

# Short-Term External Buckling With Pneumatic Retinopexy for Retinal Detachment With Inferior Retinal Breaks

HUI-CHEN CHENG, SHUI-MEI LEE, FENQ-LIH LEE, JORN-HON LIU, CHIEH-HSIUNG KUAN, AND PO-KANG LIN

- **PURPOSE:** To introduce a new approach for short-term external scleral buckling with pneumatic retinopexy for the management of rhegmatogenous retinal detachment with inferior retinal breaks.
- **DESIGN:** Retrospective, noncomparative, interventional case series.
- **METHODS:** A review of 33 consecutive eyes of 31 patients who underwent external buckling with pneumatic retinopexy for uncomplicated rhegmatogenous retinal detachment with inferior retinal breaks from December 2006 through December 2010. An external buckle was made of a 505 sponge sutured along the blunt side of a 279 tyre (MIRA Inc). The buckle was inserted deeply into the inferior fornix without suture after pneumatic retinopexy and was kept in place for 3 days. Primary and final anatomic outcomes, visual acuity, and adverse events were recorded.
- **RESULTS:** All patients tolerated the procedure. The mean follow-up period was 24.0 months (range, 9 to 61 months). Primary success, defined as successful retinal reattachment within 6 months without further treatment, was achieved in 29 (87.9%) eyes. All patients attained final retinal reattachment (100%). Overall, the mean best-corrected visual acuity improved significantly at the end of follow-up (0.30 logarithm of the minimal angle of resolution units; Snellen equivalent, 6/12), compared with the preoperative best-corrected visual acuity (0.82 logarithm of the minimal angle of resolution units; Snellen equivalent, 6/38;  $P < .001$ ).
- **CONCLUSIONS:** Short-term external buckling with pneumatic retinopexy is a novel and effective treatment for rhegmatogenous retinal detachment with inferior retinal breaks, with a comparable success rate with other treatment methods. This approach also can avoid complications of long-term buckle implantation. Further

comparative cohort studies may be necessary to compare the clinical efficacy with other conventional operations. (*Am J Ophthalmol* 2013;155:750–756. © 2013 by Elsevier Inc. All rights reserved.)

**R**HEGMATOGENOUS RETINAL DETACHMENT (RRD) IS an important cause of visual loss worldwide, with a reported annual incidence between 6.3 and 17.9 per 100 000 persons in Western countries.<sup>1–4</sup> Approximately 29% of cases of RRD result from inferior retinal breaks.<sup>5</sup> Among the main surgical options in treating RRD with inferior retinal breaks, vitrectomy shows favorable anatomic success rates, alone or in combination with scleral buckling.<sup>6–8</sup> However, scleral buckling may be complicated by implant displacement, strabismus, refractive change, decreased retinal blood flow, and risk of anterior segment ischemia.<sup>9–14</sup> In addition, vitrectomy may have associated progression of cataracts, intraocular pressure fluctuations, and late-onset glaucoma.<sup>15</sup>

Pneumatic retinopexy has gained increasing popularity in the surgical management of RRD, with anatomic and visual outcomes comparable with other procedures.<sup>16,17</sup> However, it originally was contraindicated for RRD with inferior retinal breaks.<sup>17,18</sup> Chang and associates proposed inverted pneumatic retinopexy for the management of RRD with inferior retinal breaks and reported a single operation reattachment rate of 82%.<sup>19</sup> Mansour and Hwang and associates also proposed pneumatic retinopexy with a modified head tilt position for RRD with inferior breaks, with initial success rates of 76.9% to 88.2%.<sup>20,21</sup> Because all of these procedures require neck hyperextension or downward tilting of the head, the patients' cardiovascular function, cervical spinal fitness, and compliance are still major concerns.<sup>17,19–21</sup> The purpose of this study was to introduce and investigate pneumatic retinopexy with short-term placement of an external buckle for the management of RRD with inferior breaks.

## METHODS

THE STUDY PROTOCOL ADHERED TO THE TENETS OF THE Declaration of Helsinki. Before the study began, it was approved by the Institutional Review Board of the Taipei Veterans General Hospital, Taipei, Taiwan (VGHIRB

Accepted for publication Nov 6, 2012.

From the Department of Ophthalmology, School of Medicine, National Yang-Ming University, Taipei, Taiwan (H.-C.C., S.-M.L., F.-L.L., J.-H.L., P.-K.L.); the Department of Ophthalmology, Taipei Veterans General Hospital, Taipei, Taiwan (H.-C.C., S.-M.L., F.-L.L., P.-K.L.); the Department of Ophthalmology, Cheng Hsin Rehabilitation Medical Center, Taipei, Taiwan (J.-H.L.); the Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan (C.-H.K., P.-K.L.); and the Biomedical Electronics Translational Research Center and Biomimetic Systems Research Center, National Chiao Tung University, Hsinchu, Taiwan (P.-K.L.).

