# Current Concepts in the Management of Subluxated Lens- An overview

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Management of subluxated lens poses a great challenge to the surgeon planning to perform phacoemulsification with PCIOL in the bag, as each step of the surgical procedure may complicate the situation and every case may require different surgical technique. The different surgical strategy depends on the extent of subluxation, position of subluxation and presence or absence of vitreous prolapse.

The adoption of new devices (various type of endocapsular rings) and techniques that minimize the stress on compromised zonules have gained acceptance over the conventional approaches i.e intracapsular cataract extraction or pars plana vitrectomy/lensectomy.

## Some important anatomical facts related to lens

- Lens is suspended in its anatomic position by ciliary zonule s(suspensory ligament of Zinn). These zonules are inserted till 1.5mm anterior and 1mm posterior to equator.
- Mean lens diameter is 9.72±0.31mm with a central zone(6.83±0.35mm) free of zonular insertion. This diameter (i.e central zone free of zonules) remains constant irrespective of the age and diameter of lens.
- It has been shown that the lens capsule displays considerable elasticity. The circumference of an intact capsulorhexis may expand upto 62% before a radial tear occurs and capsular elasticity does not seem to be related to the age.
- A radial tear rarely extends beyond the equator, provided that the zonules situated above and adjacent to tear remain intact.

### Etiology:

Subluxation of lens may be congenital or acquired. Congenital subluxation of lens can occur as an isolated anomaly or associated with heritable disorders (like Marfan's, Weil- Marchesani, homocystinuria). Acquired subluxation of lens may occur due to hypermaturity of cataract, trauma, pseudoexfoliation, high myopia, previous scleral buckling surgery and staphylomas.

### Preoperative evaluation:

Detailed ocular examination should be done. Both near and distant BCVA should be determined, keeping in mind that the patient may best see with an aphakic correction if the lens is markedly subluxated. The exact degree of zonular loss, location of defect and presence or absence of vitreous in the anterior chamber should be noted. Ultrasound biomicroscopy and anterior segment OCT, are especially useful for zonular and angle assessment in patients where the pupil fails to dilate. Gonioscopy is performed to note

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any developmental defects, pseudoexfoliative material and deformities secondary to trauma or as a sequlae to subluxation. The fundus examination is done to look for lattice degeneration, cyclitic membranes, retinal detachment or posttraumatic pathology. B-scan ultrasonography is indicated in opaque ocular media.

Besides the routine systemic examination, conscious efforts are directed towards detection of any cardiovascular abnormalities especially in Marfan's syndrome and Homocystinuria.

**Indications for surgery:**

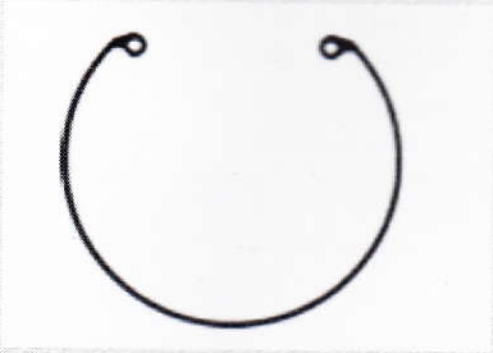
1. In younger children if there is significant or progressive dislocation or if amblyopia cannot be effectively treated by conventional means such as glasses, contact lens, and/or patching.
2. For older children and adults, if poor visual acuity is attributed to subluxated lens and is not amenable to spectacle correction, or if the lens is threatening to dislocate anteriorly or posteriorly.
3. Lens induced uveitis.
4. Significant cataract.
5. Lens induced glaucoma not controlled by medication

