

# Surgical Correction of Retinal Folds Involving the Fovea

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**BACKGROUND AND OBJECTIVE:** Retinal folds are a rare complication after retinal detachment repair. Surgery is required if the fovea is involved. There are few surgical reports in the literature, describing various surgical approaches.

**PATIENTS AND METHODS:** The authors employed a surgical technique to treat retinal folds involving the fovea in a 59-year-old woman. Perimacular subretinal blebs were created with a 41-gauge cannula in conjunction with fluid-air exchange to coalesce the fluid at the macula. Perfluorocarbon liquid was injected to flatten the retina, and subretinal fluid drainage was performed through a peripheral retinotomy.

**RESULTS:** The macula was successfully unfolded during surgery. Visual acuity improved from 20/800 to 20/50. After 3 months, mild changes at the outer nuclear layer were observed on optical coherence tomography, and autofluorescence showed tracks of hypoautofluorescence where the forced infusion of liquid started.

**CONCLUSION:** The authors describe an effective surgical approach for the correction of retinal folds involving the fovea. Prompt treatment as well as gentle surgical manipulation are key points to obtain an improvement in visual acuity.

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## INTRODUCTION

Retinal folds (RF) are a rare complication after repair of rhegmatogenous retinal detachment (RD)<sup>1-3</sup> and have been reported after scleral buckle, primary vitrectomy, or pneumatic retinopexy.<sup>4,5</sup>

Several risk factors for the formation of RF have been described, including large circumferential buckles,<sup>1,6,7</sup> bullous detachment,<sup>1,6,7</sup> recent onset,<sup>7</sup> incomplete drainage of subretinal fluid,<sup>2</sup> and retinal detachment running through the fovea.<sup>2,6</sup>

When the RF involves the central macula, it may cause severe permanent structural damage.<sup>2,8,9</sup> Previous canine experiments have demonstrated an extensive loss of photoreceptors at the retina within the folds.<sup>10</sup>

Considering the potential photoreceptor damage and the recent advances in vitreoretinal surgery, early surgical treatment may be more appropriate despite the risk of additional damage caused by the vitrectomy.<sup>11</sup>

Very few attempts to surgically correct RFs have been reported, and there is still no consensus on the best surgical approach.<sup>4,11</sup>

A 59-year-old woman had undergone a buckling procedure for a macula-off RD. At presentation 20 days later, her best corrected visual acuity (BCVA) was 20/800 in the right eye and 20/25 in the left eye. On dilated fundus examination of the right eye, a peripheral large 360° buckle effect was noted, as well as large vertical posterior RFs crossing the foveal region (Figure 1A). Optical coherence tomography (OCT) confirmed the foveal involvement (Figure 1B-C).<sup>14</sup>

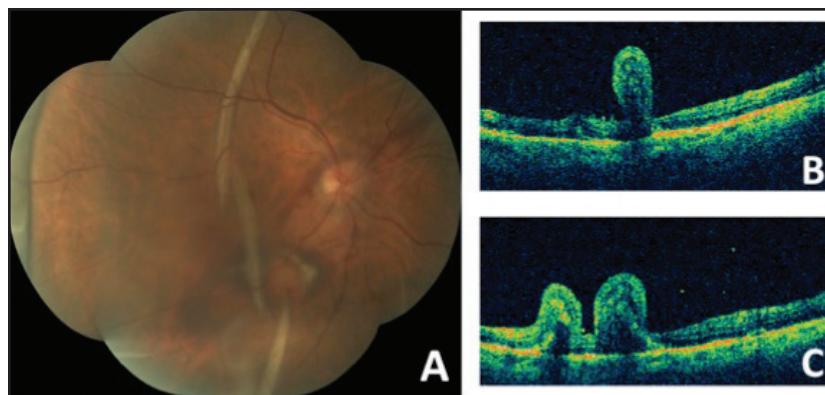
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The authors have no financial or proprietary interest in the materials presented herein.

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**Figure 1.** Retinal folds involving the fovea 20 days after scleral buckle surgery. (A) Retinography shows the vertical folds. (B, C) Two different optical coherence tomography scan orientations. The retina is completely attached, and neurosensory retina-to-retina apposition occurs at the fovea.

**TABLE**  
**Preoperative and Postoperative Visual Acuity in Cases Submitted to Macular Detachment for Retinal Folds Resolution**

	Preoperative Visual Acuity	Postoperative Visual Acuity
Witkin et al <sup>4</sup>	20/400	20/30
Herbert et al <sup>13</sup>	6/24	6/18+2
El-Amir et al <sup>11</sup>	1/60	6/12
Trihn et al <sup>12</sup>	20/320	20/100
Zacharias et al (current study)	20/800	20/50

We describe a new technique for the correction of RFs involving the fovea.

