

Reversing the paradigm on the urgency of acute retinal detachments defined by their foveal status: when off may be more urgent than on

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The visual prognosis is good for what is generally termed ‘macula-on’ rhegmatogenous retinal detachments (RRDs) but often less favourable for ‘macula-off’ RRDs. The longer the fovea is detached and the higher the detachment is from the retinal pigment epithelium, the worse the visual outcome.^{1–5} Indeed, it is the exquisitely engineered fovea that is the key determinant of good visual recovery, and as such, we need to be more precise with the terminology and replace the traditional terms of ‘macula-on/off’ with ‘fovea-on/off’.⁶ While posturing and/or immobility induced by bilateral eye patching may temporarily reduce or prevent the spread of subretinal fluid (SRF) under the fovea prior to surgery,^{7–11} prompt surgical intervention is key for improving visual outcomes.

As soon as retinal detachment occurs, inflammatory and wound healing changes start. In animal models, photoreceptor apoptosis has been shown to occur as early as 12 hours after retinal detachment, followed by extensive remodelling with functional and morphological changes eventually involving all retinal layers. Photoreceptor outer segments progressively degenerate, inner segments reorganise, rod and cone opsins are redistributed, and rod axons retract while cones undergo changes in shape.¹² The longer the retina remains detached, the more extensive these changes become and the less likely there is to be complete or near complete recovery of visual function following surgical repair. Furthermore, the damage to cellular functions in fovea-off RRDs also affect other qualities of vision besides acuity, including contrast sensitivity, colour vision and stereopsis.^{13 14} Although the exact relationships between these RRD-induced changes in retinal anatomy and recoverable function are unclear, they appear to be time critical, with irrecoverable loss occurring within 24 hours.

Studies analysing the effect of the duration of loss of central vision (LCV) prior to surgery have shown a deleterious effect of duration on postoperative visual acuity. They have, however, broadly grouped duration of LCV into intervals of 0–2, 3–5 days, etc, with the uncertainty about the history of LCV, making a more detailed analysis of time periods unreliable.^{1 2 15 16} Several studies have demonstrated better visual outcome for RRDs with lower foveal detachment height.^{3–5 17} Since it is not possible to predict in an acute RRD if, and to what extent there will be further recruitment of subfoveal fluid, early surgery is required to minimise the duration and magnitude of foveal elevation.

FOVEA-OFF RETINAL DETACHMENTS

Older studies reported better visual outcomes for fovea-off RRDs operated within a week of LCV^{18–21}; however, the exact timing of repair during this first week did not seem to effect visual results.^{3 22 23} The results of these studies led to recommendations that patients with fovea-off RRDs were placed on a routine surgical list within the week rather than being considered for more urgent treatment. Patients in those studies were treated with scleral buckling (SB) surgery^{22 23} or by a mixture of surgical methods including pneumatic retinopexy, SB, pars-plana vitrectomy (PPV) and combined PPV+SB.³

Subsequent studies on visual outcome following mainly PPV for macula-off RRDs found that visual prognosis was better if the surgery was carried out within 3 days of LCV.^{15 16} A systematic review and meta-analysis published in 2014 on the impact of duration of macula-off RRD on visual outcome found improved visual results if SB surgery was undertaken within 3 days; however, the limited amount of data precluded a meta-analysis of the results following PPV.¹



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In 2021, the largest study to date was published, including 1482 patients with fovea-off RRD with a recorded duration of LCV and of whom the vast majority were treated by PPV with gas tamponade.² The study found that patients were more likely to achieve a postoperative best-corrected visual acuity (BCVA) of ≤ 0.30 logMAR (Snellen $\geq 6/12$) if operated relatively early after LCV: 83.5% if treated ≤ 2 days, 76.1% for 3–4 days and 68.7% for 5–7 days. In this study, preoperative BCVA was better in eyes with ≤ 2 days duration of LCV, and although the height of foveal elevation was not considered, it has previously been established that preoperative BCVA is directly related to the height of foveal detachment.²⁴ This suggests that the foveal elevation may have been lower in patients in the ≤ 2 days group than in those with longer duration of LCV. Independently of duration, the height of foveal detachment has been shown as predictive factor for postoperative BCVA^{3–5} and as such may have contributed to the better visual outcome in patients with a shorter duration of LCV.

