International Medical Case Reports Journal

Dovepress
Taylor & Francis Group

Open Access Full Text Article

CASE REPORT

In situ Serial Trident Chop for Low-IOP Phacoemulsification without Nuclear Rotation: A Case Report

Hung-Chou Lin[1], Yung-Han Lin[2]

[1]Department of Ophthalmology, Dr. Lin's Eye Clinic and Laser Vision Correction Center, Taoyuan City, Taiwan; [2]Department of Medicine, Chung Shan Medical University, Taichung, Taiwan

Correspondence: Hung-Chou Lin, Department of Ophthalmology, Dr. Lin's Eye Clinic and Laser Vision Correction Center, 437, Chingkuo Road, Taoyuan District, Taoyuan City, 330, Taiwan, Email joe8168@hotmail.com

Background: Phacoemulsification had been made efficient by hydrodissection, nucleus rotation, chopping, and using high vacuum to aspirate lens fragments under high hydrostatic pressure. Yet hydrodissection might be incomplete with the lens nucleus resisting rotation. Further vigorous hydrodissection might rupture the posterior capsule and forceful nuclear rotation might cause zonular dialysis. Encountered with such conditions, we present a case using an in situ serial trident chop technique and hydrodelineation independent of complete hydrodissection and nucleus rotation to avoid related complications.

Case Presentation: A 61-year-old male patient with grade II nuclear opalescence received phacoemulsification from the author. Incomplete hydrodissection, inadvertent hydrodelineation and difficult nuclear rotation were noted during operation. The author turned to in situ serial trident chop without nuclear rotation under low intraocular pressure (IOP), which was done by dividing the nucleus into four fragments through three serial in situ horizontal chops in the 12 o'clock, 3 o'clock, and 10 o'clock directions, then the fragments were picked to the phaco tip by nucleus manipulator instead of high vacuum produced by phaco tip to reduce the hydrostatic pressure needed for keeping the safe depth of the anterior chamber. The resultant four small nuclear fragments were readily emulsified under a stable anterior chamber with an IOP of 20–28 mmHg and cumulative dissipated energy of 3.28. The eye's central corneal thickness increased from 522 μm before the operation to 540 μm on the following day.

Conclusion: Phacoemulsification could be accomplished by in situ serial trident chop under low IOP and hydrodelineation without complete hydrodissection or nuclear rotation for grade II nuclear opalescence, although further investigation is needed to confirm its safety and efficacy.

Keywords: chop in situ, low intraocular pressure, phacoemulsification, trident chop, without rotation

Introduction

Phacoemulsification had been made efficient by hydrodissection, rotating nucleus, chopping, and using high vacuum to aspirate lens fragments under high hydrostatic pressure. Yet in cases of brunescent cataract or posterior polar cataract, vigorous cortical cleaving hydrodissection might rupture the posterior capsule.[1] On the other hand, forceful nuclear rotation might cause zonular dialysis when the hydrodissection was not complete or in eyes with pseudoexfoliation syndrome[2,3] or weak zonules, which are sometimes hard to anticipate.

During phacoemulsification, high hydrostatic pressure might increase intraocular pressure (IOP), significantly reduce ocular perfusion, damage the glaucomatous optic nerve, increase postoperative corneal edema, and induce more anterior segment inflammation.[4,5]

Encountered with scenarios of poor hydrodissection and difficulties in rotating nucleus, we present a case using an in situ serial trident chop technique and hydrodelineation without further vigorous hydrodissection, forceful nuclear rotation, or high hydrostatic pressure to prevent related complications.

