Complications with Capsular Tension Rings (CTR) in Patients Undergoing Phacoemulsification and PC IOL Implantation

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**Purpose:** To evaluate handling characteristics, insertion techniques, with respect to CTRs.  
**Method:** Retrospective review of 56 consecutive patients undergoing PE PCIOL and CTR implantation. Data analysed included clinical features, intraop events, complications and postop outcome. CTR was implanted after nucleus removal with injector or manual technique if CCC was incomplete.  
**Result:** Preoperative findings: myopia (5), hard cataract (11), PEX (15), post TPPV (13), sublux. cataract (9). Intraop. complications: zonular dialysis (3), CCC tear (2), PC tear (1), CTR delivery in angle (1) and deposits from injector lumen (3), distortion of capsular bag: 6. CTR was not delivered into the bag in 1 when CCC margin tear was noticed. Delivery of CTR into bag was more precise and controlled with the injector.  
**Conclusion:** Though CTRs are safe and useful when indicated, significant complications occur which can be prevented by proper maintenance of injectors and by employing proper technique.

Capsular Tension Rings (CTRs) are used to stabilize the capsular bag of the crystalline lens both during and after cataract surgery. The idea was first put forward in 1991 by Hara et al, who developed a closed silicone equator ring in rabbit eyes.1 The concept was further developed by Nagamoto and Bissen-Miyajima (1994)2 and the first CTR was implanted during cataract surgery by Witschel and Legler in 1993.3 Capsular tension rings of varying designs are now used widely throughout the world.4 6

During surgery, a CTR helps distribute stress around the entire equatorial area of the lens capsule whenever tension is placed on any section of the capsule during manipulation of the lens or removal of cortex. This stress distribution significantly reduces the likelihood of stretching or tearing the ciliary zonule.6 After surgery, a CTR helps maintain the equatorial area of the lens capsule in a fully distended circle of 360°. This minimizes the risk of decentration of the IOL and may decrease, but not fully prevent, the risk of dislocation of the capsule/ IOL complex.6 7
Pre operative indications of a CTR are a history of trauma with compromised or partially absent ciliary zonules, previous intraocular surgery, pseudo exfoliation syndrome, high myopia or congenital metabolic and endocrine disorders that affect the ciliary zonules such as Marfan syndrome, Marchesani’s syndrome, scleroderma, homocystinuria, spherophakia etc. A CTR may also prove to be helpful in cases where exact centration of the IOL may be needed after surgery to achieve a satisfactory visual result, such as with multifocal IOLs.

Standard CTRs do not necessarily recenter an already severely subluxed or dislocated lens in profound zonulopathy. Furthermore, many zonular conditions are progressive and although the CTR can provide initial support, some patients may suffer late-onset CTR dislocation. This may lead to reduced visual acuity, uveitis and cystoid macular oedema. Management in these cases involves removal of the displaced CTR and /or IOL. Even though capsular tension rings have become extremely useful in the management of patients with subluxated cataracts, significant complications can be encountered in rare cases. As the use of CTR increases, impending problems with CTRs are also on the rise. There are various reports and published series on immediate and late complications of CTRs like decentration and dislocation of the bag due to profound zonulysis or progressive zonular weakness. The purpose of our article is to evaluate the handling characteristics and insertion techniques with respect to CTRs and the various intraoperative and immediate / late complications associated with CTRs.

**MATERIALS AND METHODS**

56 patients undergoing phaco emulsification with PC IOL implantation and CTR insertion were retrospectively reviewed. All the surgeries were performed by a single surgeon. Demographic information, previous surgical details, slit-lamp and fundoscopic findings, intraocular pressure (IOP), preoperative and post operative visual acuity and refraction were evaluated. Intra operative events and complications with respect to CTRs were also analysed. CTR was implanted after nucleus removal in all the cases either with a CTR injector or using manual technique.