#### TECHNIQUE

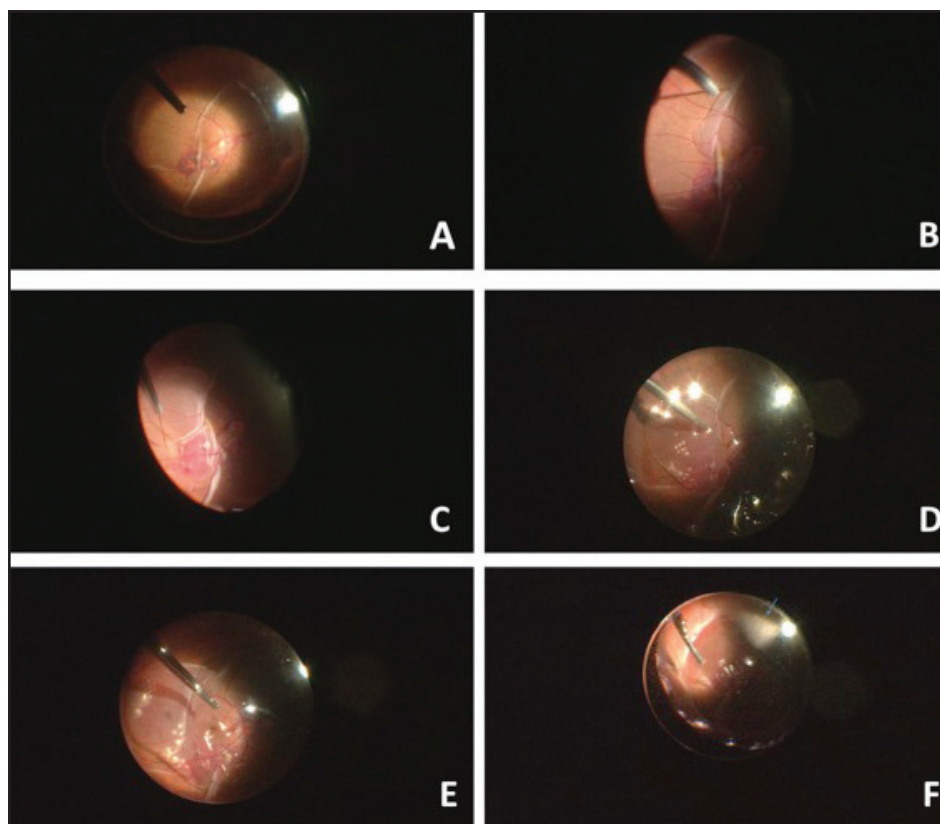
A 23-gauge pars plana vitrectomy was performed within 1 week of the diagnosis (Figure 2A, page 52). After removal of the vitreous, pockets of subretinal fluid were created around the macula with a 41-gauge cannula (MedOne, Sarasota, FL) (Figure 2B-C). The fluid was displaced to the posterior pole through a complete fluid-air exchange (Figure 2D). After the macula was completely detached, we returned the fluid and then injected heavy perfluorocarbon liquid to flatten the retina. The macular RFs disappeared immediately, but folds remained at the midperipheral areas where the retina had not been detached, even after perfluorocarbon liquid injection (Figure 2E). Finally, a superior peripheral retinotomy was created and the subretinal fluid was drained through it (Figure 2F). After endophotocoagulation of the superior break, another fluid-air exchange was performed, all perfluorocarbon liquid was removed,

10% C3F8 was exchanged with air, and no specific head positioning was requested of the patient. At 3 months postoperatively, the patient's BCVA was 20/50 (Figure 3A, page 53). Autofluorescence and fluorescein angiography both showed mild hypofluorescent or hypofluorescent lesions at the superotemporal macula, where the pockets of subretinal fluid were created, but no change under the foveal region (Figures 3B-C). OCT scans showed no folds, and the inner segment/outer segment (IS/OS) junction layer did not demonstrate hyperreflective changes. However, mild hyporeflexive changes at the outer nuclear layer and small hyperreflective dots were noted (Figure 3D).

