Prevention, Management of Subluxated Crystalline Lenses and IOLs

Glued endocapsular ring, glued IOL, and IOL scaffold techniques may address these issues.

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In cataract surgery, avoiding subluxation or enlargement of an existing subluxation of the crystalline lens is of prime importance. Similarly, intra- or postoperative subluxation of an IOL is a complication that all surgeons wish to avoid. Basic principles in pre- and intraoperative planning can help greatly to minimize the risk of these events and to manage them if they occur.

Preoperatively, factors that can predispose a patient to intraoperative subluxation should be evaluated and dealt with appropriately. These include conditions that convey zonular weakness, such as pseudoexfoliation, trauma, Marfan syndrome, ectopia lentis, hypermature cataract, high myopia, megalophthalmos, postvitrectomy status, and any other cause of preoperative phacodonesis. Additionally, any cataract that is expected to entail difficult and complicated surgery can lead to an increased risk of intraoperative subluxation secondary to surgical trauma.

The key is to be prepared in such cases and take all precautions to avoid subluxation, including creating the rhexis carefully, performing maneuvers within the eye gently, avoiding intracapsular procedures that can place stress on the zonules, and taking care to avoid sudden shallowing of the anterior chamber during maneuvers such as removing the phaco probe. IOL implantation should be done carefully without exerting stress on the zonules.

During surgery, it is important to watch for zonular dialysis so that appropriate corrective action can be taken at the earliest sign. Subluxated cataracts are a challenge at every step, from rhexis construction to IOL implantation. Successful surgical management of a subluxated cataract requires knowledge of the basic tenets to be followed during surgery.

**SURGICAL STRATEGIES**

An endocapsular ring may be implanted in eyes in which zonular weakness is likely to be present, even if frank dialysis has not yet occurred. The endocapsular ring expands and stabilizes the capsular bag during cataract surgery. It creates centrifugal forces that result in redistribution from stronger to weaker areas. The endocapsular ring also makes the capsule taut and gives counter-traction to all traction maneuvers. The surgeon may opt to place capsular hooks initially to stabilize the bag and then implant the endocapsular ring after cortex aspiration.

If, despite these precautions, subluxation does occur, it should be managed according to the degree of zonular dialysis. Smaller subluxations (up to 3 or 4 clock hours) can be managed by inserting an endocapsular ring. Larger subluxations require scleral anchoring of the capsular bag and its contents; we prefer to do this through the use of a glued endocapsular ring. Extremely large subluxations with dangling nuclei are often best managed with removal of the entire bag. Progressive forms of subluxation require either two endocapsular rings fixed 180° apart or lensectomy with implantation of a glued IOL.

**ENDOCAPSULAR RING**

If the surgeon has decided to place the IOL in the bag, surgery proceeds accordingly. Anterior vitrectomy is performed first in the event of prolapsed vitreous. Next, the capsulorrhexis is constructed, which is always challenging in subluxated cataracts because the lax capsule does not offer adequate counter-traction. The surgeon should ensure that the rhexis is as central as possible. Care should be taken to not tear too close to the capsular fornix and to have an adequate anterior capsular rim all around.

The rhexis should be started in a direction toward the dialysis, avoiding additional stress on the zonules. If this is difficult with the cystotome, the rhexis may be...
continued with microrhexis forceps. The next step is to perform good cortical cleaving hydrodissection, making sure this is done gently to avoid stress to the zonules. The surgeon must then determine which type of ring to implant. In cases with small subluxation, we prefer to insert a normal endocapsular ring to provide countertraction for all maneuvers and prevent further extension of the zonular dialysis.

**GLUED ENDOCAPSULAR RING OR SEGMENT**

If the extent of the zonular dialysis is greater than 3 clock hours, we prefer to implant a glued endocapsular ring (Epsilon) designed by Soosan Jacob, MS, FRCS, DNB. This ring is made of a single piece of polyvinylidene fluoride (PVDF) with three contiguous parts: a ring portion, a rhexis-engaging portion, and a haptic (Figure 1). The ring portion has two arms that are inserted under the rhexis to lie within the capsular fornix. The engaging mechanism has Malyugin ring-like double scrolls, which engage the rim of the rhexis between the scrolls. The haptic is a peripheral extension of the device, which is exteriorized through a 20-gauge sclerotomies made under a scleral flap in the area of dialysis. Excess length is trimmed, and the haptic is tucked into an oblique (coat hanger) intrascleral Scharioth tunnel made at the edge of the scleral flap with a 26-gauge needle. Once the bag is anchored in position, the surgeon can proceed with phacoemulsification, cortex aspiration, and in-the-bag IOL placement. At the end of surgery, IOL centration is verified and, if required, adjusted by changing the degree of tuck of the haptic within the tunnel.

