Capsular tension rings (CTRs) buttress areas of zonular weakness and recruit tension from existing zonules, but these devices are not always ideal. First, inserting a CTR into the capsular bag prior to cataract extraction creates significant torsion of the capsular bag and may result in further iatrogenic zonular loss. Additionally, a CTR is contraindicated in cases of anterior and/or posterior capsular tears. Third, the CTR is unable to adequately address moderate and profound cases of zonular weakness (eg, greater than 3 clock hours), nor is it able to prevent progressive zonular loss and capsular decentration in susceptible cases. Finally, CTRs are unable to prevent capsular phimosis and fibrosis.

In an effort to address moderate-to-severe cases of zonular weakness, Robert Cionni, MD, of Cincinnati designed a modified CTR (Morcher GmbH, Stuttgart, Germany; not currently FDA-approved) that uses an additional fixation eyelet(s) for scleral suture fixation, a design that provides long-term recentration. This article examines some shortcomings of standard CTRs and how the capsular tension segment (CTS; Morcher GmbH; not currently FDA-approved) can address them.

**IMPLANTING A CTR**

Although placing a CTR prior to removing the cataractous lens may provide additional capsular support during phacoemulsification, inserting the device at this point in the procedure can be difficult and risks the further iatrogenic loss of existing zonular support, particularly in cases of dense cataracts. Miyake-Apple video analysis1 of CTR insertion before phacoemulsification demonstrated significant torque of the capsular bag and stress on the zonules as the surgeon dialed the device into position (Figure 1). Furthermore, cortical removal can be challenging despite the use of tangential stripping techniques when a CTR is in place. Surgeons must bear these issues in mind when considering the early insertion of CTRs.

The late insertion of a CTR is somewhat less traumatic and avoids the problems of cortical removal. This approach does address the need for capsular support during lens extraction but still risks the potential collapse of the capsular bag and/or complete lens subluxation. Surgeons may decide instead to use iris or capsular retractors (Figure 2), but these devices may become dislodged during phacoemulsification. Additionally, retractors do not expand the capsular equator and therefore risk both capsu-
lar tears and iatrogenic zonular trauma during phacoemulsification and cortical removal.

THE CTS

Design
I designed the CTS as a versatile and flexible device and/or implant to address the concerns regarding CTRs outlined in this article. The 90º PMMA partial ring segment has a 5-mm radius of curvature (Figure 3). Much like Dr. Cionni’s modified CTR, the CTS possesses a centrally and anteriorly positioned third eyelet designed to allow for the intraoperative placement of a retractor and/or post-phacoemulsification suture fixation (Figure 4).

Implantation
In contrast to CTR insertion, the surgeon can place the CTSatraumatically into the capsular bag over an area (or areas) of zonular weakness after creating an anterior capsulotomy and prior to performing phacoemulsification. Placing an iris retractor through the fixation eyelet achieves intraoperative fixation and stability with a minimal risk of dislodgement or a capsular tear during lens removal (Figure 5). The effect is much like the support provided by a clothes hanger to a shirt. In my experience, stripping cortex around the implant is easy. I have found that the CTS is a versatile device and that severe cases may require two or three ring segments. The surgeon may implant a standard CTR or Dr. Cionni’s modified CTR after lens removal in order to provide additional capsular support.

Although the CTS may be removed once used, the device is also designed for permanent scleral suture fixation via an ab interno or ab externo technique over an area of zonular weakness. After placing one end of a double-armed 9–0 polypropylene suture to approximate the ciliary sulcus, the surgeon passes the suture through the segment’s fixation eyelet.
eyelet (ideally, this maneuver is performed prior to the initial placement of the CTS into the eye). He then directs the other end of the suture adjacent to the first pass. While tightening the suture, the surgeon positions the segment, which buttresses the area of dialysis and thereby creates a stable capsular bag for the implantation of a posterior chamber IOL (Figure 6). If necessary, the surgeon may suture two CTS implants 180º apart for profound, generalized zonular weakness. Owing to its design, the CTS may be used in cases of anterior and/or posterior capsular tears.

CONCLUSION

CTRs are ideally placed in evacuated capsular bags and are only indicated in mild cases of zonular weakness. Moreover, a standard CTR may not provide sufficient long-term support to eyes with progressive conditions. During phacoemulsification and cortical removal, the CTS is an alternative to capsular retractors for supporting the capsule. It is also designed for scleral suture placement in cases of significant zonular weakness.

Ike K. Ahmed, M.D., FRCSC, is Assistant Professor at the University of Toronto and Clinical Assistant Professor at the University of Utah in Salt Lake City. He holds no financial interest in any of the technologies or companies mentioned herein. Dr. Ahmed may be reached at (905) 820-3937; ike.ahmed@utoronto.ca.