**OPERATIVE PROCEDURE:-**

Depending on the degree of subluxation the surgical procedure is chosen:-

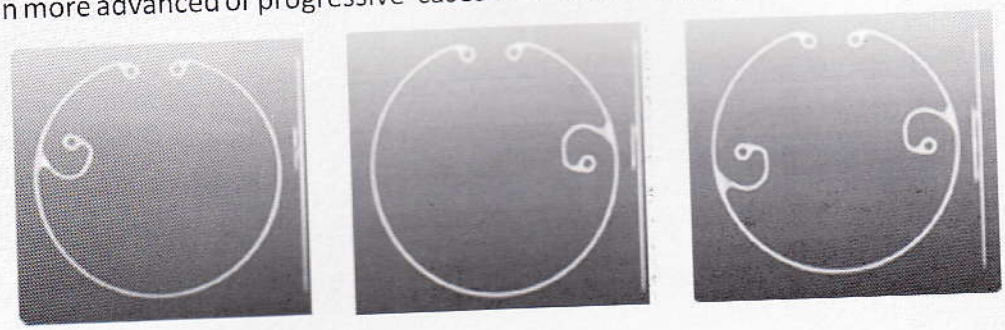
| Degree of Zonular dehiscense | Procedure chosen |
|---|---|
| upto 3'o clock | CTR with IOL implantation |
| >3 to 6'o clock | Modified CTR with single loop |
| >6 to <9'o clock | Modified CTR with double loop |
| If 9 or >9'o clock/Generalised weakness of zonules | ICCE with scleral fixated IOL/Iris fixated IOL/ACIOL |

In 1991, the CTR (capsular tension ring) was introduced by Dr Hara and subsequent studies demonstrated that CTR could provide both intra-operative and post-operative stabilization of capsular bag and IOL. These PMMA rings can be inserted anytime after the capsulorrhexis has been completed. CTRs are indicated in cases of small localized zonular dialysis of less than 3-4 clock hours.



Standard capsular tension ring

The modified CTR(MCTR), designed by Dr Robert Cionni, incorporates a unique fixation hook to provide scleral fixation without violating the integrity of the capsular bag. Depending on the extent of subluxation single or double loop models can be chose. The MCTR provides a good centration of capsular bag and are indicated in more advanced or progressive cases of zonular instability



Various types of Cionni's ring

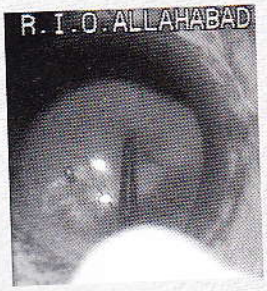
In 2002, Iqbal Ike Ahmed, MD, designed partial polymethylmethacrylate ring segments with 120º of arc length and a 5-mm radius of curvature. Like the Cionni CTR, Ahmed CTS have an anteriorly positioned eyelet for suturing to the sclera. The advantages of the CTS compared with the CTR are that the former can be implanted without a dialing technique, which minimizes trauma to an already compromised zonular apparatus. CTSs can be placed after the capsulorhexis and before cataract removal, and they can be slid into the area of greatest zonular weakness. CTSs can be used in cases of a discontinuous capsulorhexis, anterior capsular tears, or posterior capsular rents

Capsular tension segment

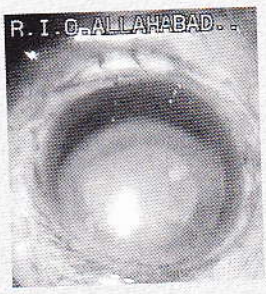


**Operative Technique:**

Peribulbar anaesthesia is preferred. Incision should be away from the site of zonular dialysis & smallest possible to reduce stress on the existing zonules and minimize fluid egress through the incision and prevent anterior chamber collapse. After intial incision a generous amount of highly molecular weight viscoelastic is placed over the area of zonular dialysis to help tamponade the vitreous and to maintain a deep non collapsing AC. Capsulorrhexis in subluxated cataract may severly test the skill of the surgeon. Staining with 0.06 % tryphan blue dye gives better visualisation of capsule during rhexis. Initial relaxing capsulotomy is difficult because of lack of tractional forces. It is advisable to begin the capsulorrhexis where zonules are intact and the anterior capsule offers sufficient resistance. Capsulorrehxis forceps is preferred over the capsulotomy needle. A 5.5-6 mm of capsulorrhexis is usually adequate.




