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ORIGINAL PAPER

Hook and flip technique: for phacoemulsification in non-rotating nuclei and posterior polar cataracts

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Abstract
Purpose We put forward a physical levitation method to hook and flip the chopped nuclear fragments that could not be solely drawn by vacuum during phacoemulsification, due to various reasons such as a non-rotating nuclei or posterior polar cataracts where hydrodissection was unsuccessful or contra-indicated, respectively.
Method A Sinskey hook is insinuated through the crack of the divided nuclei into a plane behind the nuclear pie to 'hook and flip' the chopped piece, heading it towards the phacoemulsification probe. This simple step disassembles the nuclear chunk, thereby creating space to facilitate the dismantling of the rest of the fragments. The remnant epinuclear cushion guards the posterior capsule, mitigating the chances of serious intra-operative complications.
Result We have employed this technique in 17 eyes during similar situations. No specific intra-operative complications were observed; all surgeries were uneventful. A Sinskey hook utilised for this step ensures safety and familiarity, none encountered posterior capsular rent. This technique not only eases the surgery, but also decreases the anticipated intra-operative and post-operative complications.
Conclusion 'Hook and flip technique' thus proves useful whenever dismantling difficulties are encountered during phacoemulsification.

Keywords Hook and flip · Non-rotating nuclei · Posterior polar cataract · Sinskey hook · Small capsulorhexis · Small pupil

Introduction

The ophthalmic fraternity has witnessed significant evolution in the techniques practised for cataract extraction. With the recent technologies and developments, phacoemulsification is considered to be the gold standard for this purpose [1]. Though the results of phacoemulsification are stunning in the hands of the experienced, it may not always be so, especially for the beginners. A retrospective chart review of resident doctors performed phacoemulsification surgeries showed that the intra-operative complication rates reduce significantly after their first 80 cases [2]. Unexpected difficulties may arise anytime despite following the most familiar technique. One such situation that can immensely tax a surgeon is when hydrodissection is difficult or contra-indicated like in

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posterior polar cataracts, ensuing in a non-rotatable nucleus. After an initial nuclear cracking, it is imperative that the hemispheres be rotated, to allow their end-on grasp by the phaco hand piece for subsequent division into smaller fragments. When these segments fail to rotate, especially when along with a small pupil or a small anterior capsulorhexis, it may be difficult to proceed further. We describe a universal technique that can be exercised in such situations where the chopped segments fail to rotate, posing difficulty in vacuum hold of the pieces for further cleavage and phacoemulsification.

Surgical technique

Under topical or peribulbar anaesthesia, the eye of interest is cleaned and draped. The surgeon proceeds with a temporal or superior phacoemulsification as per his convenience. The initial steps of the surgery, from incision construction to chopping, are essentially the same as any standard phacoemulsification procedure. However, we withhold hydrodissection in cases of posterior polar cataracts. After dividing the nuclei, if any difficulty is encountered in rotation and vacuum hold of these segments, the aforesaid technique can be utilised.

Witnessing the inability to rotate the nucleus, a part of the hemisphere closest to the vertical crack can be held by the phaco probe, and chopped further to create a pie. If at this point, this small chopped token fragment could not be suctioned off by vacuum alone, this technique is employed. It could be due to various reasons such as a soft nucleus, leathery fibres, small capsulorhexis or coexistence of a small pupil, presenting difficulty in exactly gauging the distance between the phaco probe and peripheral nuclear bowl.

The chopper is next replaced with a Sinskey hook. With the phaco probe providing continuous irrigation, the Sinskey hook is first inserted vertically into the cracked central fissure (Fig. 1) and then turned horizontally into the groove between the chopped nuclear pie and the epinuclear plate (Fig. 2). Having hydrodilenated, this plane is easy to achieve through the crack which has divided the central nuclear core and is also safe in that the epinuclear cushion is left in situ. The inserted Sinskey hook is then thrust anteriorly to dismantle and lift the chopped nuclear fragment (Fig. 3), stripping it in line from base to apex

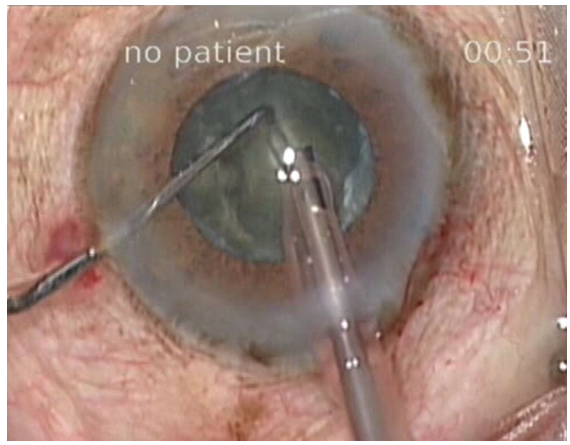

Fig. 1 The Sinskey hook is inserted vertically into the crack of the primary chop at a mid-peripheral location, under direct visualisation

