CAPSULAR TENSION RING IN SURGICAL MANAGEMENT OF THE LENS WITH ZONULAR DEHISCENCE

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ABSTRACT:

Objective: The study objective is to review the management of zonular dehiscence during cataract surgery and intraocular lens implantation. Pseudoexfoliation syndrome and traumatic lens displacement are the most common causes of zonular weakness. Phacoemulsification is usually the procedure of choice for patients with zonular dehiscence.

Method: A total of 8 patients (12 eyes) scheduled for phacoemulsification and intraocular lens implantation received capsular tension rings in Clinic of Ophthalmology Timișoara, from 2004-2009. Two clinical cases with catarctous subluxated lenses and zonular loss are presented.

Conclusions: The capsular tension ring was implanted successfully in all eyes. After a mean follow-up of 6 weeks and 12 month we did not notice signs of intraocular lens decentration or extrusion of the ring through the bag in all 12 cases. Capsular tension rings reduce the risk of intra-operative and postoperative complications and improve patient outcomes.

Keywords: capsular tension ring, zonular fragility, cataract surgery

INTRODUCTION

Endocapsular rings were originally conceived in Japan in 1990s. The capsular tension ring (CTR) was originally introduced to reinforce the zonule in eyes with zonular dehiscence and to prevent capsular phimosis in eyes at risk for postoperative capsular shrinkage.[1] Since then, other designs and applications have been developed and described.

Pseudoexfoliation and traumatic lens displacement are the most common causes of zonular weakness. The decision to use a CTR is typically made during the preoperative visit. Careful history-taking may reveal inherited causes for zonular weakness and hence lens instability, including Marfan’s syndrome[3], homocystinuria, Weill-Marchesani syndrome, microspherophakia[4], retinitis pigmentosa[5] and lens coloboma.[6] A hypermature cataract, post-vitrectomized eye and intraocular neoplasms are other causes of zonular weakness.[7]

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Other possible applications include the prevention of postoperative shrinkage of the anterior capsular opening as a result of fibrosis (capsulorhexis phimosis, capsule contraction syndrome) and, hopefully, the inhibition of posterior capsule opacification due to cell proliferation and migration.[8][9][10][11]

The following is a summary of the function of CTR:

- expansion of the capsular equator
- buttress areas of weak zonules
- recruit and redistribute tension from existing zonules
- re-center a mildly subluxed capsular bag
- place tension on the posterior capsule to decrease incidence of posterior capsule opacification (PCO).

Endocapsular ring was initially designed to inhibit the proliferation of equatorial epithelial cells. Capsular tension rings (CTRs) are polymethyl methacrylate (PMMA) intraocular implantation devices.[13] The original CTR was introduced into the market by Morcher. Since 1993 similar products have been marketed by a number of other manufacturers. (fig.1)

Modified CTRs with shields can be used in eyes with iris coloboma. A CTR with loops is intended for scleral fixation. [2] The modifications, all introduced by Morcher, include models with integrated iris shields of 90 and 60 degrees (types L, G and 50 C) (fig.2)[16]

When the zonular weakness is extensive and the lens is severely subluxed, the standard CTR will not be able to provide adequate centration of the capsular bag.

In 1998, Robert Cionni, M.D., developed the modified-CTR. This implant provides a solution to extensive and/or progressive zonular damage by allowing the surgeon to anchor the capsular bag to the eye wall.

The Cionni modified-CTR is an open-ring designed with one (model 1-C) (fig.3) or two (model 2-L) fixation eyelets attached to the central ring.

The capsular tension segment (CTS), designed by Ike Ahmed, M.D., in 2002 and manufactured by Morcher GmbH (Fig.4) is also intended for zonular dehiscence. It is designed for cases requiring intraoperative support for significant zonular weakness, or for patients in need of long-term postoperative centration of an IOL within the capsular bag. This partial PMMA ring segment is 120° of arc length with a radius of curvature of 5 mm and, like the modified-CTR, also possesses an anteriorly positioned fixation eyelet.

**Fig. 1** – Opened PMMA endocapsular ring (Morcher-Germany)

**Fig. 2d**

**Fig. 2a**
**Fig. 2b**
**Fig. 2c**

**Fig. 2** - These rings serve as coloboma diaphragms and stabilise capsular bag at the same time: a-type 96G for colobomas of 90 degrees; b-type 96L for colobomas of 60 degrees; c-type 50C for aniridia, d-type 50C for aniridia – intraoperator images. For this type of CTR two rings are implanted and rotated to form a complete diaphragm.
TECHNIQUE

Phacoemulsification is usually the procedure of choice for patients with zonular dehiscence. Capsular tension rings reduce the risk of intra-operative and postoperative complications and improve patient outcomes. In cases of severe zonular dialysis, the entire lens is usually removed, and either an IOL is implanted in the anterior chamber or a posterior chamber lens is fixated to the sclera.