Initiation of capsulorrhexis

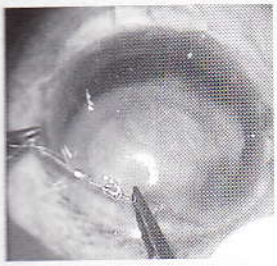



Capsulorrhexis completed

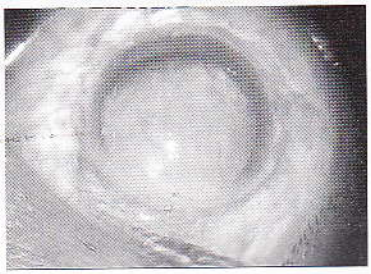
CTR/MCTR can be inserted into the capsular bag at any point after the capsulorrhexis; however the bulk of the nucleus can make visualization and placement of the CTR difficult but it is preferable to insert the CTR after capsulorrhexis and a good hydroprocedure as it reduces intra-operative herniation of vitreous in AC. The CTR is inserted using forceps or a specially designed injector.

**Insertion before nuclear extraction**

In this case a space is created between the peripheral capsular bag and remaining lenticular material with viscoelastic so as to prevent entrapment of cortex under the CTR. If the CTR is placed before phacoemulsification, a "safety-suture" (10.0 Prolene) is looped through the leading eyelet. This suture is left trailing out of the incision and can be used to retrieve the CTR in the event of a posterior capsular rent or if the CTR is difficult toplace.



Insertion of CTR



Centration of lens after CTR insertion

**Fixation of Cionni's ring:-** Steps in scleral fixation of cionni's ring is shown below in various photographs

Fig. 1

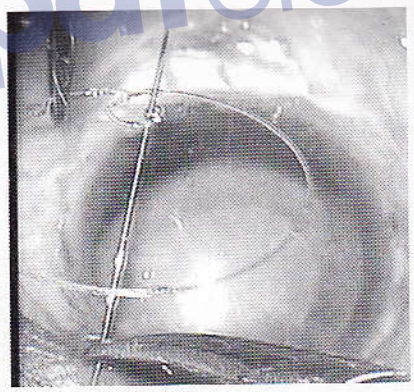


Fig. 2

Fig. 3

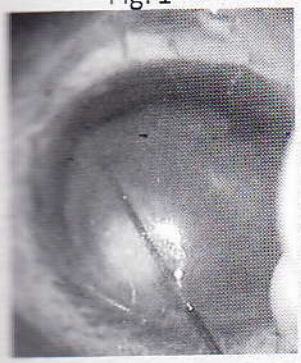


Fig. 4

Fig. 5

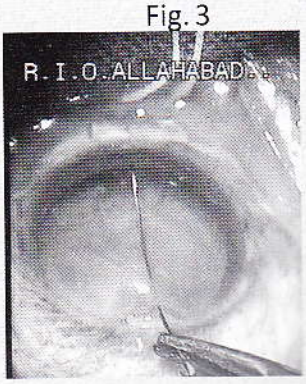



Fig. 6

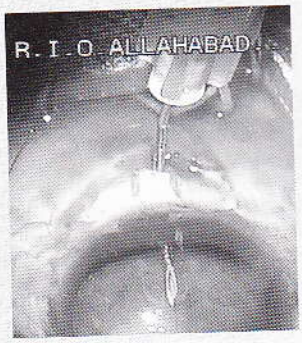



Fig. 7


Fig. 8


Fig. 9


Fig 10

***Fig.1-*** *Partial thickness scleral flap created at point of maxmium subluxation*

***Fig.2-*** *One end of double armed straight needle 10-0 polypropylene suture passed through fixation eyelet.*

***Fig.3-*** *Cionnis ring is inserted in the capsular bag.*

***Fig.4-****Cionnis ring dialled horizontally using sinskey hook.*

***Fig.5-****Fixation eyelet is positioned at point of maximum subluxation.*

***Fig.6-****Needle of the double armed 10-0 polyproplyene is passed through the main incision towards fixation site.*

***Fig.7-*** *Bent curved 26- gauge needle is introduced 1.5 mm from the limbus through scleral bed into the posterior chamber under the iris.*

