Surgical Technique

Closed chamber manual phacofragmentation in manual small-incision cataract surgery

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Manual small-incision cataract surgery (MSICS) has existed as an alternative to conventional phacoemulsification since its inception. The size of the incision has been becoming smaller in MSICS to reduce the surgically induced astigmatism. Smaller incisions go hand in hand with nucleus debulking and fragmenting techniques which have been practiced over almost four decades. Such techniques have a learning curve and require meticulous execution. The authors describe a technique to achieve nucleus bisection or trisection or debulking in a closed anterior chamber. This technique has been in use for a long time; it has shown excellent results and has a shorter learning curve. Since it is done in a closed chamber, the risk to the corneal endothelium is minimized as the anterior chamber remains deep throughout the procedure. Sudden escape of the viscoelastic and shallowing of the chamber are prevented, and the corneal endothelium is well protected. It uses iris as support and reference. The specially designed chopper is an inexpensive addition to the instruments. Fragmentation is achieved in the proximal half of the chamber where control over instruments is maximum. Pristine clear cornea on day 1 is the rule rather than the exception with this technique. This is a safe and repeatable technique for phacofragmentation in cataract extraction.

Key words: Anterior chamber manual phacofragmentation, closed chamber, manual phacofragmentation, manual small-incision cataract surgery (MSICS)

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The incision size has been growing smaller for cataract surgery in order to ensure quick rehabilitation and astigmatism control. For a reduced incision size, the nucleus can be divided by phacofragmentation. Manual phacofragmentation and pre-chop have variously been described.[1] The first example of manual phacofragmentation goes back to Kelman in 1967 when he used the Ringer forceps. After that, the technique had to wait till ophthalmic viscoelastic agents were described about a decade later, when Kansas[2] successfully performed the division. During the 1980s, a short learning curve and a relatively small financial outlay prompted the development of manual cataract nuclear fragmentation techniques parallel to the development of phacoemulsification. Nucleosuction with a Simcoe cannula as modified by Beirouty *et al.*,[3] Fry's[4] phacosandwich technique, and the nucleus size reducing techniques have been described at the turn of the millennium for an incision size from 5.5 to 8.0 mm. A smaller incision of 4.0–5.5 mm required Kansas'[2] bisection and trisection, Keener's[5] stainless steel loop, and Quintana's[6] 3-0 nylon loop. It is, however, possible to do manual phacofragmentation even under Blumenthal's MiniNuc technique with anterior chamber maintainer (ACM). The authors describe here one such technique with an axe-like chopper. Various techniques have been described and are in use in pre-chop and manual small-incision cataract surgery (MSICS). Manual phacofragmentation is a highly skilled procedure. The techniques using insertion of large instrument/s through the main incision can result in shallowing of the anterior chamber. The corneal endothelium and/or the posterior capsule can get engaged in the instruments and thereby incur damage when there is forward movement due to escape elastic and shallowing of the anterior chamber. Phacofragmentation in a "closed and deep anterior chamber" is a much safer procedure. The surgeon gets sufficient space between the nucleus and the posterior capsule.

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The procedure can be performed under the anesthesia of surgeon's choice. Proparacaine (0.5%) is instilled once and supplemented with lignocaine jelly (2%) after some time. No sedation is employed. Constant surgeon–patient communication is maintained and is essential for surgery. If the patient complains of pain, then 0.75 ml of 2% lignocaine is infused into the subtenon space using a blunt cannula. Supplementation can be given at any stage of surgery if required. For uncooperative patients, a peribulbar block may be employed. Intracameral 0.5 ml of preservative-free lignocaine is irrigated into the anterior chamber. ACM is introduced through the corneal tunnel near the lower limbus and the balanced salt solution (BSS) infusion line is started. The height of the bottle is used to create adequate amount

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of positive pressure in the anterior chamber throughout the procedure, and this pressure can be varied depending upon the case and the stage of surgery. We prefer to keep the bottle at 60 cm above the eye level at the beginning of surgery for the general population and at a lower level for myopes. The rule of the thumb is that there should not be excessive deepening of the anterior chamber when the ACM is introduced. The bottle height may be increased during capsulorhexis and/or nucleus expression, if required. A fornix-based conjunctival flap is made, and wet-field cautery is used to get a clean field as required. A 5-mm frown scleral incision is made about 1.5–2 mm behind the limbus and is extended forward at half the scleral thickness for about 1.5 mm into cornea. The anterior chamber is not entered through the tunnel at this stage. A stab incision is made using a bent micro vitreoretinal surgery (MVR) blade to create a side port. Continuous curvilinear capsulorhexis is performed using 27 G bent needle cystitome introduced through a side port incision. No side pockets are made on either side, and the internal incision is flared out to get an inverted funnel-shaped tunnel about 7–7.5 mm wide in clear cornea. Complete cortical cleaving hydrodissection is done after tenting the anterior capsule, and the nucleus is partially prolapsed out of the capsular bag by using an elevation and rotational tangential force with Sinskey hook by the tire changer rolling tire technique. Small nucleus and soft nucleus can easily be extracted using Sheet's glide by Blumenthal's MiniNuc technique, and nucleus fragmentation may not be necessary. Even in that situation, it can be performed, and the instruments can cheesewire through the nuclear mass. This technique is of use when Grade 3 and above nuclear sclerosis is encountered, with utility increasing with the increased hardness.