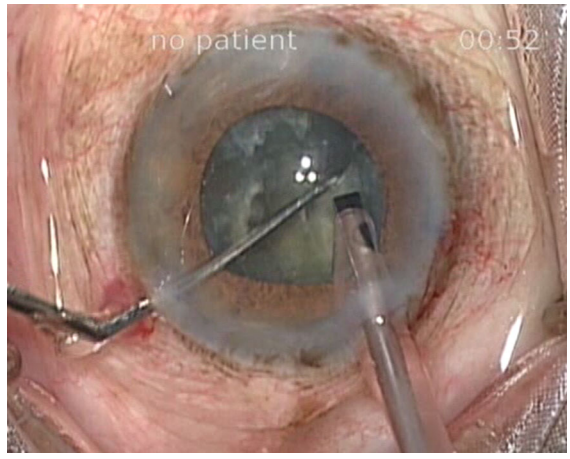

Fig. 2 The Sinskey hook is turned horizontal and inserted into the plane between the central nuclear core and the soft epinucleus to hook the nucleus

(Fig. 4). As the piece lifts off the nuclear plane, the phaco probe provides vacuum for further engagement and phacoemulsification (online supplementary video file). As a small piece is carved out from an ensemble, it loosens its coherence and creates good space within the capsular bag to allow easy nuclear rotation. Similar steps may have to be repeated, however, in cases of posterior polar cataracts. Successful evacuation of few such accessible fragments additionally imparts proclivity and room for the remaining heminucleus to dislodge easing the cases of non-rotating nuclei. They can then be positioned accordingly, for a comfortable and safe phacoemulsification. The rest of the surgery proceeds in the routine manner. After

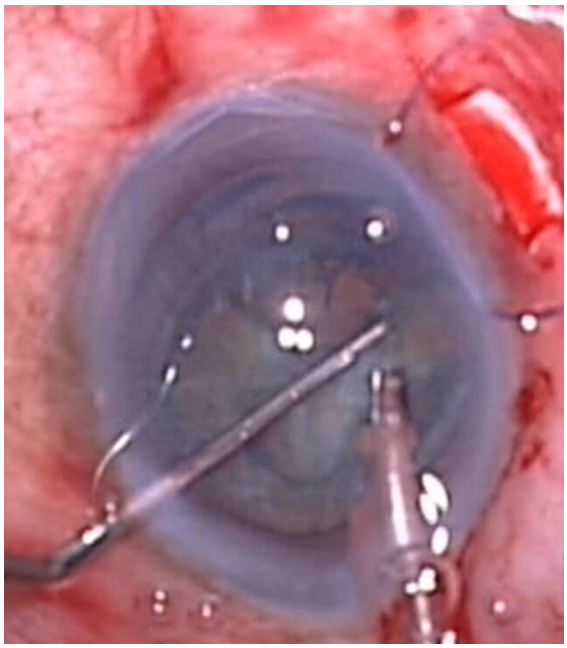

Fig. 3 The nuclear fragment is hooked and lifted by the Sinskey hook towards the phaco probe. (This surgery being a part of combined phacotrabeculectomy, a corneal traction suture and scleral flap are visible)

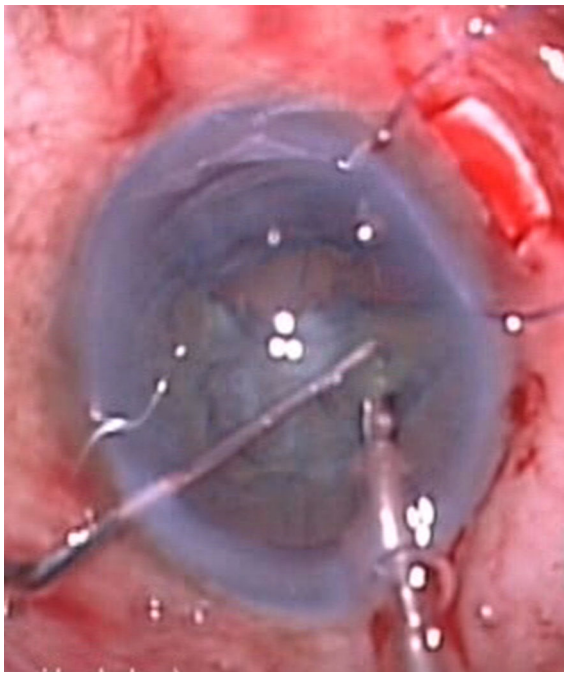

Fig. 4 Stripping of the nucleus in an inverse fashion from base to apex by the Sinskey hook, and the base being engaged into the mouth of the phaco probe. (This surgery being a part of combined phacotrabeculectomy, a corneal traction suture and scleral flap are visible)

complete removal of the nuclear fragments, the epinuclear plate is aspirated. A posterior chamber intra-ocular lens is implanted. The anterior chamber is formed with balanced salt solution and the wounds are hydrated. A schematic diagram of the procedure in small pupil and small capsulorrhexis has been depicted in Fig. 5.