Haq *et al*²⁵ found an improved visual outcome for patients with fovea-off RRD when operated within 1 day of presentation as compared with after 2 or more days. This period, however, referred to the time of diagnosis and not to the time point of LCV. Furthermore, they found no difference in the visual outcome between the fovea-on and fovea-splitting groups. While the true duration of these fovea-splitting status cases was unknown, the height of foveal elevation in foveal-splitting cases is very low, likely explaining the result.

It is unlikely that the duration of foveal elevation is the sole factor determining postoperative visual recovery. Patients following RRD repair by SB quite frequently show shallow persistent foveal detachment sometimes lasting for several weeks or months. There is no consensus in the literature, but several studies comparing visual outcomes of patients with and without persistent subfoveal fluid have not demonstrated a deleterious influence on final visual acuity after reabsorption of the subfoveal fluid bleb.^{26–29} For example, Seo *et al*²⁶ recorded persistent subfoveal fluid on optical coherence tomography (OCT) 1 month after surgery in 23 of 44 eyes, which disappeared in 12 of these eyes within 6 months postoperatively and in the other 11 eyes between 6 and 12 months postoperatively. Mean subfoveal fluid heights were reported as being relatively stable at approximately 100 μm (range 104–135) until the fluid disappeared. Final logMAR BCVA was 0.22 (SD 0.16) in the group with foveal detachment that resolved within 12 months compared with 0.18 (SD 0.17) in those without foveal detachment at 1 month postoperatively ($p=0.42$).

Several studies have demonstrated better visual outcomes for RRDs with lower macular detachment height,^{3–5 17} measured either by ultrasound^{3 4} or OCT^{5 17} when the surgical techniques were mixed, for example, SB and PPV,^{3 4 17} or when surgical repair was done exclusively by PPV with gas tamponade.⁵ Two studies considered both the height of macular elevation (on ultrasound) or

foveal elevation (on OCT) and the duration of LCV, up to a maximum of 7 days. They found that the lower the height of fluid, the better the visual acuity outcome which was independent of the duration of LCV.^{3 5}

The evidence currently available indicates that once the fovea is involved in the RRD, factors negatively associated with functional recovery include worse preoperative visual acuity, older age, female gender, duration and height of foveal detachment, the presence of proliferative vitreoretinopathy (PVR) grade C, and total retinal detachment.^{2–5 17 23 30–33} It is important to note, however, that the only modifiable factors are duration and height of foveal elevation. Prompt surgery will shorten the duration that the fovea remains detached and preoperative posturing and/or bilateral eye patching can prevent an increase in foveal detachment height and in some cases reduce it.^{8 11}

In particular, at least within the first week of foveal elevation, every day is significant.² A patient presenting with a 2-week history of LVC, for example, is less acute than someone with a 4-day history. For longer than 1-week duration of LCV, the point where improvement in visual recovery is minimal or ceases is not clear. The visual prognosis for patients with LCV >28 days has been shown to be worse than those within 13–28 days,² so time remains important at least up to 28 days.