Received: 29 March 2025
Accepted: 12 June 2025
Published: 23 June 2025

Case Presentation

A 61-year-old male Taiwanese patient with grade II senile cortical cataract and nuclear opalescence (Lens Opacities Classification System III) received phacoemulsification by the author. The eye's preoperative corrected distant visual acuity (CDVA) was 20/40 with central corneal thickness (CCT) of 522 mm, anterior chamber depth of 3.08 mm, and axial length of 22.81 mm. Under peribulbar anesthesia, a 1.2 mm limbal side port was made using a trapezoid knife, and a dispersive ophthalmic viscosurgical device (Viscoat) was injected to reform the anterior chamber. Then, a 2.4 mm temporal limbal incision was made using a diamond knife one-and-a-half clock hours away. After a 5.0 mm continuous curvilinear capsulorhexis was made, hydrodissection was performed by injecting around 0.1 mL balanced salt solution subcapsularly to the right and left, respectively, but no retrolenticular crossing wave was noted and the nucleus was hard to rotate. However, inadvertent hydrodelineation was made. Instead of more vigorous hydrodissection or forceful nuclear rotation, the author turned to in situ serial trident chop, which was done by first impaling the nucleus with the phaco tip (Active Sentry handpiece with Balanced Tip, Alcon Centurion gold) and burying it deep in the nucleus as a counterforce, passing the chopper (Akahoshi nucleus manipulator) under the distal edge of the capsulorhexis to a position below the lens equator, and then chopping through the nucleus until reaching the phaco tip (Figure 1A). The nucleus was

