A New Adjustable Macular Buckle Designed for Highly Myopic Eyes

Progressive myopia is a relatively frequent condition affecting all ocular structures, including the sclera, choroid, retina, and the vitreous. Bulb elongation and posterior staphyloma represent the hallmark of disease and can be complicated by myopic macular schisis and myopic macular hole with retinal detachment.[1]

Surgical treatment of such conditions has been lengthy debated, and many different approaches are proposed, including pneumatic retinopexy, laser treatment, scleral resection, episcleral macular buckling,[1] and pars plana vitrectomy.[2]

Purpose of present article is to introduce a novel adjustable macular buckling (AMB) device, specifically designed to improve accuracy, ease of placement, and allow customized buckling of the myopic staphyloma.

Episcleral Adjustable Macular Buckling Device

The AMB (Figures 1, A–C, and 2) is a silicone rubber (90 Shore; type A scale) radial element, consisting of a "handle" or stalk designed for meridian positioning and a "terminal plate" intended to infold the macula. The handle is $2 \times 2 \times 10$ mm with quadrangular section while the terminal plate is either quadrangular (4×4 mm) or circular (5 mm diameter) and is designed to buckle the macula. Two lateral "winglets" are placed at the opposite sides of the macular plate, to allow suture biting (Figures 2 and 3).

Surgical Technique

A limbal peritomy (180° temporal or 360°) is performed, and the superior, inferior, and lateral recti (LR) muscles are carefully isolated with 1-0 black silk bridle sutures. The LR muscle is disinserted and running double-armed 6-0 or 7-0 absorbable suture is preplaced for successive reinsertion. A 5-0 mersilene traction suture can be placed at the insertion of the LR muscle, to improve exposition of the posterior sclera.

Two double-armed 5-0 mersilene sutures are threaded through the winglets (Figures 2 and 3) of the terminal plate, previous to buckle placement. The AMB is then carefully inserted in the exposed inferotemporal quadrant, just inferior to the LR muscle and superior to the inferior oblique muscle, like a regular radial exoplant. The terminal plate is slide posterior to infold the most prominent part of the staphyloma (Figure 3) under indirect ophthalmoscope visualization. Once positioning is accurate, the radial element is secured to the sclera with a mattress 5-0 mersilene suture, just posterior to the equator. At this time, the AMB can be still withdrawn or slide further posterior along the same meridian (Figure 3).

To tension the macular element and indent the macula, the 2 double-armed 5-0 mersilene sutures threaded through the macular plate winglets must bite the sclera symmetrically distant from the meridian, where the radial element is positioned. In other words, the radial element should trace the bisector of the angle designed by the sutures. To do so, both needles of the superior 5-0 mersilene are passed underneath the lateral and superior rectus and bite the sclera anterior to the equator just nasal to the superior rectus muscle. The inferior 5-0 mersilene needles are similarly passed underneath the inferior rectus muscle and bite the sclera just nasal to the inferior rectus muscle.

Macular buckling height and minimal lateral adjustment can at this point be regulated by tying the 2 double-armed 5-0 mersilene sutures. Once macular buckling effects is judged adequate, the sutures are tied or bows can be left in place to allow further adjustment under local anesthesia in the immediate postoperative period, similarly to the adjustment of muscle sutures in strabismus surgery. Reinsertion of the LR muscle and suture of Tenon capsule and conjunctiva complete the procedure.

Selected Case Report

We report the case of a 54-year-old woman who had a residual schisis after pars plana vitrectomy (PPV), internal limiting

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Fig. 1. The AMB with its radial "handle" element and a rounded "macular plate" (**A**). Note the two winglets at the margins of the terminal plate, designed for convenient suture placement (**B**) and the rounded preshaped curvature of the handle (**C**), intended to allow a more regular radial indentation over the desired meridian.

