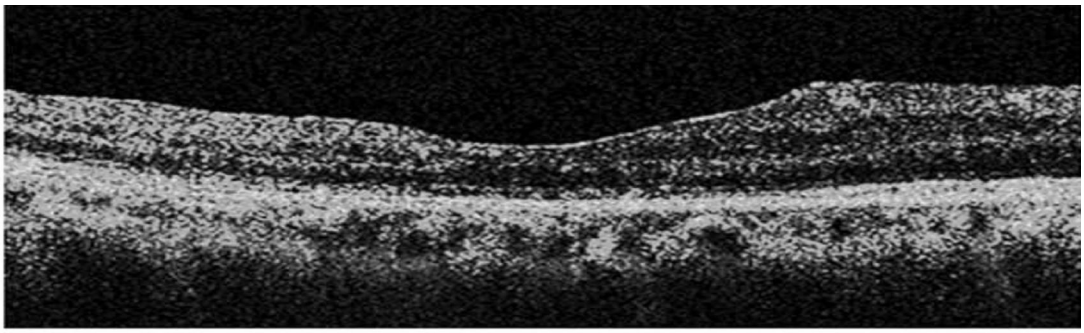
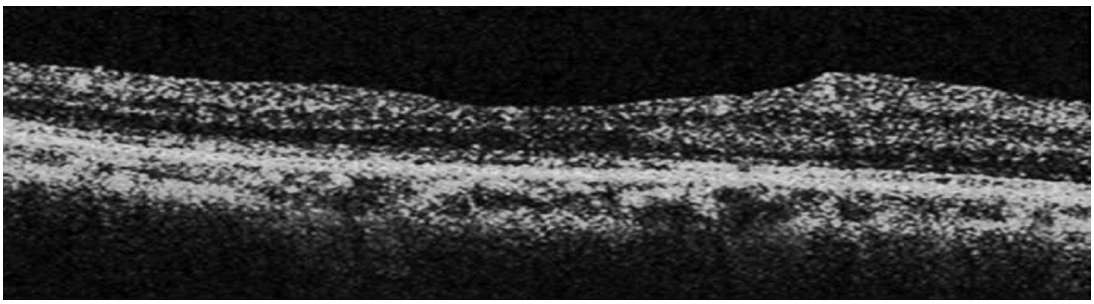


Figure (4): Preoperative optical coherence tomography (OCT) characteristics of the detached neurosensory retina at the macula. A 55-years-old man with a rhegmatogenous retinal detachment (best-corrected visual acuity, 0.06), three months after macular detachment. The detached retina showed multiple small cystic cavities in the inner and outer nuclear layers.

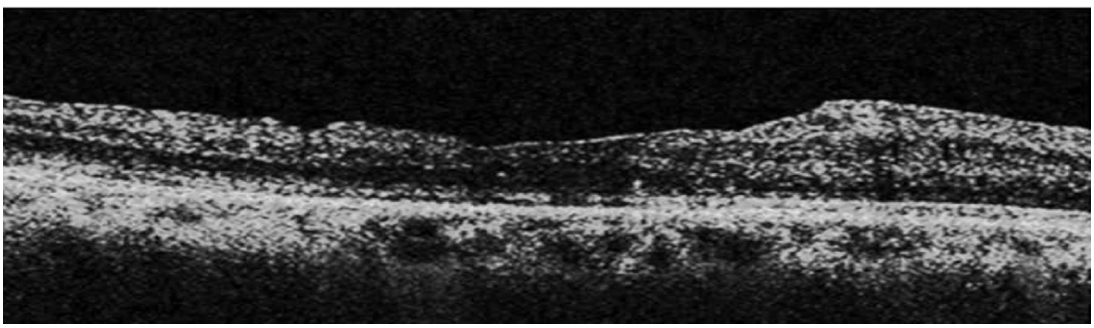
Figure (5): Preoperative (A) fundus photo (B) fluorescein angiography of detached neurosensory retina at the macula. A 55-years-old man with a rhegmatogenous retinal detachment (best-corrected visual acuity, 0.06).