#### DISCUSSION

There are no clear recommendations for surgery and its timing in cases of RFs. Folds not involving the fovea should simply be observed because they may only cause a linear scotoma and may decrease in size and symptoms during the follow-up period.<sup>8,9</sup> If the fovea is involved, an early intervention would theoretically offer a higher chance of restoration of reapposition of the photoreceptors and retinal pigment epithelium, as well as preservation of photoreceptors and retinal function. Moreover, it may also be easier to unfurl the fold at an earlier stage.<sup>5</sup> So far, six surgically approached RF cases have been reported in the literature.<sup>4,11-14</sup>

Surgery was effective in improving visual acuity in all four reported cases in which the RFs were fixed by macular re-detachment (Table, page 51).<sup>4,11-13</sup> Ideally, the foveal region should not be directly detached by the stream of fluid originating in the 41-gauge needle because it may cause direct cellular damage, and foveal rupture may also occur after forceful injection of subretinal fluid under the macula.<sup>4</sup> Alternatively, pockets of fluid can be created around the macular area, and the fluid-air exchange



**Figure 2.** Intraoperative snapshots. (A) Initial aspect. Vertical retinal folds are seen at the posterior pole, and a prominent circumferential buckle effect can be observed. (B) Subretinal bleb initially performed adjacent to the fold, next to the superotemporal arcade. (C) The subretinal blebs start to coalesce, but care is taken not to reach the foveal area. (D) Subretinal fluid is displaced to the posterior pole through an air-fluid exchange. (E) After perfluorocarbon liquid injection, a normal foveal reflex can be seen. The central retina is totally unfolded, but peripheral folds persist at the area where no detachment was created, even under perfluorocarbon liquid. The subretinal fluid is displaced through the periphery. (F) Subretinal fluid is drained through a peripheral retinotomy over the scleral buckle. Note the turbid fluid at the vitreous cavity (blue arrow).

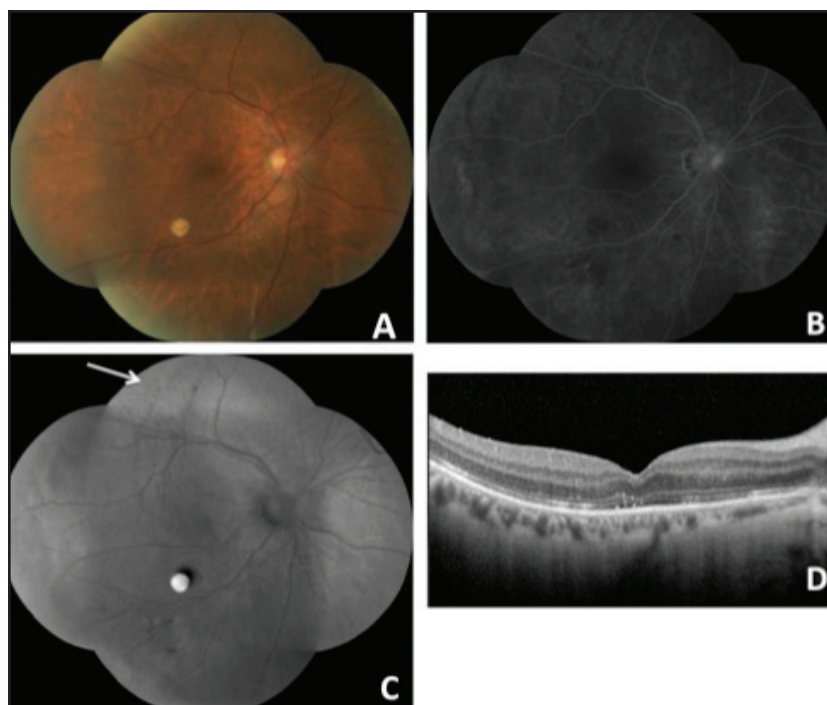
may be used as a more gentle maneuver to shift the fluid to the posterior pole with minimal tissue damage. This surgical step has already been described in a few reports<sup>4,11,12</sup> and seems to be safe and effective to coalesce the fluid in the posterior pole and unfurl the folds. After the surgical detachment of the macula, the use of air or gas as tamponades has been described<sup>4,11</sup> but requires patient positioning.

Similar to what we have performed, the use of heavy liquids in the treatment of RFs has been previously described twice. The intention would be to flatten the detached macula and squeeze the subretinal fluid to the periphery, avoiding recurrences at the posterior pole. After initial detachment of the macula, Herbert et al installed a short-term perfluorohexyloctane (F6H8) tamponade that flattened the retina and was surgically removed after 5 days.<sup>13</sup> Trihn et al used perfluorocarbon liquid to flatten the detached macula and push the subretinal bleb anteriorly, and laser photocoagulation was applied to the new border of anteriorly displaced subretinal fluid as an attempt to prevent its migration to the posterior pole.<sup>12</sup>

In our case, after the posterior pole was flattened with perfluorocarbon liquid, a peripheral retinot-

omy was created over the retina protected by the scleral buckle in order to drain the fluid. Considering that residual subretinal fluid is one of the risk factors for RF formation,<sup>2</sup> most of the subretinal fluid should be removed in order to assure a perfect apposition of the retina to the retinal pigment epithelium and to decrease the odds of fold recurrences. Because we ended the surgery with a totally flat retina, positioning the patient face down was not an issue. Therefore, in cases of poor patient compliance, draining the subretinal fluid may be essential for a good anatomic and functional outcome.

