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Case Report

A simple and safe approach of phacoemulsification cataract surgery in hard brown cataracts with different complexities using the Two-Y crushing technique: A report of two cases

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ABSTRACT

Phacoemulsification of a hard brown cataract is a challenging surgery due to the risk of both intraoperative and post-operative complications. Complications such as posterior capsular rupture and corneal burns are major concerns, and many techniques have been described to minimise these risks. The Two-Y crushing technique is a recently introduced method for posterior polar cataracts, in which the nucleus prolapses into the anterior chamber after successful delineation and then cracks using Two-Y rotators. In this article, we describe the 'Two-Y crushing technique,' which was successfully applied in performing phacoemulsification cataract surgery in two cases of hard cataracts of varying complexity. This technique is simple, safe and yields promising results.

Keywords: Hard cataract, Phacoemulsification, Cataract surgery, Two-Y crushing technique

INTRODUCTION

Phacoemulsification cataract surgery is a standard of care for many types of cataracts[1], such as senile cataracts, paediatric cataracts and complicated cataracts. However, when it comes to hard cataracts, the procedure can be challenging for many surgeons, especially those with less experience. In such cases, surgeons may encounter intraoperative complications[2], including posterior capsular rupture, zonular dialysis, nucleus drops and wound burn, as well as endothelial damage. When phacoemulsification is unsuccessful intraoperatively, the procedure may be converted to small incision cataract surgery (SICS) or extracapsular cataract extraction (ECCE). Several techniques for phacoemulsification in hard cataracts[2-9] have been described, and the choice of technique often depends on the degree of hardness and the surgeon's experience. The Two-Y crushing technique[10] is a recently introduced method for phacoemulsification in posterior polar cataracts. In this technique, the endonucleus is prolapsed from the bag into the anterior chamber and crushed into multiple pieces using a Two-Y rotator. This approach facilitates easier extraction of the nucleus with low ultrasonic phaco energy, while intact epinucleus sheets protect the posterior capsule through their cushioning effect, preventing chamber collapse. A successful hydrodelineation is a key prerequisite for this procedure. In this article, we report a safe approach to phacoemulsification cataract surgery using the Two-Y crushing technique for hard brown cataracts in various scenarios, both with and without successful hydrodelineation

CASE REPORT

Case 1: Two-y crushing technique in hard brown cataracts with successful hydrodelineation

A 64-year-old male presented with a brown cataract in his right eye, with a best-corrected visual acuity (BCVA) of 6/60 (−0.50 × 60) and normal intraocular pressure (IOP). The fundus examination was normal. Phacoemulsification cataract surgery was performed using the Two-Y crushing technique [Video 1]. Under topical anaesthesia, side ports were created at the 2'O and 9 O'clock positions, and

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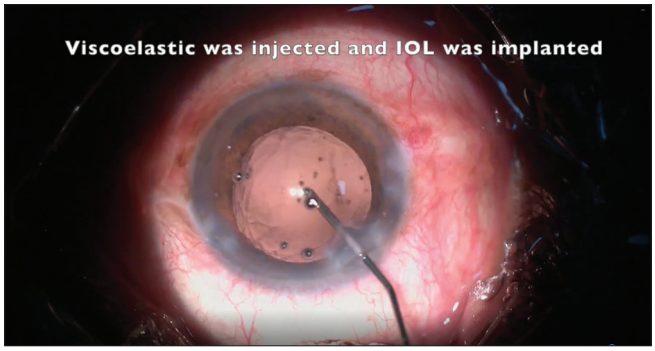
a 2.2 mm clear corneal main port incision was made at the 11 O'clock position, followed by a 6 mm continuous curvilinear capsulorhexis. Hydrodissection followed by hydrodelineation was successfully performed, indicated by the formation of a golden ring [Figure 1a]. Dispersive viscoelastic (viscodissection) was injected into the golden ring (epinucleus cleavage plane), which completely disassembled the endonucleus [Figure 1b]. A one-Y rotator was passed beneath the nucleus through the 2 O'clock side port to lift and prolapse the nucleus into the anterior chamber [Figure 1c]. Another Y rotator was inserted through the 9 O'clock side port to crush the nucleus into multiple pieces [Figure 1d], similar to bi-hand crushing as similar to the Two-Y crushing technique[10] in case of posterior polar cataract. Initially, on the first attempt, the crack did not fully occur due to the hardness of the cataract; however, the second attempt was successful. The cataract was leathery in nature, and multiple attempts were made to crush the endonucleus into smaller pieces with complete or incomplete separations. The crushed nucleus was easily removed by phacoemulsification in the iris plane [Figure 1e]. During phacoemulsification, the chamber remained stable, with the protective epinucleus sheet safeguarding the posterior capsule. Later, the epinucleus sheet [Figure 1f] was removed using irrigation and aspiration, followed by the implantation of a single-piece intraocular lens (IOL) [Figure 1g]. The cumulative dissipated energy (CDE) was 10.77. On the post-operative day (POD) 1, the cornea was clear, and the patient achieved a vision of 6/6 (Plano) with normal IOP [Figure 1h].