If the nucleus is too large and hard, then a closed chamber manual phacofragmentation needs to be performed on the partially prolapsed nucleus. The nucleus needs to be oriented in a manner that a large part remains out of the bag and a small part is either behind the pupil or behind the inferior lip of the rim of the anterior capsule. This helps to make the fragmentation safer and provides visual clues to the surgeon. The internal lip of the main port incision is now opened on the nondominant hand side of the main incision using a stiletto knife to a width of 0.9 mm. Now, an iris repositor is introduced using this as the entry. The main instrument used is an axe-shaped chopper as shown in the photograph in Fig. 1. The Axe Chopper has a handle like the handle of Sinskey hook. At the tip, it has an 0.6mm x 0.6mm axe shaped chopper. This axe has a curved cutting edge as seen in Fig. 1.

The dominant hand uses axe-shaped Boramani chopper through the side port. The iris repositor through the main port supports the nucleus from behind the prolapsed nucleus, while the chopping instrument through the side port moves tangentially across, toward the iris repositor from the front. The fracture is effected toward the periphery with the support of the wound entry as shown in Fig. 2 and the accompanying video. Gentle to and fro motion is preferred. The two instruments are apposed tangentially toward each other in the upper quadrant, always keeping the nucleus in front of the iris. The ACM ensures that the corneal endothelium is far away from the upper instrument, and the iris ensures that the posterior capsule is not at risk from the iris repositor. The procedure is done in a closed chamber, which is maintained by infusion from ACM. Phacofragmentation is achieved in the upper half of the chamber where the control of the instruments is much better. It is not essential to achieve equal fragments or even a hemi-nucleus. The part of the nucleus which gets sheared off is a thinner part and it requires less force. Care must, however, be taken when the fracture is about to be completed. The amount of tangential force vector needs to be reduced and redirected to ensure that the nucleus divides without a sudden movement. The iris repositor and the axe chopper are moved in a continuous