FOVEA-ON RETINAL DETACHMENTS

The spread of SRF in fovea-on RRDs is overall rather slow. Ho *et al*⁷ reported in a prospective observational study that only 11 out of 82 (13%) cases demonstrated progression of SRF, with only 66% (54/82) of patients being told to posture preoperatively. Mean progression in these 11 cases was 1.8-disc diameters per day. The rate of progression from fovea-on to fovea-off while awaiting surgery the next day or the day after has been reported as only about 1%.^{34–36} Kontos and Williamson³⁴ reported a conversion rate from fovea-on to fovea-off while awaiting surgery in 1.1% (10/930); however, the number of patients that received posturing instructions was not mentioned. Nine out of the 10 patients had supero-temporal breaks with RRDs extending at least to the vascular arcade at presentation. Apart from supero-temporal or superior location of the RRD including its primary break, other reported risk factors for progression of the SRF into the fovea include short baseline RRD-to-fovea distance, progression of SRF during initial posturing and a short history with rapid progression of subjective visual field loss.³⁷ Patients with fovea-on RRD with these characteristics benefit most from preoperative posturing and urgent surgery.¹

POSTURING

While both fovea-on and acute fovea-off RRDs benefit from immediate surgical repair, in situations where early surgery is not feasible, measures need to be taken to improve the patient's prognosis. One such measure is preoperative posturing (bedrest and positioning) until surgical repair. The beneficial effect of posturing

on subfoveal fluid height and subretinal fluid progression was mainly seen overnight^{8 9} and may not just be explained by the length of posturing itself, but by additional factors such as fewer head and eye movements and fewer posturing interruptions, an effect which can also be achieved or enhanced by bilateral eye patching.¹¹

Both fovea-on and fovea-off RRDs have a higher risk of progression if their breaks and detachments are located superiorly and particularly supero-temporally, and a lower risk for progression if they are located inferiorly. It has been shown that both fovea-on and fovea-off RRDs benefit from preoperative posturing. In a fovea-on RRD, posturing will significantly reduce the risk of fluid spreading to the fovea. In a fovea-off RRD, posturing will significantly reduce further subfoveal fluid recruitment and particularly in patients whose primary break and RRD are located temporally, posturing may lead to a reduction in the height of the foveal detachment.⁵ Therefore, given the evidence in the literature the elevation height of the fovea has on the functional outcome,^{3-5 17 24 38 39} these findings suggest that all patients with an acute RRD irrespective of the status of the fovea would benefit from posturing until the surgery, either to prevent progression of SRF into the fovea or to limit foveal elevation.

RECOMMENDATION

For a fovea-on RRD, if the progression of the SRF into the fovea can be prevented prior to surgery, foveal function would be expected to remain unaffected following successful repair. Conversely, for a recent fovea-off RRD, any delay in surgery may have an adverse effect on the restoration of foveal function especially if there is progressive fluid accumulation. Therefore, there are no medically justifiable reasons for delaying surgical intervention in a recent fovea-off RRD and no basis for giving surgical preference to a fovea-on over an acute fovea-off RRD. Consequently, any patient with an RRD of duration less than 1 week would benefit from having surgery as soon as possible and where this is not feasible, for them to be strictly postured to prevent or reduce fluid accumulation at the fovea. At least within the first week of LCV, every day matters.

CONCLUSION

It is time to remove the distinction between fovea-on and acute fovea-off RRDs in terms of surgical prioritisation. If we are to improve visual outcomes, then recent fovea-off RRDs will need to be treated with the same urgency as fovea-on RRDs. This will have significant implications for the delivery of vitreoretinal services. One possible solution may be the establishment of collaborative on-call models for weekends between adjacent vitreoretinal units to improve patients' outcomes.⁴⁰