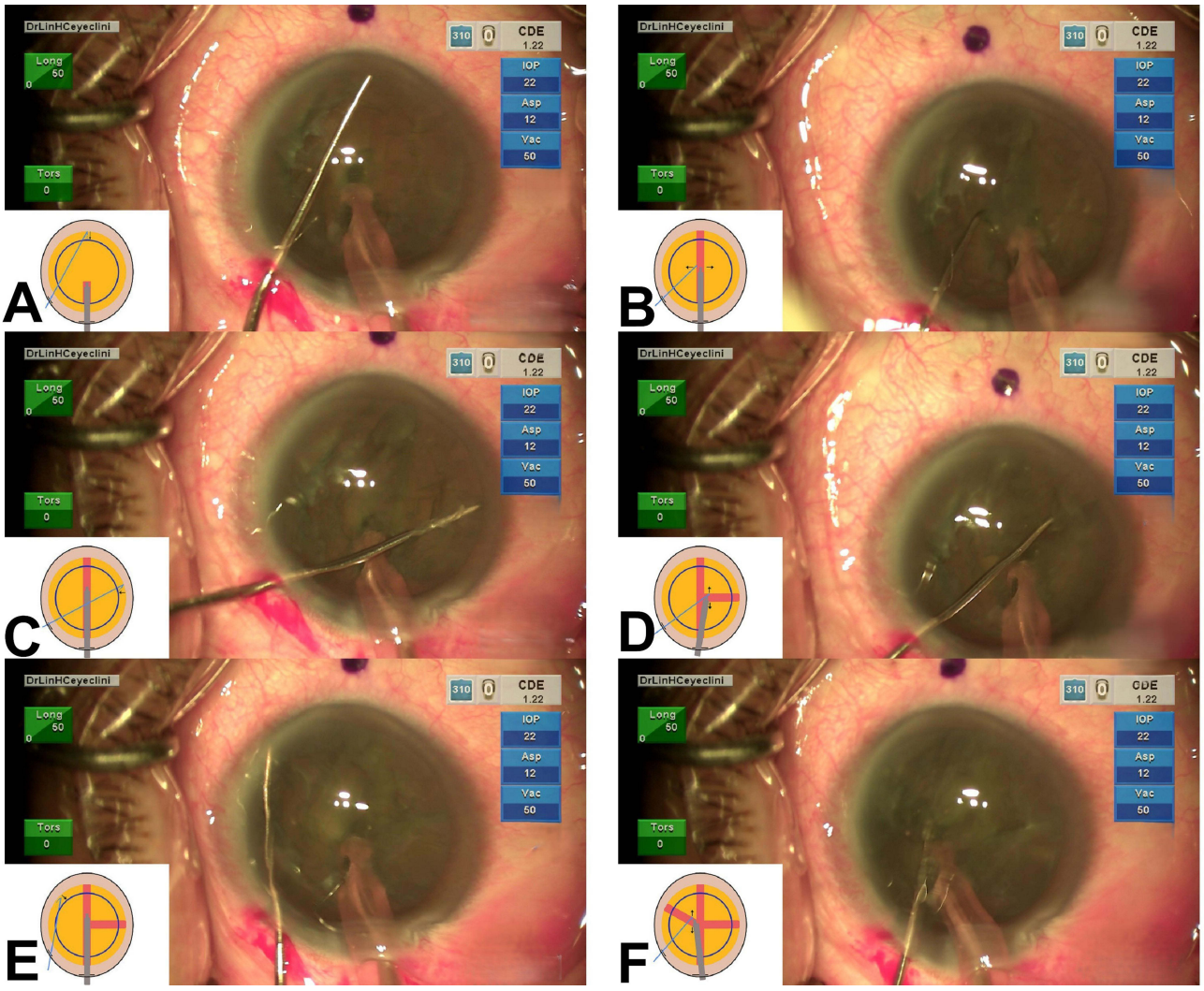

Figure 1 In situ serial trident chop. (**A**) The first chop was made by impaling the nucleus with the phaco tip and burying it deep in the nucleus as a counterforce, passing the chopper (Akahoshi nucleus manipulator) under the distal edge of the anterior capsulorhexis to a position below the lens equator and chopping through the nucleus until reaching the phaco tip. (**B**) While the phaco tip was moved to the right, the chopper was moved to the left, thus the lens was divided in half. (**C**) The second chop was made by placing the phaco tip deep in the center of the first crack and passing the chopper under the capsulorhexis edge 90° to the right of the phaco tip and then chopping the right hemisphere apart until reaching the phaco tip. (**D**) The right hemisphere was divided into two quadrants by using the chopper to push the distal quadrant and the phaco tip to pull the proximal quadrant. (**E**) The third chop was made serially by passing the chopper under the capsulorhexis edge 60° to the left of the phaco tip and then chopping the left hemisphere apart until reaching the phaco tip. (**F**) The left hemisphere was divided into two fragments by using the chopper to push the distal lens fragment and the phaco tip to pull the proximal lens fragment.

 https://doi.org/10.2147/IMCRJ.S520654

cracked into two hemispheres by moving the chopper to the left while moving the phaco tip to the right (Figure 1B).[6] Fixation of the nucleus by high vacuum of the phaco tip was not used.[7]

The second chop was made by placing the phaco tip deep in the first crack as a counterforce and passing the chopper under the capsulorhexis edge 90° to the right of the phaco tip, and then chopping through the right heminucleus until reaching the phaco tip (Figure 1C) and cracking the right hemisphere into two quadrants (Figure 1D).[7–9]

The third chop was made in the same way but passing the chopper 60° to the left of the phaco tip (Figure 1E) and the left heminucleus was chopped and cracked into a smaller left distal fragment and a larger left proximal fragment (Figure 1F).

Immediately after the in situ serial three chopping and dividing, the chopper was sequentially inserted deep between the lens capsule and the rather small left distal lens fragment, which was easily picked up to the phaco tip in the pupillary center and was readily emulsified (Figure 2A). Engaging and pulling the lens fragments by high vacuum of the phaco tip was not used and the IOP was set at 20–28 mmHg. Then the other three bigger lens fragments were easily picked up and emulsified in the same way (Figure 2B–D). The lens fragments were chopped further against the phaco tip into smaller chips before emulsification to reduce the energy consumption and the cumulative dissipated energy was 3.28 (Video S1). On the postoperative first day the eye's CCT was 540 μm with grading of anterior chamber flare and cells of +1 (Standardized Uveitis Nomenclature). On the postoperative sixth day the CCT subsided to 531 μm with CDVA improving to 20/25.