Inquiries to Po-Kang Lin, Department of Ophthalmology, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan; e-mail: pklin123@hotmail.com

no.: 2012-02-001BC). Informed consent was obtained from each patient.

• **STUDY SUBJECTS:** A retrospective review was performed for consecutive patients with RRD with inferior retinal breaks who underwent pneumatic retinopexy together with an external buckle in Taipei Veterans General Hospital from December 2006 through December 2010. An inferior retinal break was defined as a break located between the 4-o'clock and 8-o'clock positions. The patients with primary RRD were enrolled in the primary group, and the patients with recurrent RRD with causative inferior retinal breaks were enrolled in the secondary group. The exclusion criteria included RRD with breaks posterior to the equator, giant tears, proliferative vitreoretinopathy, retinoschisis, and patients who had a too loose or shallow of an inferior fornix. The inferior fornix of the patients was considered to be too loose if the buckle could not be lodged firmly or too shallow if the buckle touched the cornea after being placed.

All of the operations were performed by 1 vitreoretinal specialist (P.K.L.). Under retrobulbar anesthesia and standard sterilization, the extent of retinal detachment (RD) and location of the breaks were identified. Transconjunctival cryopexy was applied around the retinal breaks. Anterior chamber paracentesis then was performed, followed by an injection of 0.4 to 0.7 mL pure perfluoropropane gas (C<sub>3</sub>F<sub>8</sub>).

A customized external buckle was made from a 505 sponge sutured along the blunt side of a 279 tyre (MIRA Inc, Uxbridge, Massachusetts, USA) with several stitches of 6-0 black silk (Figure 1, Top left). The diameter of the 505 sponge was 5 mm and the width of the 279 tyre was 9 mm. The length of this complex buckle was trimmed to approximate the horizontal distance of the patient's inferior fornix. The buckle then was disinfected with 10% povidone iodine (Sindine; Sinphar Pharmaceutical Co, Ltd, I-Lan, Taiwan) and rinsed with balanced salt solution (BSS Plus; Alcon Laboratories Inc, Fort Worth, Texas, USA). The buckle finally was covered with 0.3% gentamicin ointment (Oftalmolosa Cusi Gentamicin 0.3%; Alcon Cusi S.A., Barcelona, Spain) and was inserted deeply into the inferior fornix without sutures. The sponge part of this complex buckle was directed toward the inferior fornix and made contact with the eyeball (Figure 1, Top right and Bottom).

After the operation, the buckle was kept in place with the eye patched, and the patients remained in a face-down position with 5 to 10 degrees of neck flexion for 3 days. The postoperative in-hospital regimen included 1% prednisolone acetate (Pred Forte Ophthalmic Suspension 1%; Allergan Pharmaceuticals, Westport County, Ireland) 4 times daily, 0.25% chloramphenicol (Chloramphenicol Ophthalmic Solution 0.25%; Synpac-Kingdom Pharmaceutical Co, Ltd, Taipei, Taiwan) 4 times daily, and 0.3% gentamicin ointment every night. After removal of the buckle, the patients remained in the face-down position without neck flexion for another 7 days. If the buckle

was found to be dislodged, it was disinfected immediately, covered with 0.3% gentamicin ointment, and inserted again by 1 of the authors (P.K.L.) or a doctor on duty. Supplementary laser photocoagulation around the breaks was carried out after the retina had reattached and the buckle had been removed. The postoperative intraocular pressure (IOP) was monitored and kept to less than 25 mm Hg with IOP-lowering agents. All patients were hospitalized for 3 to 7 days, and they were followed up at 1 week and 2 weeks and then 1, 2, 3, and 6 months after discharge.