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REFERENCES

- van Busse EM, van der Valk R, Bijlsma WR, *et al*. Impact of duration of Macula-off retinal detachment on visual outcome: a systematic review and meta-analysis of literature. *Retina* 2014;34:1917–25.
- Yorston D, Donachie PHJ, Laidlaw DA, *et al*. Factors affecting visual recovery after successful repair of Macula-off retinal detachments: findings from a large prospective UK cohort study. *Eye (Lond)* 2021;35:1431–9.
- Ross W, Lavina A, Russell M, *et al*. The correlation between height of macular detachment and visual outcome in Macula-off retinal detachments of < or = 7 days' duration. *Ophthalmology* 2005;112:1213–7.
- Mowatt L, Tarin S, Nair RG, *et al*. Correlation of visual recovery with macular height in Macula-off retinal detachments. *Eye (Lond)* 2010;24:323–7.
- Baumann C, Almarzooqi A, Johannigmann-Malek N, *et al*. Importance of Subfoveal fluid height on visual outcome in Macula-off retinal detachments. *Br J Ophthalmol* 2022.
- Klaas JE, Siedlecki J, Steel DH, *et al*. How should we report the Foveal status in eyes with "Macula-off" *Eye (Lond)* 2023;37:228–34.
- Ho SF, Fitt A, Frimpong-Ansah K, *et al*. The management of primary Rhegmatogenous retinal detachment not involving the Fovea. *Eye (Lond)* 2006;20:1049–53.
- Johannigmann-Malek N, Kaye SB, Badawood S, *et al*. Influence of preoperative posturing on Subfoveal fluid height in Macula-off retinal detachments. *Retina* 2023;43:1738–44.
- de Jong JH, Viguera-Guillén JP, Simon TC, *et al*. Preoperative posturing of patients with Macula-on retinal detachment reduces progression toward the Fovea. *Ophthalmology* 2017;124:1510–22.
- de Jong JH, de Koning K, den Ouden T, *et al*. The effect of compliance with preoperative posturing advice and head movements on the progression of Macula-on retinal detachment. *Transl Vis Sci Technol* 2019;8.
- Tang PH, Curran CD, Salman AR, *et al*. Bilateral eye patching may improve clinical outcomes for acute primary Rhegmatogenous retinal detachment. *Retina* 2024;44:591–600.
- Melo IM, Zhou TE, Nagel F, *et al*. Histological changes in retinal detachment: A systematic review for the clinician. *Surv Ophthalmol* 2024;69:85–92.
- Kawamura H, Fujikawa M, Sawada O, *et al*. Contrast sensitivity after pars Plana Vitrectomy: comparison between Macula-on and Macula-off Rhegmatogenous retinal detachment. *Ophthalmic Res* 2016;56:74–8.
- Ng H, Vermeer KA, van Meurs JC, *et al*. Visual acuity inadequately reflects vision-related quality of life in patients after Macula-off retinal detachment surgery. *Invest Ophthalmol Vis Sci* 2020;61.
- Frings A, Markau N, Katz T, *et al*. Visual recovery after retinal detachment with Macula-off: is surgery within the first 72 H better than after *Br J Ophthalmol* 2016;100:1466–9.
- Konstantinidis L, Stappeler T, Potic J, *et al*. Characteristics of patients with complete visual acuity recovery after Vitrectomy for Macula-off retinal detachment. *Eye (Lond)* 2021;35:2834–9.
- Leclaire-Collet A, Muraine M, Menard J-F, *et al*. Predictive visual outcome after Macula-off retinal detachment surgery using optical coherence tomography. *Retina* 2005;25:44–53.
- Kim JD, Pham HH, Lai MM, *et al*. Effect of symptom duration on outcomes following Vitrectomy repair of primary Macula-off retinal detachments. *Retina* 2013;33:1931–7.
- Mowatt L, Shun-Shin GA, Arora S, *et al*. Macula off retinal detachments. How long can they wait before it is too late. *Eur J Ophthalmol* 2005;15:109–17.