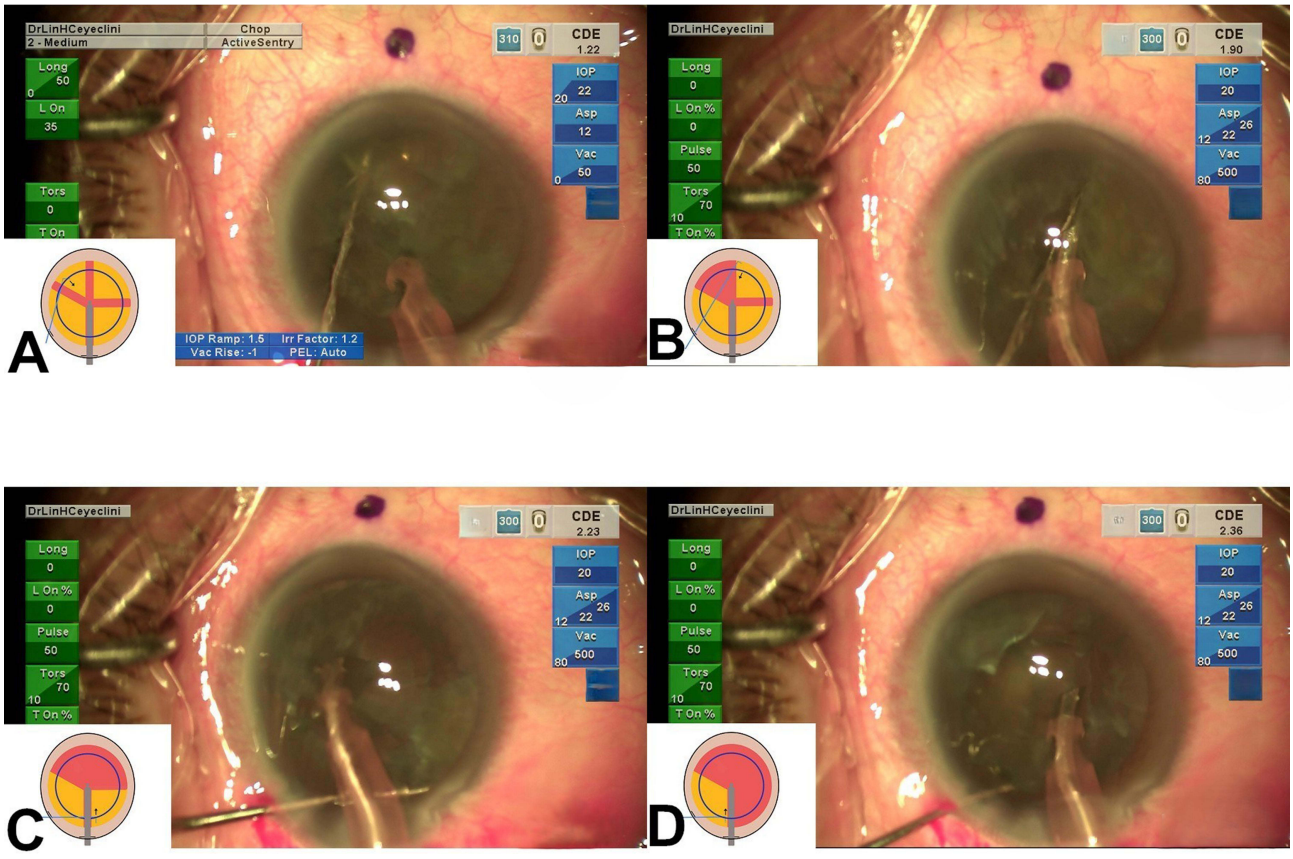

Figure 2 In situ serial trident chop. (**A**) The chopper was inserted deep between the lens capsule and the smaller left distal lens fragment, which was then picked up to the phaco tip in the pupillary center and was emulsified. (**B**) The right distal lens fragment was picked up and emulsified in the same way. (**C**) The chopper was used to push the right proximal lens fragment apart from the left one and was inserted deep between the lens capsule and the right proximal lens fragment, which was then picked up to the phaco tip and was emulsified. (**D**) The chopper was inserted between the lens capsule and the left proximal lens fragment, which was then picked up to the phaco tip and was emulsified.

https://doi.org/10.2147/IMCRJ.S520654

Table 1 Comparison of Different Surgical Techniques of Phacoemulsification

	Trident Chop	Cross Chop	Stop-and-Chop
Hydrodissection	Unnecessary	Necessary	Necessary
Sculpting time	Short	Short	Long
Nucleus rotation	Unnecessary	Unnecessary	Necessary
Hydrostatic pressure	Could set below 30 mmHg	Safer above 30 mmHg	Safer above 30 mmHg
Small first lens fragment for easier removal	Yes	No	Yes

Discussion

Hydrodissection[10] serves a prerequisite for safe nucleus rotation and helping its removal, but might rupture the posterior capsule, especially in older patients with long axial length, pseudoexfoliation syndrome[1], and eyes with posterior polar cataract.[9,11]

Rotating the nucleus facilitated lens fragmentation either through sculpting,[12] chopping,[13] or prechopping[14] techniques, but nucleus rotation might cause zonular dialysis when the hydrodissection was not complete or in eyes with weak zonules from previous trauma or pseudoexfoliation syndrome,[2,3,11] which was sometimes hard to anticipate.