A) SD OCT image obtained after 1 month The IS/OS line was disrupted at the fovea and thickness of the fovea 288µm with BC VA 0.1



B) SD OCT image obtained after 2 months The IS/OS line disrupted mild improved at the fovea and thickness of the fovea was attenuated 276µm with BC VA 0.2.



C) SD OCT image obtained after 6 months The IS/OS line disrupted restored partially at the fovea and thickness of the fovea was mild attenuated 264µm with BC VA 0.6.

Figure (6): Optical coherence tomography (OCT) findings in a 55-year-old man who underwent successful pars plana vitrectomy for a rhegmatogenous retinal detachment.

OCT examination for(Group B) showed other findings distributed as follows: 5 cases (14.66%) with an epiretinal membrane, one case of cystoid macular edema combined with an epiretinal membrane and 12 cases (26.66%) with foveal photoreceptor layer disruption.

Foveal photoreceptor layer pathology was in the form of disruption and/or loss of IS/OS junction.

(Group A): The median and the mean vision for the 8 eyes with sub-retinal fluid in OCT were as follows:

- After 1 month, the median was 0.6 LogMar (Vision of 0.2 =6/24 snellen chart), and the mean was 0.54±0.21.
- After 2 month, the median was 0.5 LogMar (Vision of 0.3=6/19 snellen chart), and the mean was 0.41±0.16.
- After 6 month, the median was 0.4 LogMar (Vision of 0.4=6/15 snellen chart), and the mean was 0.28±0.18 .
- After one year, the median was 0.3 LogMar (Vision of 0.5=6/12 snellen chart), and the mean was 0.27±0.19.

(Group B): The median and the mean vision for the 18 eyes with other abnormalities rather than sub-retinal fluid was as follow:

- After 1 month: the median was 0.7 LogMar (Vision of 0.2 =6/30 snellen chart), and the mean was 0.75±0.29.
- After 2 month: the median was 0.6 LogMar (Vision of 0.25=6/24 snellen chart), and the mean was 0.54±0.24.
- After 6 months: the median was 0.4 LogMar (Vision of 0.4=6/15 snellen chart), and the mean was 0.38±0.23.

Vision prognosis was also observed for patients with photoreceptor disruptions and those with macular cysts. Patients with macular cysts showed a better visual acuity (mean vision 0.2 LogMar after 3 months) than cases with photoreceptor disruption (mean vision 0.4 LogMar after 3 months).

(Group C): There were 4 cases with no abnormalities detected in the OCT The median and the mean vision was as follow:

- After 1 month: the median was 0.5 LogMar (Vision of 0.32 =6/19 snellen chart) ,and the mean was 0.61±0.24.
- After 2 month: the median was 0.3 LogMar (Vision of 0.5=6/12 snellen chart), and the mean was 0.36±0.16.
- After 6 month: the median was 0.2 LogMar (Vision of 0.63=6/9.5 snellen chart), and the mean was 0.17±0.04 .

Postoperative visual acuity was related to the tomographic results. There were different OCT findings which can be correlated to the bad vision rather than sub-retinal fluid. These were in the form of photoreceptors disruption and macular cysts. For cases with residual subretinal fluids.