**Vitrectomy** is done under the flap, which is glued over the haptic using fibrin glue. The conjunctiva is also closed with glue (Figure 2).

**GLUED IOL**

In the event of a large subluxation with dangling nucleus, we prefer the glued IOL technique described by Amar Agarwal, MS, FRCS, FRCOphth. With this approach, scleral flaps are created 180° apart, and an anterior chamber maintainer or an infusion cannula is fixed. The subluxated cataract is removed either by lensectomy or by bringing it out through a corneoscleral section. The posterior assisted-levitation technique described by Chang and Packard can be used to levitate the lens into the anterior chamber. Twenty-gauge sclerotomies are made under the scleral flap, and a three-piece IOL is implanted using the glued IOL technique. Alternatively, a foldable three-piece IOL is

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**Figure 1.** The glued endocapsular ring/segment has two arms, a double-scroll mechanism, and a haptic.

**Figure 2.** (A) A subluxated cataract of about 180° is seen. A lamellar scleral flap and sclerotomy are created in the area of dialysis. Once the rhexis is complete, the arms of the device are introduced into the anterior chamber under the rhexis. The haptic is then exteriorized through the sclerotomy (B) and cut to an appropriate length and tucked into an intrascleral Scharioth tunnel. (C) Phacoemulsification is performed and the IOL is implanted. (D) A coat-hanger type intrascleral tuck hooks the haptic onto the sclera. Fibrin glue is applied, and the flap is sealed over the haptic. The conjunctiva is closed with fibrin glue.
implanted with the handshake technique\textsuperscript{8} if lensectomy has been performed or a rigid IOL may be used in the event of an extended corneoscleral section. Once both haptics have been exteriorized, vitrectomy is performed under the scleral flaps, and the haptics are then tucked into intrascleral limbus-parallel Scharioth tunnels. IOL centration is assessed, and any required adjustments are made by changing the degree of tuck of the haptics into their tunnels. The scleral flaps and the conjunctiva are glued using fibrin glue (Figure 3).

**IOL SCAFFOLD TECHNIQUE**

Another option to maintain a small incision in the case of a dangling subluxated soft crystalline lens is the IOL scaffold technique described by Dr. Agarwal.\textsuperscript{9} This technique is also highlighted in this month’s Inside Eyetube.net column on page 15 and in a video at eyetube.net/?v=goral. With this approach, scleral flaps are created 180° apart. The lens is brought into the anterior chamber and made to rest on the iris. Anterior vitrectomy is performed, and intracameral acetylcholine chloride is instilled to constrict the pupil. Under cover of a dispersive ophthalmic viscosurgical device (OVD), a three-piece IOL is injected so that the leading haptic rests on the iris under the crystalline lens. The trailing haptic can also be inserted over the iris if it has a good tone and a small pupil is present. In the case of a floppy iris or nonconstricting pupil, the second haptic is left trailing outside the wound. We prefer to operate with gas-forced infusion provided by an air pump\textsuperscript{10} connected to the infusion bottle. The nucleus is emulsified while the IOL is used as a scaffold to prevent nuclear fragments falling into the vitreous. Finally, using the handshake technique, the haptics of the IOL are grabbed and sequentially exteriorized through sclerotomies under the two scleral flaps. They are then tucked intrasclerally, and the flap is glued (Figures 4 and 5).

**ADVANTAGES**

The glued endocapsular ring and glued IOL techniques obviate the need for sutures, providing an inherent stability and longevity that may not be attained with sutured IOLs and capsular tension rings. Problems associated with sutures such as suture degradation, erosion, knot unraveling, knot exposure, and late IOL subluxation can be avoided. Additionally, the degree of pseudophacodonesis that is seen with sutured fixation is not seen with the glued techniques. Because the haptics lie within intrascleral tunnels, the glued IOL and glued endocapsular ring are stable and offer great ease of adjustability. Surgery is easier and more rapid than with suture methods, as complicated intraocular maneuvering with long, thin needles is not required. The fibrin glue seals the flaps hermetically and decreases the chances of postoperative complications such as wound leak and endophthalmitis.