Some phacoemulsification techniques done without nuclear rotation had been reported before.[8,9,11,15,16] In situ nuclear disassembly was done by sculpting,[15] which consumed more energy.[17] Pre-surround division technique using an Akahoshi prechopper was more suitable for soft nucleus.[16] Cross chop[8] used the same horizontal chop technique as in situ serial trident chop for the first and second chops, but left a large left nuclear hemisphere behind. Then, it was converted to the stop and chop technique,[18] using high vacuum of the phaco tip to grasp, move, and chop the large residual heminucleus, which needed thorough hydrodissection and high hydrostatic pressure to keep the anterior chamber stable and improve the followability of the nuclear fragments (Table 1). Yet in certain circumstances, high hydrostatic pressure might increase surgical risk, especially in eyes with floppy iris syndrome or severe myopia.[1]

The serial three chops of in situ trident chop separated the nucleus in situ into four nuclear fragments without a big heminucleus left for further treatment.[7–9] The smaller left distal nuclear fragment could be sequentially and easily picked up to the phaco tip and emulsified, which made room for picking up the other three nuclear fragments to the phaco tip. Till then vacuum was activated. Thus, the anterior chamber was stable and needed no high hydrostatic pressure to prevent accidental aspiration of the lens capsule or to improve the followability of the lens fragments. In this case, while hydrodissection was incomplete, hydrodelineation played a crucial role in enabling safe phacoemulsification by acting as a buffer between the nucleus and the capsule and the IOP could be set at 20–28 mmHg to avoid the complications of high IOP. Although the Active Sentry handpiece with Active Fluidics had been shown to reduce the IOP level needed, it most often still operated at an IOP above 40 mmHg.[19,20] Thus, the surgical methods might also play a role in reducing surgical IOP level further.

Limitations and Complication

In this case of grade II nuclear opalescence, in situ serial trident chop under low IOP appeared to be safe and effective, but more investigation is needed to prove it. In the case of a denser nucleus, however, the chopping would be more strenuous and might need higher hydrostatic pressure or a secondary instrument to protect the posterior capsule. Moreover, there is still risk of posterior capsule rupture, especially in eyes with posterior polar cataract when using this technique.

Conclusion

Phacoemulsification could be accomplished by in situ serial trident chop under low IOP and hydrodelineation without complete hydrodissection or nuclear rotation for grade II nuclear opalescence, although further investigation is needed to confirm its safety and effectiveness.

Abbreviations

IOP, Intraocular pressure; CCT, Central corneal thickness; CDVA, Corrected distant visual acuity.

Data Sharing Statement

The data related to this case are available within this article; no datasets were generated or analyzed during the current study.

Ethics Approval and Consent to Participate

While ethical committee approval was not required for this case report, because of the nature of a retrospective case report, informed consent from the patient was attained and documented in writing. This study was performed in accordance with the Helsinki Declaration of 1964 and its later amendments.

Consent for Publication

Written informed consent for publication of the patient's clinical details and clinical images was obtained from the patient.

Funding

The authors did not receive any financial support for the research, authorship or publication of this article.

Disclosure

The authors declare that they have no financial or personal relationships with any individuals or organizations that could inappropriately influence their work or interpretation of the research presented in this case report.