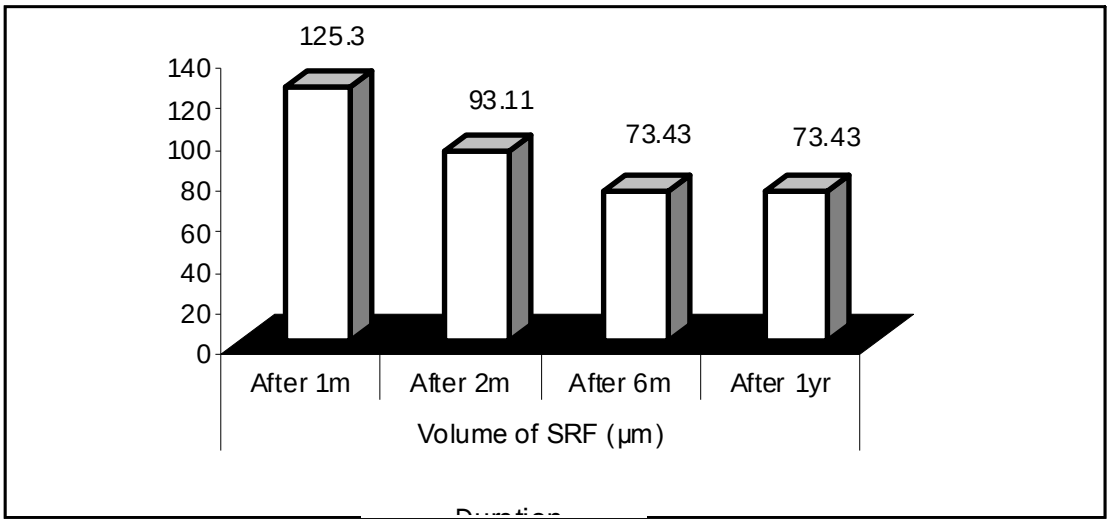


Figure (7): Postoperative amount of macular subretinal fluid after 1m, 2m, 6m and after 1 year

Table (3): Comparison between three groups regarding VA after one, two and three months.

Parameters \ Groups		Group A (8 cases)	Group B (18 cases)	Group C (4 cases)	P-value
VA after one month	Mean ± SD	0.4±0.16	0.75±0.29	0.61 ±0.24	**0.013**
	Median	0.6	0.7	0.5	
VA after 2months	Mean ± SD	0.38±0.16	0.54 ±0.24	0.36 ±0.16	**0.131**
	Median	0.5	0.6	0.3	
VA after 6 months	Mean ± SD	0.28±0.18	0.38±0.23	0.17±0.04	**0.156**
	Median	0.4	0.4	0.2	

DISCUSSION

In our study, we choosed patients with RD with proliferative vitreoretinopathy (PVR). Our results showed complete postoperative reattachment in all patients with 95% and single operation sucsess rate mean BCVA of 0.69 Snellen chart (0.2 LogMar) six months following the surgery.

Incomplete visual acuity recovery after anatomically and clinically successful repair has been attributed to several preoperative and postoperative factors. Studies proved the effect of clinically detectable pathologic changes such as ERM, cystoid macular edema, and persistent macular SRF on reducing

postoperative visual acuity **(Seo et al., 2008)**.

Panozzo et al. (2003) while studying the follow-up period of retinal detachments, was the first to observe the presence of small subfoveal lesions, and considered them as residual detachments of the neuroepithelium related to macular subretinal fluid persistence.

Studies have shown that clinically invisible pockets of subretinal fluid may persist subfoveally on optical coherence tomography several weeks after successful vitrectomy and gas tamponade **(Benson et al., 2006).** In our study, we found 26.66% of subretinal fluid on OCT one month after the surgery in which the visual acuity was 0.6 LogMar.

Benson et al. (2006) They came with conclusion that persistent SRF 6 weeks after PPV surgery occurs in approximately half of patients, may persist for many months, and can cause delayed visual recovery.

In our study, the persistent SRF group of cases showed an improvement of vision with decrease of the amount of SRF over time. Also detected other causes of decreased postoperative vision regain.