***Fig.8-*** *Needle of 10-0 polypropylene suture is fed into the barrel of 26-gauge needle.*

***Fig.9-*** *Fed 26- gauge needle containing needle of 10-0 suture is then retracted through the sclera.*

***Fig.10-****Similar technique is applied to other end of the double armed 10-0 polypropylene suture and then anchoring knot is placed and Suture knot is buried in scleral bed and covered with scleral flap and conjunctiva by 10-0 monofilament suture.*

**Insertion after nuclear extraction**

Once capsulorrhexis has been completed, if one plans to extract the nucleus prior to capsular tension ring implantation, if there is moderate subluxation, the capsular bag should be stabilized with iris retractors placed through limbal stab incisions.

Stabilisation of capsular bag with iris retractor

Phacoemulsification after stabilising capsular bag with iris retractor

Hydrodissection is then performed gently, yet thoroughly, to maximally free the nucleus and thereby decrease zonular stress during manipulation of the nucleus. Phacoemulsification should be performed using low vacuum and aspiration settings in order to keep the bottle height and flow rate at a minimum. Chop techniques are preferred for the dense nuclei to minimize zonular stress during phacoemulsification. Cortical viscodissection prior to aspiration will also limit the stress on remaining zonules. The cortex should be stripped along a vector tangential to the capsular bag periphery to decrease the risk of further damaging the zonules. The cortical entrapment can be prevented, by injecting the viscoelastic just under the surface of the residual anterior capsular rim before inserting the CTR or MCTR. This will create a space for the ring and dissect the residual cortex away from the peripheral capsule. Once the CTR/MCTR has been placed appropriately, the posterior chamber intraocular lens (IOL) is inserted in the bag. It is easier to inject a foldable IOL in comparison to a PMMA lens but either can be used. Hydrophobic acrylic lenses should be preferred as these lenses are associated with less anterior capsular fibrosis compared to silicon lenses. Three piece lens design with broad stiff PMMA haptic are considered better as they exert centrifugal tension against capsular contraction compared to soft pliable haptics of single piece lenses, thereby proving good stability and centration of IOL. It is safer to place the IOL haptics in the meridian of zonular disinsertion. Vitreous presents at any time during the procedure, it should be completely removed from the anterior chamber. Kenalog (Alcon) (triamcinolone suspension) can be used to identify vitreous in the anterior chamber

**Complications:**

Intra-operative complications include posterior capsule rupture, nucleus drop, CTR drop with the bag, and IOL drop. In addition there are usual complications encountered during lens extraction. Glaucoma, iritis, hyphaema, delayed IOL subluxation or decentration , capsular phimosis, capsulorrehxis contraction anterior capsular fibrosis, vitreous haemorrhage, retinal detachment and macular edema may be encountered postoperatively.

**Contraindications of CTR/MCTR:**

- Complete continuous capsulorrhexis is not attained
- Posterior capsular tear occurs since the expansile forces may cause the capsular bag to rupture.
- Extensive generalized zonular weakness.
- MCTR is not to be used in patients with scleral disorders.

In conclusion, with the use various types of endocapsular ring, it is now possible to save and re-centre the capsular bag, and implant a PCIOL within it. However, this requires a highly skilled surgeon and cannot always be completed. In cases where there is extensive subluxation (9 o'clock hrs or more), intraoperative extension of zonular dialysis, rupture of capsular bag, retropupillary fixation of iris claw lens can be done, the discussion of which is beyond the scope of this article.