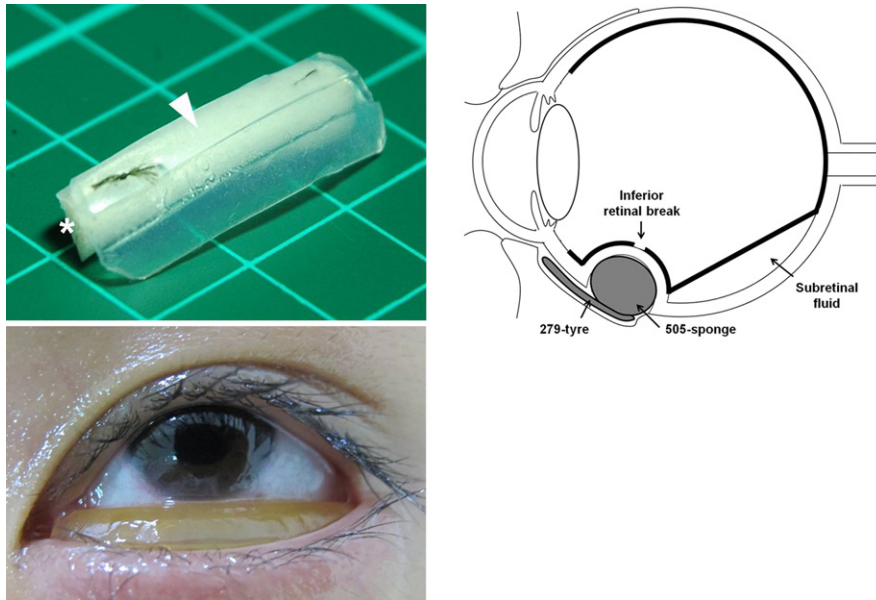
Primary anatomic success was defined as retinal reattachment at 6 months after a single operation without additional vitreoretinal surgery. Primary failure was defined as retinal redetachment within 6 months after the operation. Vitrectomy and endolaser photocoagulation then was arranged for these patients. Recurrence was defined as retinal redetachment at 6 months or more after the initial operation. The definition of final anatomic success was retinal reattachment at the end of follow-up. Clinical characteristics including age, gender, medical history, refraction status, laterality, history of trauma, lens status, macular involvement, extent of RRD, type and number of breaks, duration of follow-up, preoperative and postoperative best-corrected visual acuity (BCVA), IOP, use of IOP-lowering agents, and associated adverse events were recorded.

• **STATISTICAL ANALYSIS:** Continuous and categorical variables of the demographic and medical characteristics were compared using the Student *t* test and Fisher exact test, respectively. Preoperative and postoperative BCVA, IOP, and number of IOP-lowering agents were compared using the paired *t* test. Measured Snellen visual acuities were converted to logarithm of the minimal angle of resolution (logMAR) values. Visual acuities of counting fingers and hand movements were assigned logMAR values of 2.0 and 3.0, respectively (Snellen equivalent, 6/600 and 6/6000, respectively).<sup>22</sup> SPSS software for Windows version 18 (SPSS Inc, Chicago, Illinois, USA) was used for all calculations. A *P* value less than .05 was considered to be statistically significant.

---

## RESULTS

A TOTAL OF 33 CONSECUTIVE EYES IN 31 PATIENTS WERE enrolled in this study, subdivided into 26 eyes in the primary group and 7 eyes in the secondary group. Two patients with proliferative vitreoretinopathy change and 1 patient with a shallow inferior fornix were excluded. The mean age of the enrolled patients was 48.8 years (range, 17 to 81 years), with a mean follow-up time of 24.0 months (range, 9 to 61 months). The proportion of pseudophakic RRD was higher in the secondary group



**FIGURE 1.** External buckle in short-term external buckling with pneumatic retinopathy for retinal detachment with inferior retinal breaks. (Top left) The external buckle was made of a 505 sponge (\*) sutured along the blunt side of a 279 tyre (arrowhead; MIRA Inc, Uxbridge, Massachusetts, USA). The length of this complex buckle was trimmed to approximate the horizontal distance of the patient's inferior fornix. (Top right) Schematic drawing of the position of the external buckle relative to the eyeball. (Bottom) A demonstration of the external buckle in the inferior fornix.

than in the primary group (42.9% vs 23.1%;  $P = .36$ ). The average extent of RD was 5.0 clock hours (range, 1 to 12 clock hours), with a mean of 1.6 breaks (range, 1 to 4 breaks). Of the 33 eyes, 20 (60.6%) had macular detachment, of which 14 (70%) were in the primary group and 6 (30%) were in the secondary group (Table 1). The mean duration from onset of symptoms to seeking medical help in the patients with macular detachment was 15.7 days (range, 1 to 60 days). All patients were hospitalized for 3 to 7 days (mean, 5.5 days). Postoperative lid swelling and chemosis can prohibit fundus examination to some extent. In the patients with mild lid swelling, retinal indentation from the buckle with a correct location relative to the breaks was observed.

In the secondary group, 4 patients underwent vitrectomy with endolaser photocoagulation, and 3 patients received pneumatic retinopathy as the primary operation. However, all 7 patients demonstrated recurrent RRD 1 to 4 months later as a result of new inferior breaks and underwent pneumatic retinopathy with external buckling as salvage management.

Primary anatomic success was attained in 29 (87.9%) of 33 eyes, with 23 (88.5%) of 26 eyes in the primary group and 6 (85.7%) of 7 eyes in the secondary group (Table 2). In all of these eyes, the subretinal fluid (SRF) was completely absorbed and the retina reattached within 3 days after the operation. The external buckle then was removed, followed by adjunctive laser retinopathy (Figure 2).