References

1. Ota I, Miyake S, Miyake K. Dislocation of the lens nucleus into the vitreous cavity after standard hydrodissection. *Am J Ophthalmol*. 1996;121(6):706–708. doi:10.1016/S0002-9394(14)70637-3
2. Drolsum L, Haaskjold E, Sandvig K. Phacoemulsification in eyes with pseudoexfoliation. *J Cataract Refract Surg*. 1998;24(6):787–790. doi:10.1016/S0886-3350(98)80132-6
3. Dosso AA, Bonvin ER, Leuenberger PM. Exfoliation syndrome and phacoemulsification. *J Cataract Refract Surg*. 1997;23(1):122–125. doi:10.1016/S0886-3350(97)80162-9
4. Findl O, Strenn K, Wolzt M, et al. Effects of changes in intraocular pressure on human ocular haemodynamics. *Curr Eye Res*. 1997;16(10):1024–1029. doi:10.1076/ceyr.16.10.1024.9024
5. Vasavada V, Raj SM, Praveen MR, Vasavada AR, Henderson BA, Asnani PK. Real-time dynamic intraocular pressure fluctuations during microcoaxial phacoemulsification using different aspiration flow rates and their impact on early postoperative outcomes: a randomized clinical trial. *J Refract Surg*. 2014;30(8):534–540. doi:10.3928/1081597X-20140711-06
6. Nagahara K. Phaco chop. Film presented at: the ASCRS 3rd American– international congress on cataract, IOL and refractive surgery, Seattle, Washington, USA, May 1993.
7. Matsuura K, Takanashi N. The stop and press technique; an occlusion free stop-and-chop technique in cataract patients with soft to moderate nuclei. *Clin Ophthalmol*. 2022;16:3283–3287. doi:10.2147/OPTH.S379325
8. Kim DB. Cross chop: modified rotationless horizontal chop technique for weak zonules. *J Cataract Refract Surg*. 2009;35(8):1335–1337. doi:10.1016/j.jcrs.2009.03.028
9. Chee SP. Management of the hard posterior polar cataract. *J Cataract Refract Surg*. 2007;33(9):1509–1514. doi:10.1016/j.jcrs.2007.05.027
10. Faust KJ. Hydrodissection of soft nuclei. *J Am Intraocul Implant Soc*. 1984;10(1):75–77. doi:10.1016/S0146-2776(84)80088-9
11. Titiyal JS, Kaur M, Nair S. Chop and tumble nucleotomy – a technique for safe nuclear emulsification in posterior polar cataract. *Indian J Ophthalmol*. 2023;71(6):2578–2582. doi:10.4103/ijo.IJO_2120_22
12. Gimbel HV. Divide and conquer nucleofractis phacoemulsification: development and variations. *J Cataract Refract Surg*. 1991;17(3):281–291. doi:10.1016/S0886-3350(13)80824-3
13. Fine IH, Packer M, Hoffman RS. Use of power modulations in phacoemulsification; choo-choo chop and flip phacoemulsification. *J Cataract Refract Surg*. 2001;27(2):188–190. doi:10.1016/S0886-3350(00)00834-8
14. Akahoshi T. Phaco prechop: manual nucleofracture prior to phacoemulsification. *Operative Tech Cataract Refract Surg*. 1998;1:69–91.
15. Koplin RS, Anderson JE, Seedor JA, Ritterband DC. In situ nuclear disassembly: efficient phacoemulsification without nuclear rotation using lateral sweep sculpting and in situ cracking techniques. *J Cataract Refract Surg*. 2009;35(9):1487–1491. doi:10.1016/j.jcrs.2009.04.029
16. Kamoi K, Mochizuki M. Pre-surround division technique: precise cracks surrounding the posterior opacity prior to phacoemulsification in posterior polar cataract surgery. *J Cataract Refract Surg*. 2014;40(11):1764–1767. doi:10.1016/j.jcrs.2014.09.002
17. Park J, Yum HR, Kim MS, Harrison AR, Kim EC. Comparison of phaco-chop, divide-and-conquer, and stop-and-chop phaco techniques in microincision coaxial cataract surgery. *J Cataract Refract Surg*. 2013;39(10):1463–1469. doi:10.1016/j.jcrs.2013.04.033

18. Koch PS, Katzen LE. Stop and chop phacoemulsification. *J Cataract Refract Surg*. 1994;20(5):566–570. doi:10.1016/S0886-3350(13)80239-8
19. Jir´askov´a N, Stepanov A. Our experience with active sentry and centurion ozil handpieces. *Cesk Slov Oftalmol*. 2021;77(1):18–21. doi:10.31348/2021/1
20. Cyril D, Brahmani P, Prasad S, et al. Comparison of two phacoemulsification system handpieces: prospective randomized comparative study. *J Cataract Refract Surg*. 2022;48(3):328–333. doi:10.1097/j.jcrs.0000000000000769