Video 1: The application of the Two-Y crushing technique in hard brown cataracts with successful hydrodelineation.

Case 2: Two-y crushing technique in hard, deep brown cataract without successful hydrodelineation

A 72-year-old male presented with a deep brown cataract [Figure 2a] in his left eye, with a BCVA of 6/60 (+1.00 Dioptre sphere/−1.00 Dioptre cylinder × 90) and normal IOP. On posterior segment examination, only a hazy view of the optic disc was visible, and a B-scan was normal. Phacoemulsification cataract surgery with IOL implantation using the Two-Y crushing technique was performed under a peribulbar block [Video 2]. In this procedure, hydrodissection was successful, but hydrodelineation did not occur due to the thick and adherent epinucleus with the endonucleus, which is typically seen in deep brown cataracts.

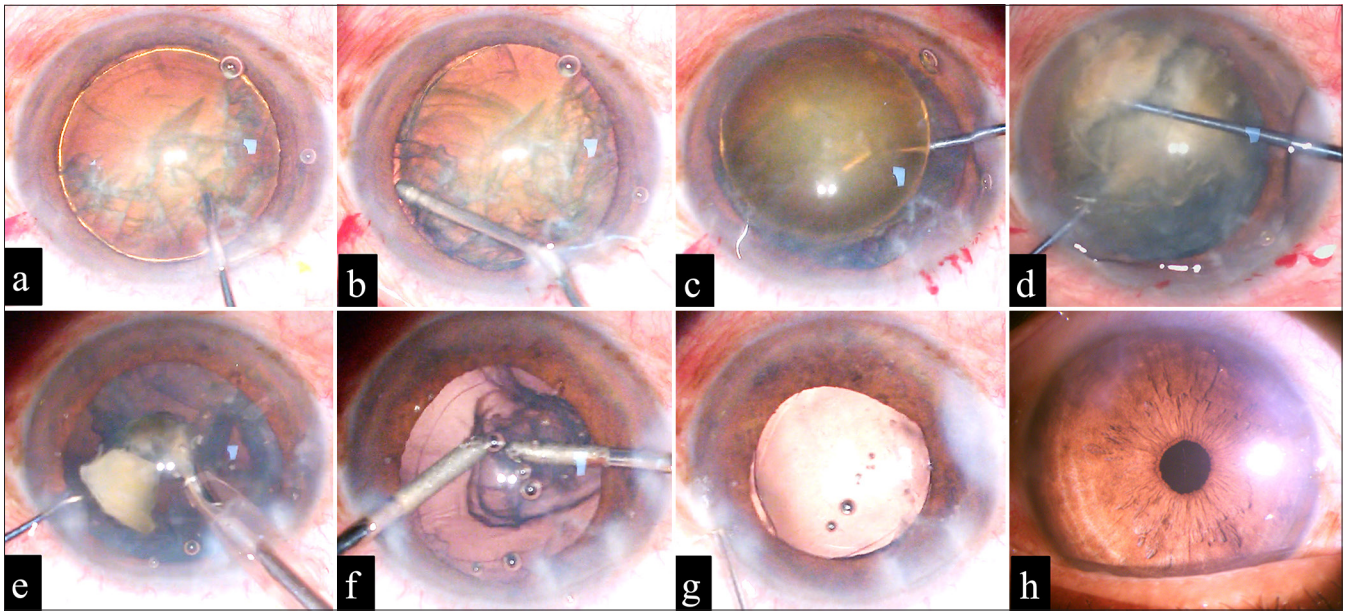


Figure 1: (a-h) (a) The successful hydrodelineation indicated by golden ring. (b) Successful viscodelineation using Hydroxypropylmethyl cellulose (HPMC) 2%, which completely disassembled the endnucleus from the epinucleus. (c) The prolapse of the nucleus using