OCT changes have already been described in cases of RFs. An untreated case with spontaneous resolution of the RFs after 20 months of follow-up reveals a hyperreflective line at the location corresponding to the previous macular fold on the level of the photoreceptor IS/OS junction layer and the outer segment layer, suggestive of photoreceptor injury.<sup>8</sup> In our case, we could not note hyperreflective changes at the IS/OS junction layer, probably due to the fast intervention, which prevented further photoreceptor damage. However, some hyperreflective dots could be noted at the outer retina, which could indicate tissue damage. Based on previous



**Figure 3.** Aspect after 3 months of surgery. (A) Retinography shows resolution of the folds at the posterior pole. (B) Fluorescein angiography shows no change at the foveal area. (C) Autofluorescence demonstrates tracks of hypoautofluorescence where the subretinal bleb was created, indicative of a retinal pigment epithelium lesion (white arrow). No autofluorescence changes were seen at the macula. (D) High-definition optical coherence tomography shows mild hyporeflective changes at the outer nuclear layer and small hyperreflective dots, indicative of photoreceptor damage.

studies<sup>4,5</sup> and our results, we recommend early intervention for RFs involving the central macula.

In conclusion, we report a case in which RFs were successfully managed by pars plana vitrectomy, macular detachment, perfluorocarbon liquid infusion, and subretinal fluid drainage through a peripheral retinotomy. We believe the technique described here can successfully and systematically manage this very uncommon complication with minimum procedure-related tissue damage.

## REFERENCES

1. Pavan PR. Retinal fold in macula following intraocular gas: an avoidable complication of retinal detachment surgery. *Arch Ophthalmol.* 1984;102(1):83-84.
2. Larrison WI, Frederick AR, Jr, Peterson TJ, Topping TM. Posterior retinal folds following vitreoretinal surgery. *Arch Ophthalmol.* 1993; 111(5): 621-625.
3. Twomey JM, Leaver PK. Retinal compression folds. *Eye (Lond).* 1988; 2: 283-287.
4. Witkin AJ, Hsu J. Surgical repair of macular folds after vitrectomy for bullous rhegmatogenous retinal detachment. *Retina.* 2012; 32(8): 1666-1669.
5. Heimann H, Bopp S. Retinal folds following retinal detachment surgery. *Ophthalmologica.* 2011; 226: 18-26.
6. Lewen RM, Lyon CE, Diamond JG. Scleral buckling with intraocular air injection complicated by arcuate retinal folds. *Arch Ophthalmol.* 1987;105(9):1212-1214.
7. Van Meurs JC, Humalda D, Mertens DA, Peperkamp E. Retinal folds through the macula. *Doc Ophthalmol.* 1991;78(3-4):335-540.
8. Ahn SJ, Woo SJ, Ahn J, Park KH. Spontaneous resolution of macular fold following retinal reattachment: morphologic features on SD-OCT. *Ophthalmic Surg Lasers Imaging.* 2011;42:e81-e83.
9. Ruiz-Moreno JM, Montero JA. Sliding macular fold following retinal detachment surgery. *Graefes Arch Clin Exp Ophthalmol.* 2011;249(2):301-303.
10. Hayashi A, Usui S, Kawagushi K, et al. Retinal changes after retinal translocation surgery with scleral imbrication in dog eyes. *Invest Ophthalmol Vis Sci.* 2000;41(13):4288-4292.
11. El-Amir AN, Every S, Patel CK. Repair of macular fold following retinal reattachment surgery. *Clin Experiment Ophthalmol.* 2007;35(9):791-792.
12. Trinh I, Glancet-Bernard A, Colasse-Marthelot V, Leynaud JL, Soubrane G. Macular fold following retinal detachment surgery. *J Fr Ophthalmol.* 2006;29(9):995-999.
13. Herbert EN, Groenwald C, Wong D. Treatment of retinal folds using a modified macula relocation technique with perfluoro-hexyloctane-tamponade. *Br J Ophthalmol.* 2003;87(7):921-922.
14. Kertes PJ, Peyman GA. Management of dry retinal folds. *Int Ophthalmol.* 1997;21(2):53-55.

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