Surgical Technique

Endoexpression technique of nucleus delivery in manual small-incision cataract surgery

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Manual small-incision cataract surgery (MSICS) is a cost-effective alternative to phacoemulsification and extracapsular cataract extraction (ECCE) for cataract surgery. The surgical technique in MSICS is heterogeneous, and the maximum variation exists in incision and nucleus delivery techniques. Many studies on various incisions are available, and most of them are dedicated to surgically induced astigmatism (SIA), utility, and visual outcomes. The nucleus delivery techniques have less-extensive literature available. They can be divided into "pulling" techniques like phacosandwich technique, fish hook technique, and vectis delivery and "pushing" techniques like viscoexpression or hydroexpression with irrigating vectis/Blumenthal's MiniNuc technique. Postoperative surgical-induced astigmatism is comparable in all techniques. The authors describe a pushing technique which does not raise the pressure of the anterior chamber and can be utilized with variable-sized and irregularly shaped nuclear fragments. It has universal application, especially when the size of the incision is getting smaller in MSICS and phacofragmentation is being used as an adjunct to reduce the incision size. It can be used in situations like posterior polar cataracts, where pressure variations in the anterior chamber can be dangerous.

Key words: Endoexpression, manual small-incision cataract surgery, nucleus delivery, push technique

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DOI: 10.4103/ijo.IJO_1606_22

Quick Response Code:

Manual small-incision cataract surgery (MSICS) is practiced widely throughout India and in many parts of the world.[1,2] There are many variations of the technique. The widest variation in the technique is in the method of expressing the nucleus from the anterior chamber. There are "pulling" techniques like phacosandwich technique, fish hook technique, and vectis delivery. There are also "pushing" techniques like viscoexpression or hydroexpression with irrigating vectis/Blumenthal's MiniNuc technique.[3-5] Anterior chamber maintainer (ACM) and viscoexpression have the advantage that they give early visual rehabilitation.[3] Phacosandwich is extremely effective for nuclear sclerosis grades 3–4. Fish hook technique was found to have limited application for white soft cataract nuclear grades and for black cataracts. Irrigating vectis, viscoexpression, and ACM technique were compatible with all types of cataracts.[6-8] Postoperative surgical-induced astigmatism was comparable in all techniques.[5]

As the size of the incision has decreased and the use of manual phacofragmentation in the anterior chamber or in the tunnel has increased, there is a need for using a pushing technique that can work even if the tunnel is not occluded by the nucleus. With manual phacofragmentation, the size of fragments is not equal and the shape of the pieces also can be fairly irregular. These pieces require to be guided out of the tunnel. It can be done using instruments and pull techniques like the phacosandwich. The push techniques require that the nucleus occludes the tunnel and gets pushed out. A technique that can combine the benefits of a push technique with the versatility of pull technique instruments is needed.

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The authors describe the technique of endoexpression of nucleus, which Boramani J (JB) has been using for more than 8 years. It was later named endoexpression by late Dr. KVS Dhaliwal. The surgery can be performed under topical (proparacaine 0.5%) or peribulbar anesthesia (lignocaine 2% and bupivacaine 0.5%), according to the choice of the surgeon. The author uses continuous irrigation of balanced salt saline (BSS) through ACM. A fornix-based conjunctival flap is raised on the steepest meridian. After achieving hemostasis, with simple pressure or a very light wet-field cautery if required, the main incision is marked about 1.5 mm from the limbus and the sclerocorneal tunnel is made at half the scleral thickness. It is disected forward till about 1.5–2 mm into the cornea. The side port

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Received: 30-Jun-2022 Revision: 02-Sep-2022
Accepted: 07-Sep-2022 Published 25-Oct-2022

Cite this article as: Boramani J, Bali J, Boramani P, Bali O. Endoexpression technique of nucleus delivery in manual small-incision cataract surgery. Indian J Ophthalmol 2022;70:4060-2.