the Y rotator. (d) The manual crushing of the nucleus using Two-Y rotators. (e) The emulsification of the nucleus using phaco probe in the iris plane. (f) The removal of epinucleus using irrigation and aspiration. (g) The implantation of the single-piece intraocular lens in the capsular bag. (h) The clear cornea at post-operative day 1.

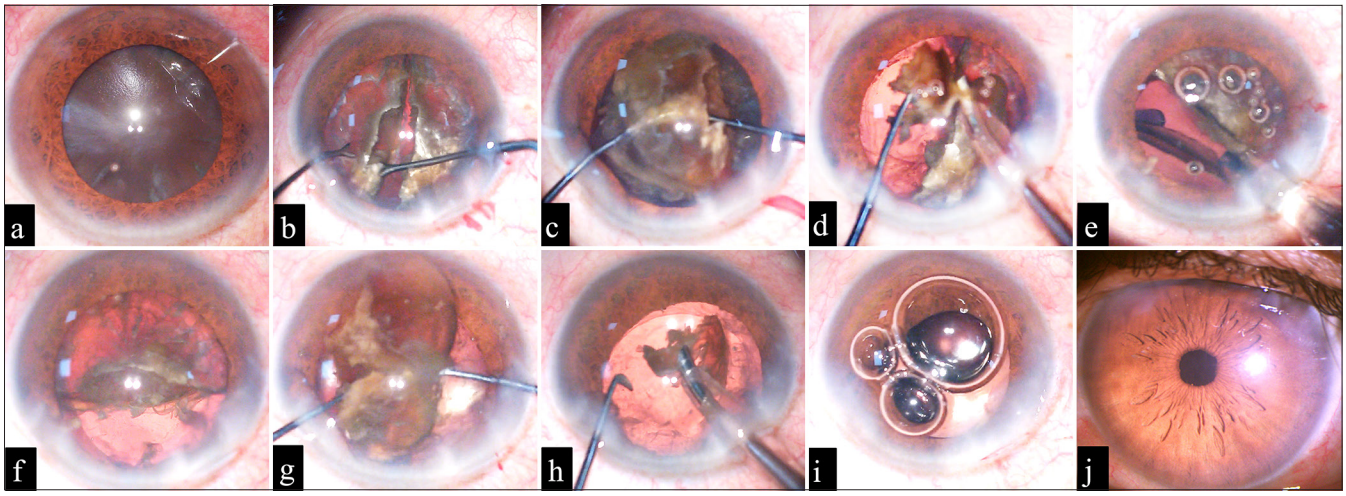
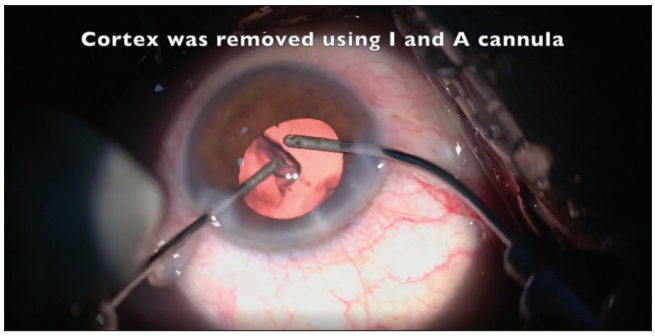


Figure 2: (a-j) (a) The deep brown hard cataract. (b) Prolapsing one nucleus half after successfully cracking into the anterior chamber using a Two-Y rotator. (c) The crushing of one nucleus half into multiple pieces using a Two-Y rotator. (d) Phacoemulsification of the crushed nucleus half in the iris plane. (e) The implantation of intraocular lens (IOL) into the bag. (f) The IOL unfolded below the second nucleus half. (g) The crushing of the second nucleus half was carried out using Two-Y rotators. (h) The phacoemulsification of the second half nucleus in the iris plane. (i) The implanted single-piece IOL in the capsular bag with the ports are sealed. (j) shows the clear cornea at post-operative day 3.