The glued endocapsular ring is made of the same material (PVDF) and has the same dimension as some IOL haptics. It can be inserted into the anterior chamber using the fishtail technique of Angunawela and Little\textsuperscript{11} or can be inserted with arms first and haptics last. With either method, there is no need to tie sutures to the device, which increases the speed and ease of surgery. Because the haptic is exteriorized through a sclerotomy, there is no risk of the glued endocapsular ring falling into the vitreous. Elastic memory allows the ring to regain its shape once it is in the anterior chamber. PVDF has been shown to be inert intrasclerally in our experience with glued IOLs,\textsuperscript{5,6} and the same was also reported by Scharioth et al.\textsuperscript{4}

The double scroll engaging mechanism is atraumatic. The device ensures intraoperative and postoperative horizontal and vertical stability of the bag as well as expansion of the capsular fornix. The robust intraoperative support that it
provides allows safer performance of intracapsular maneuvers such as in-the-bag nucleus chopping. Explantation, if required, is also relatively simple. This requires the surgeon (under cover of OVD) to grasp the edge of the double scroll and pull the device through the main port. The flexible device can easily be explanted in this manner.

The glued IOL also has inherent advantages, including greater IOL stability and lack of pseudophacomatosis compared with sutured scleral-fixated IOLs. Surgery is simple and rapid, and good centration of the IOL can be achieved by adjusting the tuck of the haptics. The procedure can be done with any three-piece IOL and does not require an inventory of lenses to be maintained, unlike with scleral-fixated and anterior chamber IOLs. There is a reduced chance of uveitis-glaucoma-hyphema syndrome, as compared with scleral-fixated IOLs, and less chance of long-term endothelial cell loss because the IOL is placed far from the endothelium.

An advantage of the IOL scaffold technique is that the procedure can be completed via small incisions. The optic of the IOL blocks the pupil, preventing nuclear fragments from falling into the vitreous. The optic compartmentalizes the eye, preventing hydration and prolapse of the vitreous and aspiration of the vitreous into the phaco probe. Although the same can be achieved with a Sheets glide, the HEMA contact lens described by Mehta et al., or perfluorocarbon liquid, all of these procedures require implantation of a material or device that must eventually be removed from the eye. The Sheets glide also requires extension of the incision, and PFCL flotation and emulsification of the nucleus requires the assistance of a vitreoretinal surgeon. The IOL scaffold technique utilizes the IOL to be implanted, thereby advancing its placement to an earlier time point in the surgical procedure.

**SUBLUXATED IOLs**

The management of subluxated IOLs follows essentially the same decision-making process as described above, depending on the degree of zonular dialysis. A glued endocapsular ring can be inserted into the bag after it is expanded with OVD, and the bag-IOL complex can be anchored to the sclera using the technique described above for subluxated cataracts. In case of large three-piece IOL subluxations or secondary repair of sulcus-fixated three-piece IOLs found postoperatively to be unstable and subluxating, a closed-globe technique of refixing the same IOL can be employed using the glued IOL technique. This is done by holding the IOL haptic with microforceps while performing vitrectomy to clear any vitreous traction. Each haptic is then sequentially exteriorized through the sclerotomies, then tucked and glued down.

In the case of a dangling subluxated one-piece IOL, the lens can be explanted...
after partial bisection, and then a foldable glued IOL can be implanted.

CONCLUSION

Zonal weakness presents challenges during cataract surgery. In the event of a subluxated crystalline lens or IOL, the surgeon must plan the type of surgery and the individual surgical steps with great care.

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TAKE-HOME MESSAGE

- Subluxation should be managed according to the degree of zonular dialysis.
- The glued endocapsular ring and glued IOL techniques obviate the need for sutures.
- The entire procedure for the IOL scaffold technique can be completed via a small incision.
- The management of subluxated IOLs follows the same decision-making process as with subluxated cataracts, depending on the degree of dialysis.