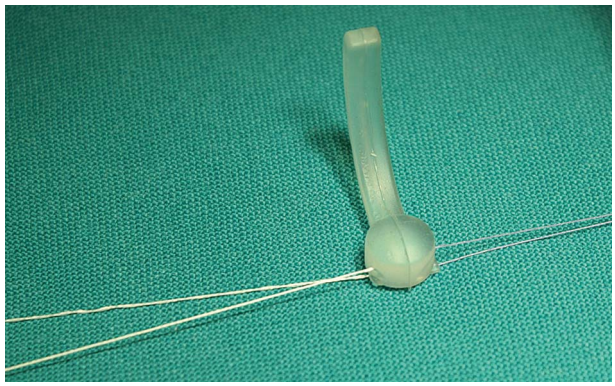

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Fig. 2. A photograph of the AMB. A suture is being prethreaded through the winglets' positioning and will be passed through the sclera at the equator after correct meridian placement.

membrane (ILM) peel, and gas tamponade for macular detachment with myopic macular schisis (Figure 4A). Vision was 20/400. Adjustable macular buckling was performed, and 3 months later, the fovea was attached with visible infolding and vision improved to 20/200 (Figure 4B).

Discussion

Bagolini and Ravalico[2] and Ando et al[3] independently proposed buckling of macular hole + regmatogenous retinal detachment (MH+RRD) in highly myopic eyes with posterior staphyloma. Although the treatment proved efficacious, surgery was challenging and required experience and skill. Many different buckle shapes have been proposed ever since, including a Y-shaped sponge, a macular "sling," and an "armored" silicone rubber buckle with an embedded wire. More than a decade later, the advent of vitrectomy[4] improved surgical results significantly and macular buckling remained confined to a residual "niche" until recently, when several authors reaffirmed its role in selected cases.[5]

Ando's buckle became the most popular design because of the relative ease of implant. Its embedded wire, in fact, allows buckling customization, shape memory, and eliminates the need for sutures on the posterior staphylomatous sclera. Drawbacks include its stiffness, limitations in the fine adjustment of buckling height, a less accurate centering, and a tendency toward reducing its effect with time. The presence of a metal wire, although embedded in silicone, also poses questions of long-term safety and medical imaging interference.

The AMB we designed does not contain a metal wire and can be easily implanted, similarly to Ando's buckle. In our hands, it produced a more regular indentation of the temporal meridian, where the radial element is secured and allowed a better customization and fine localization of macular infolding; thanks to

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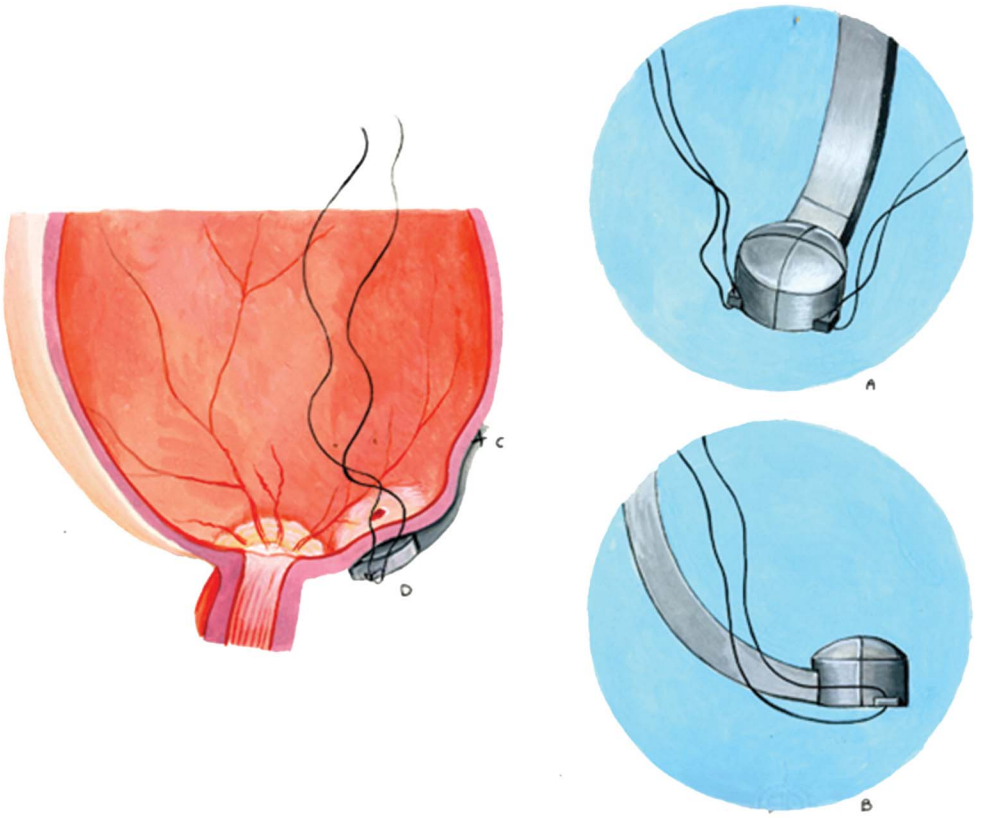