Of the 33 eyes, 4 (12.1%) experienced primary failure, with breaks located between 6 and 7 o'clock and an average

RD extent of 7 clock hours (range, 4.5 to 12 clock hours). Three of these 4 patients were in the primary group, and they had persistent SRF for approximately 4 days (range, 3 to 5 days) after the first operation. Of these 3 patients, 2 had causative flap tears and 1 had a round hole. The fourth patient was in the secondary group and had initial success with the SRF absorbed within 3 days. However, retinal redetachment occurred 2 months after surgery because of subsequent proliferative vitreoretinopathy change without breaks. All 4 patients ultimately attained retinal reattachment after further vitrectomy, endolaser photocoagulation, and gas tamponade. One patient in the primary group had recurrent RRD with 2 new breaks supratemporally 2 years later. In this case, the retina was reattached after conventional pneumatic retinopathy. All of the patients had completely attached retinas and achieved final anatomic success at the end of the follow-up period (Table 2).

Overall, the mean BCVA improved significantly at the end of follow-up (0.30 logMAR; Snellen equivalent, 6/12) compared with the preoperative BCVA (0.82 logMAR; Snellen equivalent, 6/38;  $P < .001$ ). A similarly significant improvement was seen in the primary, secondary, and macula-off subgroups ( $P < .05$ ). However, the eyes with macula-on RD showed no significant change in BCVA ( $P = .26$ ; Table 3).

The mean IOPs on the first, second, and third day after the operation were 18.7 mm Hg, 17.6 mm Hg, and 16.9 mm Hg (range, 8 to 37 mm Hg), respectively, and the average numbers of IOP-lowering agents used were 0.73, 0.72, and 0.72 (range, 0 to 3), respectively. The

**TABLE 1.** Preoperative Characteristics of the Patients in Short-Term External Buckling with Pneumatic Retinopexy for Retinal Detachment with Inferior Retinal Breaks

	Total (n = 33)	Primary Group (n = 26)	Secondary Group (n = 7)
Age (y)	48.8 ± 19.9 (17 to 81)	47.0 ± 20.8 (17 to 81)	55.3 ± 15.7 (35 to 81)
Spherical equivalent (D)	-4.83 ± 4.72 (-13.50 to 4)	-4.52 ± 4.33 (-12.25 to 4)	-6.63 ± 7.08 (-13.50 to 1.5)
Male gender (%)	20 (60.6%)	15 (57.7%)	5 (71.4%)
Laterality (% right eye)	16 (48.5%)	11 (42.3%)	5 (71.4%)
Trauma	4 (12.1%)	3 (11.5%)	1 (14.3%)
Lens status (% pseudophakic)	9 (27.3%)	6 (23.1%)	3 (42.9%)
Macular status (% off)	20 (60.6%)	14 (53.8%)	6 (85.7%)
RD extent (clock hours)	5.0 ± 2.5 (1.0 to 12)	5.2 ± 2.7 (1.0 to 12)	4.2 ± 1.0 (3.3 to 6)
Break types <sup>a</sup>			
Flap tear	11 (33.3%)	6 (23.1%)	5 (71.4%)
Round hole	22 (66.7%)	20 (76.9%)	2 (28.6%)
No. of breaks	1.6 ± 1.0 (1 to 4)	1.8 ± 1.1 (1 to 4)	1.1 ± 0.4 (1 to 2)
Follow-up (mos)	24.0 ± 17.5 (9 to 61)	22.5 ± 17.4 (9 to 61)	29.7 ± 18.1 (12 to 60)

D = diopters; RD = retinal detachment.

Continuous variables are presented as mean ± standard deviation (range) and compared using the Student *t* test. Categorical variables are presented as numbers (percentage) and compared using the Fisher exact test.

<sup>a</sup>There was a significant difference in break types between the primary and secondary groups (*P* = .027).

**TABLE 2.** Anatomic Outcomes of the Patients in Short-Term External Buckling with Pneumatic Retinopexy for Retinal Detachment with Inferior Retinal Breaks

	Total (n = 33)	Primary Group (n = 26)	Secondary Group (n = 7)
Primary anatomic success	29 (87.9%)	23 (88.5%)	6 (85.7%)
Recurrence	1 (3.0%)	1 (3.8%)	0 (0%)
Final anatomic success	33 (100%)	26 (100%)	7 (100%)

Categorical variables are presented as numbers (percentage).

mean IOPs on each of the first 3 postoperative days were higher than the preoperative IOP (mean, 14.0 mm Hg; range, 7 to 21 mm Hg; *P* < .05). The IOP on the first and sixth months after the operation showed no difference from the preoperative IOP (*P* = .47 and *P* = .54, respectively). No patient received IOP-lowering agents 6 months after the operation. Almost all patients experienced some lid swelling and conjunctival chemosis.