- 20 Diederens RMH, La Heij EC, Kessels AGH, *et al.* Scleral buckling surgery after Macula-off retinal detachment: worse visual outcome after more than 6 days. *Ophthalmology* 2007;114:705–9.
- 21 Abouzeid H, Wolfensberger TJ. Wolfensberger TJ: macular recovery after retinal detachment. *Acta Ophthalmol Scand* 2006;84:597–605.
- 22 Ross WH, Kozy DW. Kozy DW: visual recovery in Macula-off Rhegmatogenous retinal detachments. *Ophthalmology* 1998;105:2149–53.
- 23 Ross WH. Ross WH: visual recovery after Macula-off retinal detachment. *Eye* 2002;16:440–6.
- 24 Hagimura N, Suto K, Iida T, *et al.* Optical coherence tomography of the Neurosensory retina in Rhegmatogenous retinal detachment. *Am J Ophthalmol* 2000;129:186–90.
- 25 Haq Z, Mitra RA, Parke DW, *et al.* Impact of Foveal status and timing of surgery on visual outcome in Rhegmatogenous retinal detachment. *Retina* 2024;44:88–94.
- 26 Seo JH, Woo SJ, Park KH, *et al.* Influence of persistent Submacular fluid on visual outcome after successful Scleral buckle surgery for Macula-off retinal detachment. *Am J Ophthalmol* 2008;145:915–22.
- 27 Baba T, Hirose A, Moriyama M, *et al.* Tomographic image and visual recovery of acute Macula-off Rhegmatogenous retinal detachment. *Graefes Arch Clin Exp Ophthalmol* 2004;42:576–81.
- 28 Fu Y, Chen S, Gu Z-H, *et al.* Natural history of persistent Subretinal fluid following the successful repair of Rhegmatogenous retinal detachment. *Int J Ophthalmol* 2020;13:1621–8.
- 29 Ricker LJAG, Noordzij LJ, Goezinne F, *et al.* Persistent Subfoveal fluid and increased preoperative Foveal thickness impair visual outcome after Macula-off retinal detachment repair. *Retina* 2011;31:1505–12.
- 30 Doyle E, Herbert EN, Bunce C, *et al.* How effective is Macula-off retinal detachment surgery. In: *Might good outcome be predicted? Eye (Lond)*. . 2007; 21. 534–40.
- 31 Williamson TH, Shunmugam M, Rodrigues I, *et al.* Characteristics of Rhegmatogenous retinal detachment and their relationship to visual outcome. *Eye (Lond)* 2013;27:1063–9.
- 32 van de Put MAJ, Croonen D, Nolte IM, *et al.* Postoperative recovery of visual function after Macula-off Rhegmatogenous retinal detachment. *PLoS One* 2014;9:e99787.
- 33 Liu F, Meyer CH, Mennel S, *et al.* Visual recovery after Scleral buckling surgery in Macula-off Rhegmatogenous retinal detachment. *Ophthalmologica* 2006;220:174–80.
- 34 Kontos A, Williamson TH. Rate and risk factors for the conversion of Fovea-on to Fovea-off Rhegmatogenous retinal detachment while awaiting surgery. *Br J Ophthalmol* 2017;101:1011–5.
- 35 Hajari JN, Kyhnel A, Bech-Azeddine J, *et al.* Progression of Foveola-on Rhegmatogenous retinal detachment. *Br J Ophthalmol* 2014;98:1534–8.
- 36 Wykoff CC, Smiddy WE, Mathen T, *et al.* Fovea-sparing retinal detachments: time to surgery and visual outcomes. *Am J Ophthalmol* 2010;150:205–10.
- 37 de Jong JH, Viguera-Guillén JP, Wubbels RJ, *et al.* The influence of prolongation of interruptions of preoperative posturing and other clinical factors on the progress of Macula-on retinal detachment. *Ophthalmol Retina* 2019;3:938–46.
- 38 Matsui A, Toshida H, Honda R, *et al.* Preoperative and postoperative optical coherence tomography findings in patients with Rhegmatogenous retinal detachment involving the macular region. *ISRN Ophthalmol* 2013;2013.
- 39 Klaas JE, Rechl P, Feucht N, *et al.* Functional recovery after Macula involving retinal detachment and its correlation with preoperative biomarkers in optical coherence tomography. *Graefes Arch Clin Exp Ophthalmol* 2021;259:2521–31.
- 40 Teh BL, Al-Zubaidy M, Hillier RJ, *et al.* Outcomes of weekend surgery for acute retinal detachment. *Eye (Lond)* 2023;37:1942–3.