Video 2: The application of the Two-Y crushing technique in hard, deep brown cataracts without successful hydrodelineation.

Sculpting was attempted but failed with parameters set at torsional (100) and longitudinal (10) because of the hardness.

Consequently, the longitudinal parameter was increased to 40, allowing the phaco needle to embed into the nuclear material and crack the nucleus into two halves [Figure 2b] using the second instrument (direct chop). The cracking could also have been accomplished by making a deep trench followed by lateral separation. One half was brought into the anterior chamber and crushed into smaller pieces using the Two-Y rotator [Figure 2c]. By injecting hydroxypropylmethyl cellulose (HPMC) 2% beneath the first heminucleus, it was lifted away from the posterior capsule and subsequently brought into the anterior chamber with the Y rotator. The crushed nucleus was easily removed by phacoemulsification in the iris plane with parameters of torsional (100) and longitudinal (10) [Figure 2d]. Viscoelastic (sodium hyaluronate 1.4%) was injected into the bag, pushing the remaining half to one side, and a single-piece IOL was injected into the bag in the space [Figure 2e]. The IOL was adjusted to unfold and spread below the remaining nucleus (IOL scaffold technique[5]). The IOL was implanted before phacoemulsification of the second piece to provide a protective sheet in the absence of the cushion effect from the epinucleus [Figure 2f]. The second half was then brought into the anterior chamber and crushed into multiple pieces using the Two-Y rotators [Figure 2g], followed by phacoemulsification in the iris plane [Figure 2h]. At the end of the procedure, the ports were hydrated [Figure 2i]. The total CDE count was 20.60. On day 1, there was mild central corneal oedema, which completely resolved by day 3 [Figure 2j], with a BCVA of 6/6 (+0.50 DS/−1.50 DC × 110) and normal IOP.

DISCUSSION

Various techniques have been described for phacoemulsification in rock-hard cataracts, including the crack, reduce and implant technique,[2] crater and chop technique,[3] modified crater technique,[4] IOL scaffold technique,[5] drill and crack technique,[6] multilevel chop technique,[7] miLOOP technique[8] and femtosecond laser-assisted cataract surgery.[9] Each technique has a different learning curve, and the choice of technique depends on the surgeon's exposure and experience. In our experience, phacoemulsification in hard cataracts is challenging primarily due to their leathery nature, which makes cracking difficult and often leads to capsule rupture. High ultrasonic phaco energy can also cause corneal burns and damage the endothelium. Our approach minimises the need for high ultrasonic energy, as indicated by the lower CDE counts in both cases compared to a study by Davison[11] showing higher

CDE counts (over 50) for hard cataracts. Both Case 1 and Case 2 demonstrated quick recovery, with clear corneas on POD 1 and 3, respectively. The main prerequisites for this technique in hard cataracts are either (i) successful hydrodelineation, indicated by the golden ring, or (ii) successful division of the nucleus into halves through deep trenching or direct chop when hydrodelineation fails. The advantages of these techniques are that they are simple to perform, especially for inexperienced surgeons, as they do not involve complex mechanisms for cracking the nucleus, utilise less phaco energy, and thereby reduce the risk of corneal burns and endothelial damage. Disadvantages could be the inadvertent endothelial touch and performing phacoemulsification close to the endothelium, which may damage the endothelium. This can be prevented by positioning the cracking nucleus in the iris plane from the anterior chamber before carrying out the phacoemulsification along with frequent dispersive viscoelastics.

CONCLUSION

Phacoemulsification cataract surgery is a standard of care for cataracts; however, in difficult cases such as rock-hard cataracts, which makes ophthalmologists, particularly inexperienced surgeons, may consider older techniques like SICS or ECCE due to potential intra- and post-operative complications. The Y-crushing technique for hard cataracts appears to be a comfortable and safe option for manually breaking the hard and leathery nucleus. Further studies are advocated to validate its efficacy through larger case enrolments or randomised controlled trials.

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