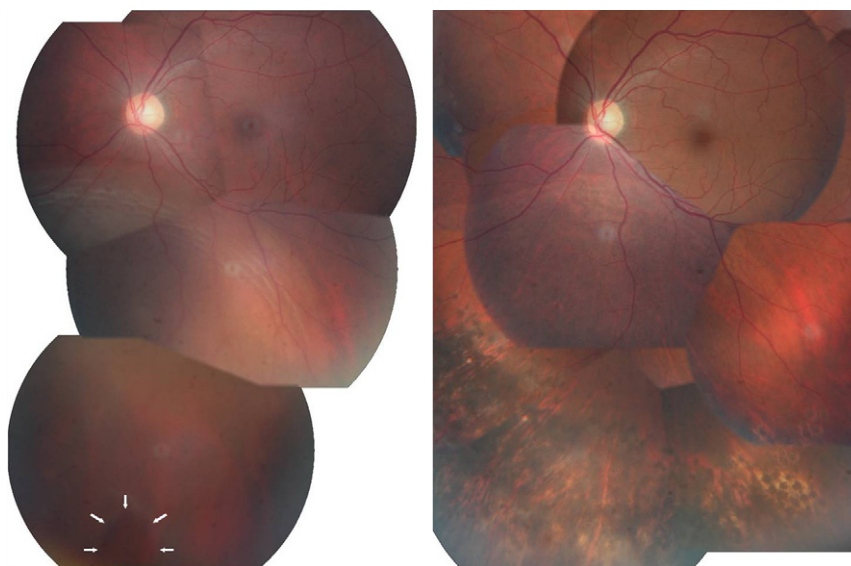
Of the 33 eyes, 8 (24.2%) had buckle dislocations, 3 (9.1%) had corneal epithelial defects, and 2 (6.1%) had IOP elevations, defined as an IOP higher than 30 mm Hg. All of the adverse events were transient and tolerable.

## DISCUSSION

IN THIS STUDY, WE DEMONSTRATED THAT PNEUMATIC RETINOPEXY combined with short-term placement of an

external buckle and a face-down position in the management of RRD with inferior retinal breaks resulted in a primary anatomic success rate of 87.9%. This primary success rate is comparable with that of other procedures for RRD with inferior retinal breaks, including 81.3% to 90% in vitrectomy, 73% to 95% in vitrectomy with scleral buckling, and 76.9% to 91% in pneumatic retinopexy with a modified neck and head position.<sup>6,8,19-21,23,24</sup>

Although pneumatic retinopexy has gained popularity for the management of RRD in recent decades, it originally was contraindicated for RRD with inferior retinal breaks.<sup>17,18</sup> Only a limited number of studies on modified pneumatic retinopexy for the management of RRD with inferior breaks have been reported.<sup>19-21</sup> Chang and associates reported inverted pneumatic retinopexy for RRD with inferior retinal breaks in 11 patients and reported a single operation reattachment rate of 82%.<sup>19</sup> However, the strict inverted position may exclude patients with physical limitations and may challenge the patients' compliance. Mansour reported graduated inverted retinopexy in 17 patients with 10-degree Trendelenburg positioning, 10-degree neck overextension, and 10-degree ocular supraduction and reported an 88.2% retinal reattachment rate, although there were concerns regarding cataractogenesis resulting from air-lens contact.<sup>20</sup> Hwang and associates reported another modified position with a lateral recumbent posture with head tilting 10 to 30 cm downward in 13 patients and reported a 76.9% reattachment rate.<sup>21</sup> All of these positioning modifications may have limitations with regard to the patients' cardiovascular function, cervical spinal fitness, and compliance.<sup>17,19-21</sup> External buckling with pneumatic retinopexy provides an effective alternative to these methods.



**FIGURE 2.** Case illustration of short-term external buckling with pneumatic retinopexy for retinal detachment with inferior retinal breaks. A 40-year-old man had blurred vision of the left eye for 6 weeks. (Left) Fundus examination disclosed a round hole at 7 o'clock (arrow) with inferior retinal detachment of the left eye. (Right) One month after pneumatic retinopexy and external buckling, the retina was well attached.

**TABLE 3.** Functional Outcomes of the Patients in Short-Term External Buckling with Pneumatic Retinopexy for Retinal Detachment with Inferior Retinal Breaks

BCVA (logMAR)	Total (n = 33)	Treatment Subgroups		Macular Status Subgroups	
		Primary Group (n = 26)	Secondary Group (n = 7)	Macula Off (n = 20)	Macula On (n = 13)
Preoperative	0.82 ± 0.92 (0.00 to 3.00)	0.61 ± 0.76 (0.00 to 3.00)	1.57 ± 1.11 (0.22 to 3.00)	1.06 ± 0.90 (0.15 to 3.00)	0.43 ± 0.86 (0.00 to 3.00)
Final	0.30 ± 0.41 (-0.08 to 1.48)	0.24 ± 0.34 (-0.08 to 1.48)	0.53 ± 0.61 (0.00 to 1.48)	0.33 ± 0.43 (-0.08 to 1.48)	0.27 ± 0.41 (0.00 to 1.48)
P value <sup>a</sup>	<.001	.014	.007	<.001	.26

BCVA = best-corrected visual acuity; logMAR = logarithm of the minimal angle of resolution.