Results

We have employed this technique multiple times (17 eyes) in situations of posterior polar cataract and where unexpected intra-operative difficulties in advancing the semi-chopped hemi-nuclei were faced with. This technique was useful and successful in both soft-type and leathery hard-type cataracts, as was in posterior polar cataracts. It significantly eased the surgery in all of them, irrespective of the pupil and the capsulorhexis size. A Sinskey hook utilised for this step ensures safety and familiarity, none encountered posterior capsular rent. No specific intra-operative complications were observed. It significantly decreased the anticipated intra-operative hurdles and post-operative morbidity of the patients, making all the surgeries uneventful.

Discussion

The standard procedure for phacoemulsification is the division of the nucleus into two, followed by rotation of the hemi-nuclei and further fragmentation into smaller pieces. This division is important to dismantle and emulsify the nucleus in a stepwise manner with ease and minimise the use of applied phaco power. However, well-divided hemi-nuclei may fail to be emulsified, especially in soft cataracts where the probe has a propensity to cut through while attempting to hold and carve out the piece, inadvertently causing a posterior capsule defect (PCD). Another situation is the presence of a non-rotating nucleus. The problem is exaggerated when a small pupil or small capsulorhexis coexists. This is primarily attributed to the difficult manoeuvrability encountered in such scenarios. A non-rotating nucleus may be intrinsic due to cortico-capsular adhesions [3], or voluntarily averted in cases

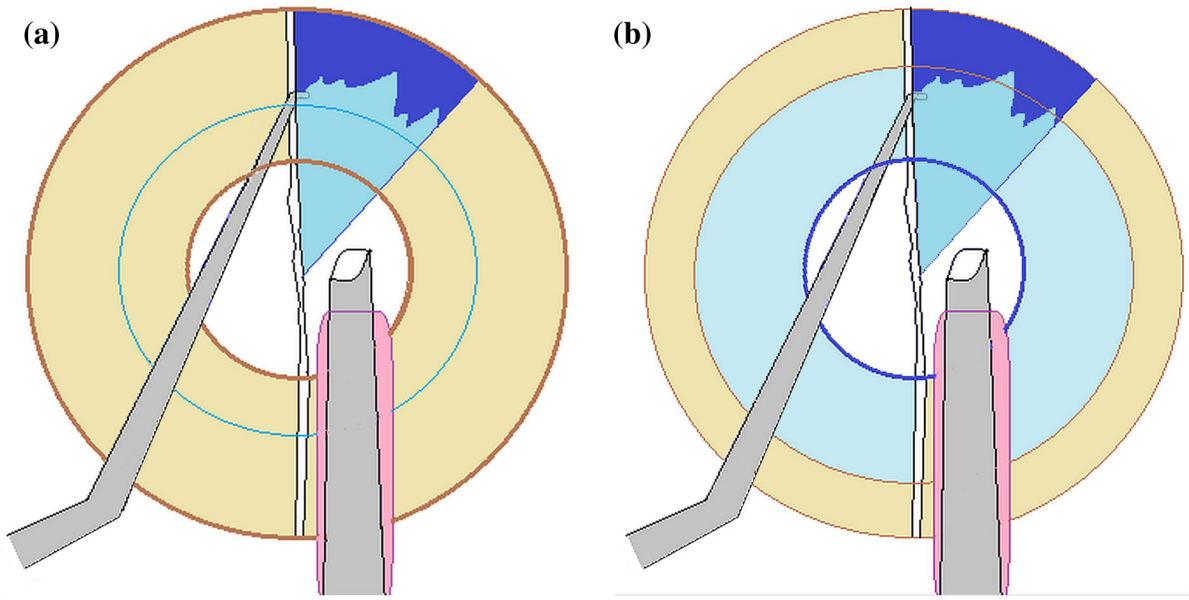

Fig. 5 **a**, **b** Schematic representation of 'hook and lift technique' under a small pupil or a small anterior capsulorhexis

with a suspicion of pre-existing PC defect such as posterior polar, post-traumatic and post-vitrectomy lens touch cataract cases. A small pupil compromises the visibility, thereby mounting problems in gauging the depth and relation of the pieces to the probe. In contrast, a small capsulorhexis directly restricts the advancement of the nuclear fragments. A hard nucleus may also be added to the above list, for the lens fibres being more cohesive, exhibit a leathery consistency defying complete division and the drawing forth [4]. Our proposed technique can help conquer these situations, especially when the surgeon faces more than one of them in combination.