**RESULTS AND DISCUSSION**

Out of the 56 consecutive patients who underwent phacoemulsification with PC IOL and CTR implantation, 30 were females and 26 males. The mean age was 64.1 with a range of 55 to 76 years. 5 patients were myopic, 11 with hard cataract and 15 had pseudoexfoliation, 13 patients had history of trans pars plana vitrectomy and subluxation was present in 9 eyes.
Intra operative zonular dialysis was encountered in 3 of our patients. CTR is effective in providing improved intra operative centration in mild generalized zonular weakness or localized zonular dialysis. Early follow up of CTR use in loose zonules found excellent IOL centration 2 to 11 months post operatively in the study by Gimbel et al. Another study of 21 eyes with zonular dialysis of \( \leq \) 150 degrees found a 90.5% success rate, post operatively, at a mean follow up of \(<\) 1 year, all eyes with a CTR placed had a well centred IOL within the bag. In a comparative study of CTR in pseudoexfoliation eyes, the use of a CTR reduced the risk of intra operative zonular separation.

However there is considerable debate as to the limits of CTR use in more profound zonulopathy where the Cionni modified variant or the Ahmed CTS - both of which can be suture fixed to the sclera- have been proposed as more appropriate devices.

In the early cases, decentration was likely due to in appropriate selection of a capsular tension device at the time of surgery. (i.e, standard CTR insufficient for the degree of zonular stability) or further iatrogenic trauma to existing zonules. Late onset spontaneous post operative capsular bag decentration is a sequela of progressive zonular loss due to underlying pathology, particularly a concern in pseudo exfoliation syndrome.

2 patients had rhexis margin tears. CTR insertion in one of the above patients (who had angle closure glaucoma) exhibited strange twists and turns in the CTR segment instead of the CTR being smoothly delivered into the capsular fornix. The emerging CTR segment instead of becoming parallel to the capsular fornix did not come out smoothly and the trailing eyelet got stuck to the plunger hook. The sudden release of the trailing loop impeached on the rhexis margin resulting in rhexis tear. The presence of CTR in the capsular bag in this scenario is acceptable. However a CTR is contraindicated in situations where the capsular bag is already torn.

In the second case (with rhexis tear) also, CTR release was not smooth and excessive stretching of the capsular bag put great stress to the capsulorhexis margin ultimately leading to a subincisional discontinuity of the rhexis margin. A 3 piece hydrophobic IOL was implanted in the sulcus in this case.

Ciliary sulcus placement of a posterior chamber IOL is a potential method of avoiding late spontaneous dislocation of intraocular lens especially in patients with pseudo exfoliation. Because of the high frequency of intra operative complications with in-the-bag placement, the routine use of sulcus-placed IOL's in eyes with PEX has been previously advocated. Long - term visual outcomes with foldable IOL's placed in the ciliary sulcus have been shown to be comparable to in-the-bag placement; however, pupillary capture and increased inflammation caused by iris touch are significantly greater in sulcus fixated IOL's.
Distortion of the capsular bag during CTR insertion was noticed in 6 patients. In another patient with congenital cataract where CTR insertion was attempted by the manual hand over hand technique there was a premature release of the CTR while trying to release the trailing haptic into the capsular bag using a sinskey hook. So the CTR was inadvertently released into the anterior chamber. However we were able to relocate the CTR in the capsular bag after careful manipulations. These manipulations may be hazardous and there is always a chance of damage to the anterior chamber angle structures. This problem perhaps could have been avoided with the use of a CTR injector. Delivering of CTR into bag was more precise and controlled with the injector.

Another complication which we encountered during the use of CTR was specific to the injector. As the CTR was injected into the capsular bag some extraneous material was noticed around the trailing eyelet which perhaps was debris accumulated from residual viscoelastic agent and blood derivatives.
The debris was inadvertently injected into the capsular bag along with the trailing eyelet which was flushed out by gentle irrigation with the irrigation cannula of the bimanual I/A. Presence of debris could be a potential cause of toxic anterior segment syndrome (TASS) if proper care is not taken in cleaning the injectors. In another case, since we were aware of the possibilities of debris, it was detected as soon as it emerged from the injector tip and hence the CTR along with the debris were withdrawn from the eye.

In view of the disasters experienced with CTRs, the following guidelines should be kept in mind: careful pre-insertion inspection of the device under the microscope, proper maintenance of the injector devices and considering the use of disposable injectors. Though CTRs are safe and useful when indicated, significant complications occur which can be prevented by proper maintenance of injector and by employing proper technique.

REFERENCES