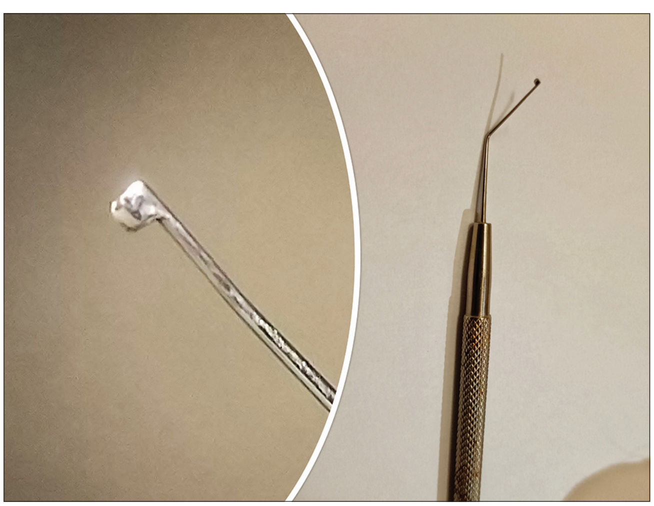

Figure 1: Boramani chopper with close-up

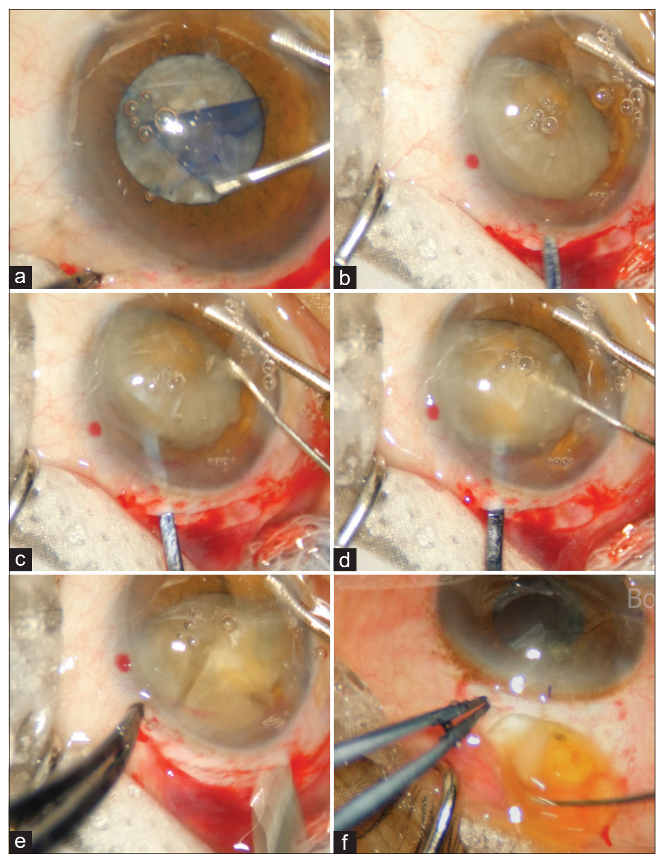

Figure 2: Collage of surgical steps. (a) Continuous curvilinear capsulorhexis. (b) Nucleus dialed out of the bag and positioned half inside the pupil. Preparing for phacofragmentation with iris repositor entering from main incision entry point and chopper from the side port. (c and d) Fragmentation of the nucleus in progress. (e) Fragmented nucleus in the anterior chamber. (f) The main incision opened on the inner lip and the fragments removed

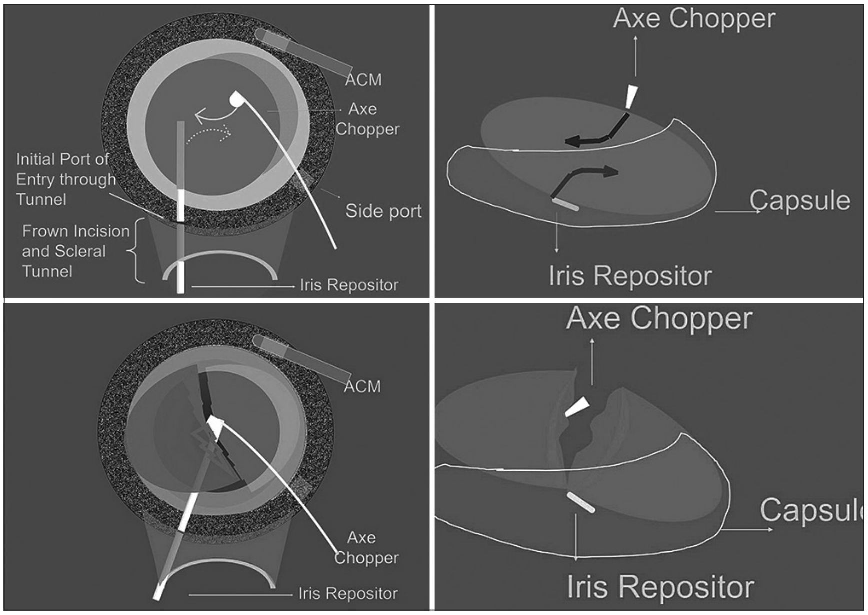

Figure 3: Schematic line diagram of the technique

curvilinear fashion, first to fragment the nucleus and then to push the fragments away from each other as shown in the photograph above [Fig. 3] as well as in the accompanying video.

Curvilinear movements bring the instruments closer to each other to fragment the nucleus, and then, they move away from each other so as to separate the fragments. This is like breaking the edges of a plate. The shortest diameter can we debulked to less than 7-mm width as endpoint. The instruments should not be straightway opposed to each other as this results in sudden hazardous tumbling of the nucleus, rupturing the posterior capsule and at the same time rubbing the corneal endothelium, leading to corneal decomposition. The chopper is advanced into the bulk of the nucleus initially toward the iris repositor, and then it is moved tangentially away from it. The bite is taken and then separated as inward and then outward separating movement.

After this, the internal incision of the square tunnel is opened using a keratome, ensuring that the cutting is done on the inward movement. The authors use Sheet's glide to engage the nuclear fragments and express them. The main problem with nuclear fragments is that they are not capable of occluding the tunnel, and therefore, if required, a Sinskey hook from the side port can be used to nudge out the fragments into the tunnel and express them. The main bulk of the nucleus as well as the bigger nuclear fragments are amenable to removal by hydroexpression using Sheet's glide by Blumenthal MiniNuc technique.[7] To use any other method of nucleus expression, the ACM should be closed temporarily. In such a situation, it is extremely important to use adequate amount of dispersive viscoelastic to coat the corneal endothelium and prevent damage to it. It also pushes away the posterior capsule and allows manipulation of the nucleus into the tunnel using viscoexpression or vectis delivery. The epinuclear mass can be easily delivered using Sheet's guide or viscoexpression. Water jetting of the bag is done through a fine cannula passed through the side port. For cortical aspiration, a single-port canula attached to a silicon tube is used from the side port in the bag. Hydroimplantation of intraocular lens is done, and the case is closed after hydrating the ports and pressurizing the eye with saline. The conjunctiva can be closed with wet-field cautery.

Conclusion

This technique has been in practice over the past two decades. It has the advantage of completing the process of phacofragmentation in a closed chamber with very high safety margins. It has a small learning curve and low investment. It is safe, repeatable, and can be practiced with minimal additional instrumentation.

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Conflicts of interest

There are no conflicts of interest.

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