The difficulties encountered in extracting the fragmented pieces were put into light when 'in situ fracture' came into vogue. Different techniques were suggested to solve this issue, some by lifting the base and others by lifting the apex. The former occurs when a quadrant's apex is pushed posteriorly with a spatula, tumbling it to bring the base up [5]. The apex can first be brought up by the 'crack and flip technique', where the second instrument gives a downward pressure at the quadrant's periphery, which rotates and elevates its apex, ready to be engaged into the phaco probe [6]. However, these techniques, by thrusting on the nuclear fragment downwards, may indirectly threaten the integrity of the PC and zonules. Another is the 'split and lift technique', where a notch is sculpted into the apex of the pie which can engage a spatula to lift it, so that the apical posterior corticonuclear plate can be directly accessed by the phaco needle [7]. Goncalves described the 'chop, trip and free' technique where the chopper was inserted beneath a wedge's epinucleus to free both the nucleus and epinucleus in conjunction [8]. In our technique, a Sinskey hook is inserted beneath the crack at the mid-peripheral location under direct visualisation to enhance safety. The chopper having a sharp tip can compromise the capsule, especially in the absence of an epinuclear cushion, while our instrument, by having a blunt finish can safeguard the PC from inadvertent injury. However, sliding the instrument into the right plane is important. We first insert it vertically to trace the existing track and then turn horizontally to insinuate it into the right strata between the nucleus and the epinucleus. This is done to retain the epinuclear plate, which can keep the PC distended, and also shield it from accidental instrumental trauma. Another precaution undertaken by us to evade this complication is the use of continuous irrigation to fend off the PC.

A mid-peripheral location was considered appropriate to hook these pieces, because it lifted the base of the pie, in addition to the benefit of manipulation under direct observation. Also for the reason that the leathery fibres in hard cataracts have a strong tendency to remain unified in the centre [4], this step helps in

sequential stripping of such wedges, from the divided bulky periphery towards the tied-in wispy core. Furthermore, the thinnest part of the PC is avoided in routine, rather than specifically for posterior polar cataracts.

Though numerous techniques have been described for chopping a nucleus, procedures to safely propel the chopped fragments are hardly few as discussed above. Viscodissection can be experimented in situations where thinned out or stuck fragments are encountered. By injecting an ophthalmic viscodispersive device behind the intended piece, it can be passively forced forward. This technique is usually followed for epinuclear emulsification in posterior polar cataracts [9]. Though viscoexpression may appear to be a gentle technique, the repeated fiddling of the corneal wound by removal and insertion of instruments multiple times is not without complications and so is the tendency of the iris to prolapse out due to increased chamber pressure. This frequent switching of instruments also lengthens the surgical time. Our technique, on the other hand, is a simple extrapolation of the routine manoeuvres used in the surgery.

This technique is devised to dismantle and manually advance the chopped nuclear fragments when vacuum alone could not do so. It minimised the need for high vacuum, especially crucial for soft cataract cases where the probe can cut through pieces to end up in a PC rent. With respect to hard cataracts and non-rotating nuclei, manual centripetal propulsion of the pieces can significantly counterpoise the vigorous manipulation attempts that would have been required, efficiently decreasing the stress that could be transmitted to the zonules. It also checks the undesired dissipation of phaco energy initiated on these easily give way fragments, and the resultant endothelial damage [10]. This hooking to feed the nucleus on to phaco needle is much different from the 'stop, chop, chop and stuff' technique, where the already freed fragments are stuffed into the probe's mouth, primarily aiming for a low-energy phacoemulsification [11]. A similar confounder by name is the 'fishhook technique', where a bent 30G needle is inserted into the bulk of the nucleus to safely extract it out of the self-sealing tunnel during manual small incision cataract surgery [12].

In conclusion, we propose a simple technique of proceeding with phacoemulsification in difficult intraoperative scenarios, viz. non-rotating nuclei, posterior polar cataracts, small pupil or a small capsulorhexis, battled through the efficient usage of a surgeon's accustomed second instrument, without any added demerits.

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Compliance with ethical standards

Conflicts of interest All authors declare that they have no conflict of interest.

Research involving human participants The procedures performed in this report involving human subject were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

Informed consent Informed consent was obtained from all the participants of this study.

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