Fig. 3. Surgical positioning of the AMB. 5-0 mersilene double-armed sutures are prepositioned through lateral winglets (**A**); lateral view (**B**). Once the mattress suture through the radial element is properly positioned (**C**), the macular plate (**D**) can be tensioned in a customized fashion by passing the prepositioned winglets sutures equatorially or anterior to the equator or a bow tied for postoperative fine adjustment.

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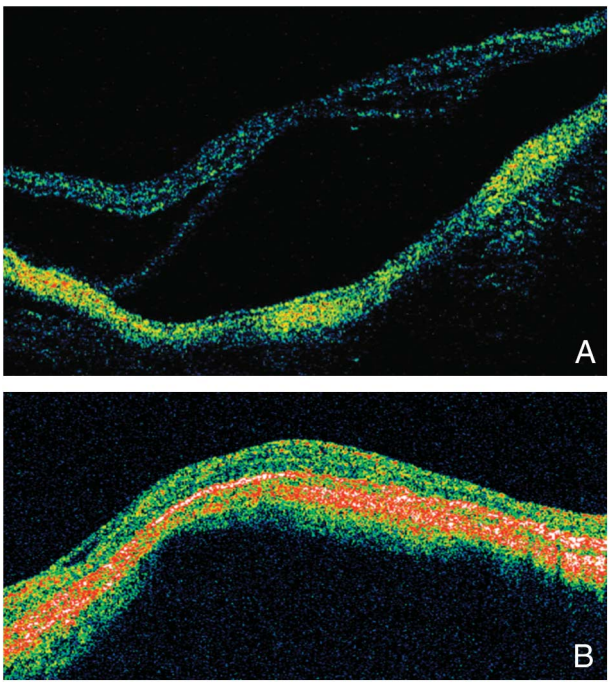

Fig. 4. **A**. The OCT shows residual foveoschisis over the staphyloma in a highly myopic patient previously operated on for PPV. **B**. The OCT shows macular infolding and a perfectly attached retina to the RPE after successful AMB placement.

the possibility of exerting adjustable posteroanterior force on the staphyloma. The sutures passed through the macular plate, in fact, bite the sclera far from the thin, staphylomatous sclera and can be safely, simply, and efficiently tensioned like "bridles" to control indentation and macular centering. The possibility of postoperative releasing or augmenting the buckling effect by simply tying temporary knots can also be valuable.

In summary, we introduce a new macular buckle, characterized by the possibility of adjusting infolding amount and localization and propose an accordingly modified surgical technique. While we acknowledge PPV as a primary procedure for most staphyloma-associated conditions, we believe that there is a residual role for buckles, mostly as a "salvage" procedure, when the staphylomatous contour prevents effective foveal tamponade contact, RPE makes long-term reattachment more difficult, or "stretch schisis" stiffens the macula, preventing complete attachment despite vitreous traction relief.

Key words: high myopia, adjustable macular buckle, macular hole, staphyloma, posterior retinal detachment, myopic macular schisis.

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