Continuous variables are presented as mean ± standard deviation (range).

<sup>a</sup>Paired t test.

Scleral buckling has been a treatment method for RRD through releasing vitreous traction, closing the retinal breaks, and bringing the retina and retinal pigment epithelium into closer proximity.<sup>25</sup> From a study on fluid mechanics, laminar flow and the Bernoulli effect resulting from indentation of the buckle may facilitate fluid outflow and retinal reattachment.<sup>26,27</sup>

We used the inferior fornix as the space to hold the buckle. The length of the complex buckle was approximately the horizontal distance of the patient's inferior fornix, and tension from the lower lid kept the external buckle in place. The 279 tyre contributed mainly to the stabilization of the complex in the inferior fornix. The inferior tarsus and orbicularis muscle together exerted a compressive force to push the complex buckle against the eyeball from outside. The 505 sponge, sutured

along the blunt side of the 279 tyre, strengthened this indentation.

The width of the complex buckle was 9 mm, and it covered the area of indentation at least 9 mm posterior to the limbus, approaching the equator of the eyeball. Thus, patients with RRD with breaks posterior to the equator may not be candidates for this procedure, because such breaks would be far from the indentation.

Gas provides a further tamponading force from inside and helps to seal the breaks.<sup>17</sup> For an average eye, 0.3 ml of gas can cover 60 degrees of the retinal surface, whereas it takes 1.2 ml of intraocular gas to cover 90 degrees of the retinal surface.<sup>17</sup> Because pure C<sub>3</sub>F<sub>8</sub> expands to 4 times its size in 3 days, we gave 1 injection of 0.4 to 0.5 mL pure C<sub>3</sub>F<sub>8</sub> in normal-sized globes to attain at least 2 clock hours of initial coverage of the retinal surface and more than

3 clock hours of final coverage of the retinal surface. In highly myopic or vitrectomized eyes, 1 injection of 0.6 to 0.7 mL pure C<sub>3</sub>F<sub>8</sub> was given.

With the aid of the buckle, our patients required only the face-down position with 5 to 10 degrees of neck flexion, rather than other less tolerable positions. After removal of the buckle, the patients remained in the face-down position for another 7 days to avoid cataract formation and to provide residual tamponade for the retina.

Transconjunctival cryopexy also is necessary to create chorioretinal adhesion around the breaks. For cryotherapy, however, the adhesive force is relatively weak in the first week, possibly because of local tissue inflammation or edema, and 7 to 10 days may be required to achieve effective tensile strength.<sup>28</sup> Alternatively, laser photocoagulation produces a bond that approaches normal adhesive tensile strength within 24 hours.<sup>17,28</sup> To secure the force of adhesion adjunctively, we performed laser retinopexy after the retina had reattached and the buckle had been removed 3 days after surgery. At this time, the retinas were well attached without anterior retinal detachment in all patients except for 3 who had persistent SRF and experienced primary failure.

All of our patients were hospitalized for at least 3 days to ensure absolute bed rest, were placed in a face-down position with 5 to 10 degrees of neck flexion, and were monitored for possible adverse events such as corneal erosion.

With short-term external buckling, RRD with inferior breaks is no longer a contraindication for pneumatic retinopexy. It is less invasive and relatively simple and may have better compliance compared with conventional scleral buckling, vitrectomy, and modified pneumatic retinopexy. It also may avoid the complications of long-term buckling, such as implant exposure, refractive change, high-order aberration, diplopia, strabismus, infection or inflammation, compromised retinal blood flow, and risk of anterior segment ischemia.<sup>11,29</sup>

In 1979, Lincoff and associates introduced a temporary balloon buckle for the treatment of RD with breaks subtending an arc of no more than 1 clock hour in

diameter.<sup>30</sup> An inflatable silicone explant is inserted through the conjunctiva and expanded beneath the retinal break for 7 to 12 days. The reported initial success rate varied from 83% to 96%, with a redetachment rate of 6.9% to 14.9%.<sup>30-35</sup> Our external buckling method shares some similarities with Lincoff and associates' temporary balloon buckle, such as temporary explant placement, a comparable success rate, and the possible adverse events of corneal erosion and elevated IOP.<sup>30,33-35</sup> The associated adverse events in this study included buckle dislocation (24.2%), cornea epithelial defects (9.1%), and elevated IOP (6.1%). These were tolerable and not related to final visual outcomes.