A total of 8 patients (12 eyes) scheduled for phacoemulsification and IOL implantation received CTRs in Clinic of Ophthalmology Timisoara, from 2004-2009.

5 eyes had a traumatic dehiscence and cataractous subluxated lenses, 4 eyes had high myopia, 2 eyes had pseudoexfoliation, and 1 eye had aniridia and congenital cataract.

In all cases we performed preoperative assessment of extent of zonular weakness. With the eye maximally dilated, the lens was examined using the slit-lamp. It was noted: lens phacodonesis or iridodonesis. If any question of loss of zonular integrity exists on the basis of slit lamp evaluation, the zonules must be evaluated gonioscopically.

Before inserting any CTR, the capsular bag should be inflated with a dispersive viscoelastic solution. Dispersive viscoelastics such as chondroitin sulfate maintain capsular bag expansion while the CTR is manipulated. Cohesive viscoelastics made from sodium hyaluronate can be inadvertently extruded during implantation.

A large capsulorrhexis (at least 5.5 mm in diameter) is made to facilitate removal of nuclear fragments with minimal stress on the zonules. Capsulorrhexis should be continuous and well defined. Start capsulorrhexis away from zonular dehiscence area.

In 11 cases it was used opened PMMA endocapsular ring (Morcher type 14 TM- Germany) and in 1 case Morcher ring modification – type 50C for aniridia. CTRs can be inserted with forceps or injectors through the tunnel or paracentesis.

The timing of CTR implantation varies depending on the individual clinical case. The objective is to place the CTR so that it provides the best stability of the lens capsule diaphragm.

In some cases, the CTR should be placed immediately after the capsulorrhexis is made. In others, it is not needed until cortical removal or immediately before IOL insertion.

In all 12 cases the CTRs were placed before phacoemulsification, after the capsulorrhexis.

The rings come in various sizes: the 12.3/10.0 mm diameter ring (Morcher type 14TM) and the 12.0/10.0 mm diameter ring (Ophtec type PC 275 TM) are mostly used for routine cases. The selection of CTR size is based on capsular bag dimensions. A larger capsular bag usually requires a larger ring. The size of the capsular bag positively correlates with the globe’s axial length. The corneal diameter is also an indicator of capsular bag size. On the basis of this information, white-to-white corneal measurement and axial measurements can be used as a guide to CTR sizing, although many surgeons advocate routinely using larger sizes to ensure adequate overlap of end terminals, especially in myopic eyes. In the cases of high myopia, 14.5/12.0 mm diameter rings (Morcher type 14A TM) are preferred.

We present two significant cases from the 12 patients with cataractous subluxated lenses and zonular dialysis.

The first case is a 60 years old man who preoperatively presented a traumatic cataract and superotemporal zonular dialysis following a blunt injury that occurred 10 years ago. The patient presented with recent visual...
deterioration due to the cataract. His visual acuity (VA) was 0.04. After a central capsulorrhexis we expanded the capsular bag with viscoelastic material, and the CTR was inserted (Morcher type 14 TM- Germany) through the side port with the forceps. After phacoemulsification it was implanted a IOL in the capsular bag. The patient’s preoperative VA (0.04) improved to 0.6 after surgery. At 12 month follow-up, the lens was central and stable.

The second case is a 57-year old woman with cataract, pseudoexfoliation and zonular dialysis which was detected superonasal. Her visual acuity (VA) was 0.02. Macular hard drusen and nonproliferative diabetic retinopathy was also observed. A CTR was inserted with a forceps through the paracentesis into the area with the most weaker zonular area and rotated clockwise. Stable lens fixation facilitated removal of the lens material with phacoemulsification. A IOL AcrySof Natural was implanted in the capsular bag. The patient’s preoperative VA (0.02) improved to 0.1 after surgery. At 12 month follow-up, the lens was central and stable. The CTR was implanted successfully in all eyes. After a mean follow-up of 6 weeks and 12 month we did not notice signs of IOL decentration or extrusion of the ring through the bag in any of the 12 cases.

**CONCLUSION**

Cataract surgery has transformed over the last 15 years from large-incision lensectomy to sutureless small-incision phacoemulsification. Capsular support devices and understanding of zonular behavior and pathology likewise have improved. Capsular tension devices reduce the risk of intra-operative and postoperative complications and improve patient outcomes. When faced with a case of suspected or confirmed zonular weakness, capsular tension devices should be used in order to ensure safe removal of the crystalline lens as well as adequate and stable placement of the IOL for long term centration and stability. In summary the CTR is an alternative to restore centration and stability of the capsular bag of subluxated lenses. CTR is relatively easy to implant and may be used to restore the round contour of the capsular bag and maintain even tension over the lens equator.

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