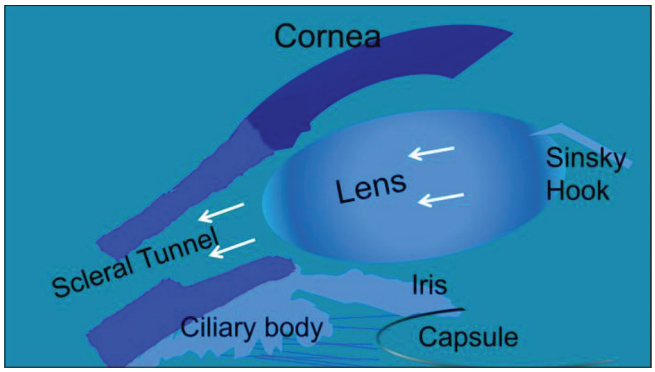

Figure 1: Schematic diagram of the technique

is made using microvitreoretinal (MVR) blade. The anterior capsule may be stained with sterile and pyrogen-free 0.05% trypan blue dye. A continuous curvilinear capsulorhexis is performed using a two-bend needle cystitome through the side port. The main incision and Utrata forceps can be used, though the authors rarely use this technique. Cortical cleaving hydrodissection is preferred using a 24-G cannula. The nucleus is dialed out of the bag by elevating one pole out of the rhexis and then rotating it after nuclear rotation has been achieved. When using the side port, you need to be careful about the amount of fluid used in hydrodissection. For manual phacofragmentation by closed chamber technique, the authors prefer a bimanual technique with the side port and MVR entry through the sclerocorneal tunnel made for the main incision. The main incision is then opened using a 3.2-mm keratome. However, hydrodissection can be done through the main incision in a controlled manner and manual phacofragmentation is achieved. If a large nucleus gets stuck in funnel-shaped scleral tunnel, the nucleus is pushed by a Sinsky hook passed through the side port on the dominant hand side of the surgeon. The nucleus either stretches the scleral tunnel and comes out undivided or is fragmented in the scleral tunnel. The fragments are delivered by using endoexpression as shown in the video. Mostly, the first fragment gets pushed out by the Sinsky hook. The ACM keeps the chamber well formed. The nucleus rubs against the wall of the scleral tunnel and is away from the corneal endothelium, making the technique quite safe [Fig. 1]. Endoexpression can also be performed without ACM, using ocular viscoelastic devices (OVDs). Dispersive OVD is injected through the side port and the OVD cannula through the side port is used to manipulate the nuclear fragment out of the tunnel. With experience, the exact amount of viscoelastic to be injected to keep the chamber deep and the vector force to direct the fragment using the cannula tip engaged to the fragment can be mastered. A second instrument can assist countertraction from outside if required to engage the fragment into the tunnel.

The epinucleus is delivered by the hydrostatic pressure of the ACM. Viscoexpression can also be used using OVDs. Cortical cleanup can be achieved by the method of surgeon's choice, with the ACM remaining *in situ*. Intraocular lens can be implanted under ACM-BSS hydrocover or, alternatively, the ACM can be stopped and a dispersive OVD (like 2% hydroxypropyl methylcellulose) can be used. We prefer to use the hydroimplant technique of intraocular lens implantation.

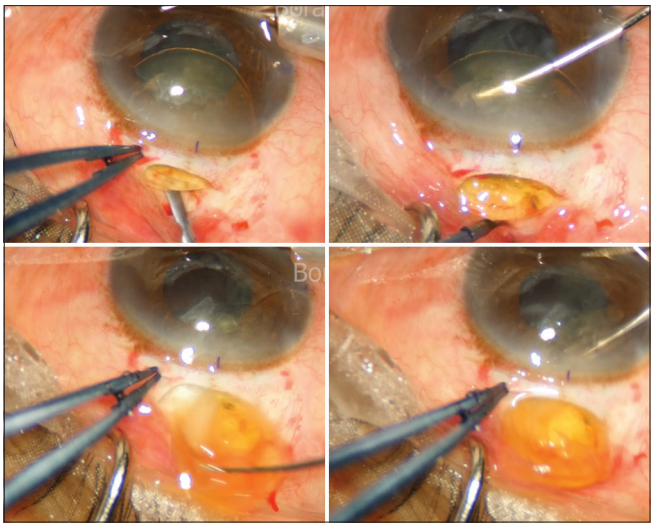

Figure 2: Steps of endoexpression. From top left clockwise: Nucleus engaged in the scleral tunnel of the main incision. Side port used for entry of the Sinsky hook/accessory instrument. Nucleus nudged out with traction from inside. Countertraction with forceps. Nucleus delivered

Discussion

This technique can be used for any grade of cataract, but it is very useful when hard cataracts are encountered, especially when there is a mismatch between the size of the nucleus and the incision, with the incision being shorter. This helps by stretching the external lip of the scleral tunnel which is capable of stretching without any damage to the incision [Fig. 2]. The stretching of the tunnel takes place mainly in the scleral region, and a minor mismatch can easily be overcome without putting strain on the posterior capsule. With hard nucleus and a size mismatch, the instruments like vectis entering the anterior chamber in the pull technique can put both the posterior capsule as well as the corneal endothelium at risk. The room for maneuvering with bigger nucleus is also reduced when the instrument is occupying the tunnel. That having been said, viscoexpression and vectis delivery with or without assistance of adjunct device still remain popular nucleus delivery techniques for most situations.[1,9] Irregularly shaped nuclear fragments are formed when manual fragmentation is done in an attempt to reduce the size of the incision. These fragments usually require assistance out of the tunnel.