Retropupillary fixated iris claw lens

**Key points to remember:-**

- Make the corneal incision in the meridian where the zonules are intact.
- For better visualisation of capsule stain with 0.06% tryphan blue dye.
- Make a large rhexis, starting at where zonules are intact.
- Do gentle hydroprocedure.
- Minimal rotation of nucleus to minimize zonular stress.
- During phacoemulsification decrease vaccum, flow rate and irrigation level to prevent undu turbulence in the AC and zonular disturbance.
- Use stop & chop or direct chop for minimal manipulation of the zonules.
- Place the IOL in the bag and avoid dialing the lens.
- Hydrophobic acrylic lenses with three piece lens design having broad stiff PMMA haptics a considered better.

**References:-**


1.Hara T, Hara T, Yamada Y. "Equator ring" for maintenance of the completely circular contour of the Capsular b equator after cataract removal. *Ophthalmic Surg* 1991:22:358-9.

2. Nagamoto T, Bissen-Miyajima H. A ring to support the capsular bag after continuous curvilinear capsulorhexis *Cataract Refract Surg.* 1994;20:417-20.

3.Gimbel HV, Sun R, Heston JP. Management of Zonular dialysis in phacoemulsification and IOP implantation us the capsular tension ring. *Ophthalmic Surg Lasers* 1997;28:273-81.

4.Menapace R, Findl O, Georgopoulous M, et al. The capsular tension ring: designs,applications, and techniques *Cataract Refract Surg.* 2000;898-912.

5.Bayraktar S, Altan T, Kucuksumer Y, Yilmaz OF. Capsular tension ring implantation after Capsulorhexis phacoemulsification of cataracts associated with pseudoexfoliation syndrome: intraoperative complications a early postoperative findings. *J Cataract Refract Surg.* 2001;27:1620-8.

6.Jacob S, Agarwal A, Agarwal A, et al. Efficacy of a capsular tension ring for phacoemulsification in eyes with Zonu dialysis. *J Cataract Refract Surg.*2003;29:315-21.

7.Bayraktar S, Altan T, Kucuksumer Y, Yilmaz OF. Capsular tension ring implantation after Capsulorhexis phacoemulsification of cataracts associated with pseudoexfoliation syndrome. Intraoperative complications a early postoperative findings. *J Cataract Refract Surg.* 2001;27;1620-8.

8.Bopp S, Lucke K. Chronic cystoid macular edema in an eye with a capsule defect and posteriorly dislocat capsular tension ring. *J Cataract Refract Surg.* 2003;29:603-8.

9. Ahmed IK, Crandall AS. Ab externo fixation of Cionni modified capsular tension ring. J Cataract Refract S 2001;97:977-81.

10. Praveen MR, Vasavada AR, Singh A. Phacoemulsification in subluxated cataract. Ind J Ophthal 2003;51:14754.

11. Cionni RJ, Watanabe TM. Congenitalsubluxation of the crystalline lens and the surgical treatment. In: Catar Surgery in Complicated Cases. Buratto L, Osher RH, Masket S. (Eds).Thorofare, Slack Inc, 2000,15-22.

12. Santoro S, Carmela S, Cascella MC, et al. Subluxated lens: phacoemulsification with iris hook. J Cataract Ref Surg 2003;29:2269-73.

13. Chang DF. Capsular tension rings versus capsular retractors. Cataract Refract Surg Today 2004 Jan, 38-41.

14. Dieticin TS, Jacobi PC, Konen W, et al. Complications of endocapsular tension ring implanted in child w Marfan's syndrome. J Cataract Refract Surg 2000;26:937-40.

15. Bahar I, Kaiserman I, Rootman D. Cionni endocapsular ring implantation in Marfan's syndrome. Br J Ophthalmol 20

16. Hara T, Hara T, Hara T. Preventing posterior capsule opacification with an endocapsular equator ring in yo human eye. Arch Ophthalmol 2007,125:483-86