Another factor that was suggested to decrease the visual acuity was the formation of postoperative cystoid or spongiform macular thickening **(Seo et al., 2008).**

The integrity of photoreceptor outer segments (OS), i.e. the cone OS in the central macular region, could serve as a marker of the health of the cones, The cells are primarily responsible for visual acuity **(Sheth et al., 2010)**. In our study the intigrity of IS/ OS junction affected the visual acuity so, we classified into four stages according to the junction . The IS/OS junction line was intact in 11 (36.66%) eyes, and V/A ranged between 0.5 and 0.3 LogMar. After 1 month from mildly disrupted in 4 eyes (25%) ranged from 0.8 to 0.7 LogMar after 1 month moderately disrupted IS/OS in 10 eyes (33.%) ranged from 1.2 to 0.9 LogMar, at 1 month, and severely disrupted IS/OS in 5 eyes (16.66%) ranged from1.9 to 1.8 LogMar at 1 month The length of the defect ranged from 0 in the intact group to 1800µm in the severely disrupted group with a mean of 831±718 micron.

Although the preoperative duration of a rhegmatogenous retinal detachment (RRD) continues to be an important factor for the postoperative functional prognosis of the eye, it remains controversial in acute macula-off RRD should be treated as an emergency case **(Panozzo et al. (2003).**

In our study, the IS/OS junction line integrity was made as continuous variable by measuring the length of its disruption on raster scans on SD-OCT. There was a moderately strong correlation between the length of IS/OS defect and the visual acuity**.**

Many studies reported use of SD-OCT to investigate changes in the foveal microstructures and correlate it with postoperative visual acuity in patients after anatomically successful repair of RRD. According to these studies, a discontinued IS/OS junction was the most frequent lesion found in 40% to 82% of patients and was described as a marker of poor prognosis for visual recovery. **(Nakanishi et al., 2009; Wakabayashi**

et al., 2009; Lai et al., 2010 and Shimoda et al., 2010).

Our study showed moderately strong correlation between length of IS/OS defect and the duration of retinal detachment (**r= 0.602, p= 0.05**). A similar correlation was shown by **Baba et al. (2008)**.

On the other hand, **Sheth et al. (2010)** showed no significant relationship between the area of IS and OS junction disruption and duration of vision loss before RRD surgery.

Otani et al. (2010) published an article on visual recovery in macula-off retinal detachments. In this article he reported that 53% of patients (who could provide adequate information regarding the onset of macular involvement) operated on by 9 days after detachment achieved 20/20 to 20/50 acuity. The proportion attaining 20/20 to 20/50 acuity diminished to 34% in those operated on from days 10 through 19 and to 29% in those operated on after 19 days. He concluded that patients with macular detachment of 9 days or less had a statistically significant better chance of obtaining final visual acuity of 20/50 or better than those with macular detachment of 10 through 19 days and longer than 20 days duration .

Wakabashi et al. (2009), performed a non-controlled, prospective, interventional case series on 104 patients with macula-off detachments of 7 days or less .We evaluated the relationship between the central foveal thickness and the post-operative visual outcome where we found a fair inverse correlation between them **Wakabashi et al. (2009)** failed to demonstrate a correlation between foveal thickness and visual acuity outcome, but there was no significant correlation with the IS/OS defect.

CONCLUSION

SD-OCT is an irreplaceable instrument for the postoperative assessment of macula in patients who have undergone surgery for macula-off RRD. It permits detection of the presence of foveal changes that are not visible with ophthalmoscope. Persistent sub-retinal fluid is responsible for the poor prognosis after surgery. Although there was a detectable improvement in vision with decrease of the amount of subretinal fluid, Visual prognosis related to other pathological finding as photoreceptors integrity, and presence or absence of Cystoid macular edema.

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تغيرات الماقولة بعد استئصال الجسم الزجاجي في عمليات الانفصال الشبكي باستخدام جهاز الماسح الضوئي المقطعي الترابطي

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خلفية البحث: مرض الإنفصال الشبكي، هو عبارة عن إنفصال طبقة الجزء العصبي الحسي للمستقبلات الضوئية من الجزء الصبغي الشبكي وتستمد هذه الطبقتين من الجزء الظاهري العصبي التي تغطي الحويصلة البصرية خلال مرحلة التطور الجيني .

الهدف من البحث : دراسة هو بحث العلاقه بين التصوير الضوئي المقطعي الترابطي للعين والمجال الطيفي مع حده الابصار بعد الإزالة الأولية للجسم الزجاجي.