Conclusion

Endoexpression of the nucleus is very helpful in converting to smaller incision size with comfort and ease. This is an essential skill in the toolkit of any cataract surgeon.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Commentary: Changing trends and preferred surgeons' practice for nucleus delivery in manual small-incision cataract surgery—Haven't they changed?

Since the inception of manual small-incision cataract surgery (MSICS) in the late 1980s, it has undergone continuous finer refinements to obtain a perfect post-operative outcome. MSICS is the surgery of choice in developing countries and is used extensively in tertiary eye care centers due to its low cost, less time consumption, and comparable outcomes.[1] One of the critical steps of the MSICS is safe nucleus delivery through the sclerocorneal tunnel safeguarding the capsular bag, iris, and corneal endothelium. The nucleus delivery techniques have undergone continuous changes and evolved over time. The nucleus can be delivered in toto or can be bisected or trisected.[2] However, all these techniques have nearly similar outcomes in experienced hands. The various techniques are as follows:

Blumenthal or anterior chamber maintainer technique

In this technique, a hollow steel tube anterior chamber maintainer (ACM) (0.9 mm outer diameter and 0.65 mm inner diameter) is inserted at one of the side ports, preferably on the temporal side. The steel tube is attached to a balanced salt solution bottle suspended 50–60 cm above eye level. After keratome entry, the nucleus is first engaged in the sclerocorneal tunnel with the help of a lens glide or iris spatula. Furthermore, the nucleus is pushed exteriorly by the hydropressure of ACM, and if required, the nucleus is pulled with the help of a needle.[3]

Irrigating wire vectis method

After the nucleus prolapse in the anterior chamber (AC), a viscoelastic is injected above and below the nucleus. The Vectis is attached to the infusion syringe, and patency is checked. The Vectis is inserted below the nucleus by slightly tilting it down toward the posterior capsule to engage the nucleus. The infusion is initiated, and the nucleus is extracted from the tunnel with hydro- and counter-pressure. The other hand stabilizes the globe either by holding a superior rectus suture or with the help of forceps. The pull of the rectus or slight pressure on the lower lip opens the tunnel, and the nucleus is delivered.[4]

Viscoexpression

Viscoexpression can be assisted with the help of wire Vectis connected to a syringe filled with low-molecular-weight viscoelastic, or the nucleus can be directly delivered with counter-pressure by injecting the viscoelastic in the AC and capsular bag from the syringe.[5]

Ruit technique

In this technique, a 7 mm sclerocorneal tunnel is fashioned, and AC entry is done. The nucleus is prolapsed in the AC, and a viscoelastic is injected around the nucleus. A bimanual irrigating and aspirating Simcoe cannula is inserted below the nucleus, and the nucleus is delivered through the tunnel.[6]

Fish hook technique

In this technique, the superior pole of the nucleus is partially prolapsed in the AC. An adequate viscoelastic is injected in front and behind the nucleus. A 30G needle is bent in the form of a hook and inserted from behind into the substance of the nucleus. The nucleus is engaged, brought out, and delivered through the tunnel.[7]

Phacosandwich technique

In this technique, the nucleus is delivered through the conventional SICS tunnel by sandwiching it between a Sinskey hook and wire Vectis or Sinskey hook and a spatula or a spatula with wire Vectis. The prime requirement for this technique is a bigger incision size. The technique is also helpful even if the tunnel is compromised, like a buttonhole or a premature entry.

Phacofracture technique

In this technique, the nucleus is prolapsed out of the capsular bag using two Kuglen hooks. The nucleus is gently rotated to loosen the cortical adhesions. After filling the AC with the help of a viscoelastic, the solid Vectis is insinuated under the nucleus, the nucleotome is placed above the nucleus, and both the instruments are brought toward each other. This splits the nucleus into two halves. The bisected pieces are then brought into the tunnel with the help of nuclear forceps with 9 mm long jaws one by one. Another modification of this technique is the use of a Sinskey hook, a wire Vectis is used instead of nucleotome, and the solid Vectis and the rest of the technique remain the same.