There are some limitations to this study. The sample size was relatively small and there was no control group. Although the face-down position may be more tolerable than neck hyperextension or downward head tilting, it is still contraindicated for patients with significant cardiopulmonary dysfunction. The temporarily placed buckle also may have shortcomings. Even if the SRF is absorbed completely, vitreous traction may persist after the removal of the external buckle. Our primary anatomic success rate at 6 months was 87.9%, with a 3.0% recurrence rate, both similar to other series.<sup>19-21</sup> Besides initial cryopexy, adjunctive laser retinopexy was performed after the retina had reattached and the buckle had been removed to reinforce the chorioretinal adhesion. It is suggested that the patients should be followed up closely during the critical period between the removal of the buckle and the formation of stable chorioretinal adhesion.

In conclusion, short-term placement of an external buckle combined with pneumatic retinopexy is a novel, effective, and well-tolerated treatment for retinal detachment with inferior retinal breaks that originally was contraindicated for pneumatic retinopexy. It had a success rate comparable with that of other existing treatment methods and was able to avoid the complications of long-term buckle implantation. Further comparative cohort studies may be necessary to compare the clinical efficacy with that of other conventional operations.

---

ALL AUTHORS HAVE COMPLETED AND SUBMITTED THE ICMJE FORM FOR DISCLOSURE OF POTENTIAL CONFLICTS OF INTEREST and the following was reported. The external buckle has been patented by Po-Kang Lin. The other authors have no financial disclosures. Involved in Design and conduct of study (H.-C.C., S.-M.L., P.-K.L.); Collection, management, analysis, and interpretation of data (H.-C.C., S.-M.L., F.-L.L., J.-H.L., C.-H.K., P.-K.L.); and Preparation, review, or approval of manuscript (H.-C.C., S.-M.L., F.-L.L., J.-H.L., C.-H.K., P.-K.L.). The authors thank Dr Chunfea A. Hsu, Southern California Endocrine Center, Pasadena, California, for the help with English editing.

---

## REFERENCES

1. D'Amico DJ. Clinical practice. Primary retinal detachment. *N Engl J Med* 2008;359(22):2346-2354.
2. Rowe JA, Erie JC, Baratz KH, et al. Retinal detachment in Olmsted County, Minnesota, 1976 through 1995. *Ophthalmology* 1999;106(1):154-159.
3. Mitry D, Charteris DG, Fleck BW, Campbell H, Singh J. The epidemiology of rhegmatogenous retinal detachment: geographical variation and clinical associations. *Br J Ophthalmol* 2010;94(6):678-684.
4. Mitry D, Charteris DG, Yorston D, et al. The epidemiology and socioeconomic associations of retinal detachment in Scotland: a two-year prospective population-based study. *Invest Ophthalmol Vis Sci* 2010;51(10):4963-4968.
5. Chou SC, Yang CH, Lee CH, et al. Characteristics of primary rhegmatogenous retinal detachment in Taiwan. *Eye (Lond)* 2007;21(8):1056-1061.