المرضى و طرق البحث : تم تأثير الإزالة الأولية للجسم الزجاجي علي ثلاثين عينا لثلاثين مريضا منهم ثمانية عشر رجلا وإثنتي عشرة إمرأة تراوحت أعمارهم بين سبعة عشر وثلاثة وسبعين عاماً يعانون من انفصال شبكي قطعي أولي شاملا الماقولة مترددين علي مستشفيات جامعة الأزهر بالقاهرة، وذلك في المدة ما بين أكتوبر عام 2012 وحتى مايو 2015 مع فحص دوري بعد شهر وشهرين وستة أشهر وعام بعد العمليه وذلك عن طريق بحث العلاقات بين التصوير الضوئي المقطعي الترابطي للعين.

ولقد تم فحص المرضي المعنيين قبل اجراء العمليه بالآتى:

- التعرف الكامل للتاريخ المرضي
- قياس حدة الابصار
- التعرف من حيث الزمن الذي انقضي بين بداية الأعراض ووقت إجراء العملية.
- فحص العين بواسطة المصباح الشقي.
- فحص قاع العين بواسطة منظار قاع العين المباشر وغير المباشر للتعرف علي خاصية الإنفصال.

ولقد تم إختيار الحالات التي تعاني من إنفصال شبكي أولي قطعي شاملاً الماقولة، كما إستبعدت حالات الإنفصال المرتجع وحالات الإنفصال نتيجة للشد علي الشبكية وأيضاً إستبعدت حالات الإنفصال المصاحبة للحول والمياه الزرقاء وكسل العين وتحلل الماقولة الشيخوخي والعصب البصري والنزيف داخل الجسم الزجاجي والإنسداد الوريدي والإلتهاب القزحي وحالات عتامات المجال

البصري، كما أستبعدت أيضاً حالات ثقب الماقولة. كما أجريت فحص الحالات بعد العملية لتقييم النهاية العظمي لحده الإبصار وضغط العين وفحص العين بواسطة منظار قاع العين المباشر والغير مباشر وتقييم الماقولة عن طريق جهازOCT عند شهر، وشهرين ، وستة أشهر وعام بعد العملية مظهرة المنسوب وحجم تجمع السائل تحت الماقولة للحالات.

كما أن الحالات التي قيمت منها واحد وعشرون عينا بها عدسة العين الطبيعيه، وتسع أعين بها عدسة صناعية. كذلك أجريت لست حالات إستئصال للجسم الزجاجي مع إستحلاب بعدسة العين ووضع عدسة صناعية وخمس عشره عين إستئصال للجسم الزجاجي فقط مع حقن زيت السيلكون في جميع الحالات ليحل محل الجسم الزجاجي.

النتائج : إلتئام الشبكية في كل المرضي مع نسبة نجاح بعد عملية واحدة تصل إلى 95%، ويرجع إنخفاض حدة الإبصار الى عدة عوامل منها تجمع السائل تحت الشبكية وتأثر خط إلتقاء الجزء الداخلي/ الجزء الخارجي للمستقبلات الضوئية او غشاء الحد الخارجي. ولقد أظهرت النتائج ايضا أن هناك علاقة بين طول تأثر خط إلتقاء الجزء الداخلي / الجزء الخارجي للمستقبلات الضوئية مع حدة الإبصار، وقد تم تقسيم طول تأثرهما الى أربعة درجات، ووجد أن هناك فرق إحصائي في حدة الإبصار بين الدرجات الأربعة. كما وجدت ايضا علاقة هامة بين سمك مركز الإبصار مع حدة الابصار.

الاستنتاج: يعتبر التصوير الضوئي المقطعي الترابطي للعين وسيلة دقيقة لتقييم التغيرات الدقيقه في مركز الإبصار، وتعد درجة تأثر خط إلتقاء الجزء الداخلي / الجزء الخارجي للمستقبلات الضوئية مقياس لحده الإبصار.