Weakened or missing zonules present a serious challenge to the cataract surgeon. Fortunately, the use of a capsular tension ring (CTR) in these cases has been shown to decrease the risk of complications. Nevertheless, although a CTR can be helpful in patients who have a moderate loss of zonular support, eyes with profound zonular compromise (or lens subluxation) may not obtain adequate stabilization or centration despite CTR placement. In 1997, Robert Osher, MD, of Cincinnati demonstrated the idea of synthetic zonules by suturing the CTR to the scleral wall with a 10–0 PROLENE suture (Ethicon Inc., Somerville, NJ). Vladimir Pfeifer, MD, of Ljubljana, Slovenia, preferred to fashion a small peripheral capsulorhexis through which a similar suture passage could be made. Although both techniques provide a solution for eyes with severe zonular insufficiency, they violate the integrity of the peripheral capsular bag and thereby risk its rupture. The modified CTR (Morcher GmbH, Stuttgart, Germany) differs from the CTR in that the former has a fixation hook that loops anteriorly into a second plane, wraps around the capsulorhexis edge, and thereby allows scleral fixation without violating the integrity of the capsular bag (Figures 1 through 3).

MODIFIED CTR TECHNIQUE
The Capsulorhexis
I usually work through a near-clear corneal incision and place a generous amount of a dispersive viscoelastic over the area of zonular dialysis to tamponade vitreous. Next, placing a cohesive viscoelastic over the crystalline lens provides a deep, noncollapsing anterior chamber. I then initiate the capsulorhexis in an area remote from the dialysis in order to make use of the stronger remaining zonules for countertraction. The capsulotomy should be large enough to allow for easy nucleus manipulation. It may be necessary to stabilize the capsular bag with a dull second instrument or with an iris retractor to complete the capsulorhexis.

The Modified CTR
Although the modified CTR may be inserted into the capsular bag at any point after the creation of the capsulorhexis, a bulky nucleus can make visualization and the placement of the device difficult. I prefer to remove the nucleus and as much cortex as possible before placing the ring. It is often necessary to stabilize the bag during phacoemulsification with iris retractors. The capsular tension segment (Morcher GmbH) designed by Ike Ahmed, MD, of Toronto can provide a broader area of temporary stabilization. Hydrodissection maximally frees the nucleus and thereby decreases zonular stress during manipulation of the nucleus. Moreover, hydrodissecting the nucleus completely into the anterior chamber greatly simplifies nuclear removal and helps eliminate zonular stress during phacoemulsification.

Figure 1. The modified CTR model 1-L can be sutured through the ciliary sulcus to the scleral wall without violating the integrity of the capsular bag.
syndrome.

subluxation due to Marfan's eye exhibited congenital lens Figure 2. Preoperatively, this

flap and then tied to itself. After suture fixation of the modified CTR, any remaining cortex may be aspirated. I then re-inflate the capsular bag with viscoelastic in preparation for IOL implantation. I prefer the single-piece AcrySof posterior chamber IOL (Alcon Laboratories, Inc., Fort Worth, TX) in these cases for its ease of insertion, low rate of posterior capsular opacification, and ability to stay well centered.

I manually remove viscoelastic either through the side-port incision or with an automated I/A handpiece. Instilling Miotoch (CIBA Vision, Duluth, GA) ensures that the pupil becomes round. After re-approaching conjunctiva over the scleral flap, I hydrate the corneal incision and ensure that it is watertight.

CONCLUSION

CTRs and modified CTRs of any model should not be used if a complete continuous capsulorhexis is not attained or if a posterior capsular tear occurs, because the expansive forces may cause the capsular bag to rupture. Surgical options in such cases include either suturing the IOL to the iris or to the scleral wall or implanting an anterior chamber IOL.

At present, only Morcher's CTR (distributed in the US by FCI Ophthalmics, Inc., M arshfield Hills, M A) has been approved for use in the US. Although the modified CTR can improve the surgical management of eyes with significant zonular weakness, it is important that the surgeon be familiar with advanced surgical techniques, because these cases represent some of the most difficult procedures that we ophthalmologists encounter.

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