6. Sharma A, Grigoropoulos V, Williamson TH. Management of primary rhegmatogenous retinal detachment with inferior breaks. *Br J Ophthalmol* 2004;88(11):1372–1375.
7. Martinez-Castillo V, Verdugo A, Boixadera A, Garcia-Arumi J, Corcostegui B. Management of inferior breaks in pseudophakic rhegmatogenous retinal detachment with pars plana vitrectomy and air. *Arch Ophthalmol* 2005;123(8):1078–1081.
8. Alexander P, Ang A, Poulson A, Snead MP. Scleral buckling combined with vitrectomy for the management of rhegmatogenous retinal detachment associated with inferior retinal breaks. *Eye (Lond)* 2008;22(2):200–203.
9. Flindall RJ, Norton EW, Curtin VT, Gass JD. Reduction of extrusion and infection following episcleral silicone implants and cryopexy in retinal detachment surgery. *Am J Ophthalmol* 1971;71(4):835–837.
10. Birgul T, Vidic B, El-Shabrawi Y. Intrusion of an encircling buckle after retinal detachment surgery. *Am J Ophthalmol* 2003;136(5):942–944.
11. Kasbekar SA, Wong V, Young J, Stappeler T, Durnian JM. Strabismus following retinal detachment repair: a comparison between scleral buckling and vitrectomy procedures. *Eye (Lond)* 2011;25(9):1202–1206.
12. Hayashi H, Hayashi K, Nakao F, Hayashi F. Corneal shape changes after scleral buckling surgery. *Ophthalmology* 1997;104(5):831–837.
13. Yoshida A, Feke GT, Green GJ, et al. Retinal circulatory changes after scleral buckling procedures. *Am J Ophthalmol* 1983;95(2):182–188.
14. Kwartz J, Charles S, McCormack P, Jackson A, Lavin M. Anterior segment ischaemia following segmental scleral buckling. *Br J Ophthalmol* 1994;78(5):409–410.
15. Koreen L, Yoshida N, Escario P, et al. Incidence of, risk factors for, and combined mechanism of late-onset open-angle glaucoma after vitrectomy. *Retina* 2012;32(1):160–167.
16. Schaal S, Sherman MP, Barr CC, Kaplan HJ. Primary retinal detachment repair: comparison of 1-year outcomes of four surgical techniques. *Retina* 2011;31(8):1500–1504.
17. Chan CK, Lin SG, Nuthi AS, Salib DM. Pneumatic retinopexy for the repair of retinal detachments: a comprehensive review (1986–2007). *Surv Ophthalmol* 2008;53(5):443–478.
18. Tornambe PE, Hilton GF, Kelly NF, Salzano TC, Wells JW, Wendel RT. Expanded indications for pneumatic retinopexy. *Ophthalmology* 1988;95(5):597–600.
19. Chang TS, Pelzek CD, Nguyen RL, Purohit SS, Scott GR, Hay D. Inverted pneumatic retinopexy: a method of treating retinal detachments associated with inferior retinal breaks. *Ophthalmology* 2003;110(3):589–594.
20. Mansour AM. Pneumatic retinopexy for inferior retinal breaks. *Ophthalmology* 2005;112(10):1771–1776.
21. Hwang JF, Chen SN, Lin CJ. Treatment of inferior rhegmatogenous retinal detachment by pneumatic retinopexy technique. *Retina* 2011;31(2):257–261.
22. Holladay JT. Visual acuity measurements. *J Cataract Refract Surg* 2004;30(2):287–290.
23. Wickham L, Connor M, Aylward GW. Vitrectomy and gas for inferior break retinal detachments: are the results comparable to vitrectomy, gas, and scleral buckle? *Br J Ophthalmol* 2004;88(11):1376–1379.
24. Martinez-Castillo V, Boixadera A, Verdugo A, Garcia-Arumi J. Pars plana vitrectomy alone for the management of inferior breaks in pseudophakic retinal detachment without facedown position. *Ophthalmology* 2005;112(7):1222–1226.
25. Thelen U, Amler S, Osada N, Gerding H. Success rates of retinal buckling surgery. Relationship to refractive error and lens status: results from a large German case series. *Ophthalmology* 2010;117(4):785–790.
26. Clemens S, Kroll P, Stein E, Wagner W, Wriggers P. Experimental studies on the disappearance of subretinal fluid after episcleral buckling procedures without drainage. *Graefes Arch Clin Exp Ophthalmol* 1987;225(1):16–18.
27. Foster WJ, Dowla N, Joshi SY, Nikolaou M. The fluid mechanics of scleral buckling surgery for the repair of retinal detachment. *Graefes Arch Clin Exp Ophthalmol* 2010;248(1):31–36.
28. Kita M, Negi A, Kawano S, Honda Y. Photothermal, cryogenic, and diathermic effects of retinal adhesive force in vivo. *Retina* 1991;11(4):441–444.
29. Okamoto F, Yamane N, Okamoto C, Hiraoka T, Oshika T. Changes in higher-order aberrations after scleral buckling surgery for rhegmatogenous retinal detachment. *Ophthalmology* 2008;115(7):1216–1221.
30. Lincoff HA, Kreissig I, Hahn YS. A temporary balloon buckle for the treatment of small retinal detachments. *Ophthalmology* 1979;86(4):586–596.
31. Lincoff H, Kreissig I, Farber M. Results of 100 aphakic detachments treated with a temporary balloon buckle: a case against routine encircling operations. *Br J Ophthalmol* 1985;69(11):798–804.
32. Schoch LH, Olk RJ, Arribas NP, et al. The Lincoff temporary balloon buckle. *Am J Ophthalmol* 1986;101(6):646–649.
33. Binder S. Repair of retinal detachments with temporary balloon buckling. *Retina* 1986;6(4):210–214.
34. Green SN, Yarian DL, Masciulli L, Leff SR. Office repair of retinal detachment using a Lincoff temporary balloon buckle. *Ophthalmology* 1996;103(11):1804–1810.
35. Oge I, Birinci H, Havuz E, Kaman A. Lincoff temporary balloon buckle in retinal detachment surgery. *Eur J Ophthalmol* 2001;11(4):372–376.



### **Biosketch**

Hui-Chen Cheng, MD, is undergoing resident training at the Department of Ophthalmology, Taipei Veterans General Hospital, Taipei, Taiwan. She received her medical degree from National Yang-Ming University, Taipei, Taiwan and completed a medical internship at Taipei Veterans General Hospital.