Crater-and-divide technique for phacoemulsification of hard cataract

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Received 20 November 2016
Accepted 20 December 2016

The Egyptian Journal of Cataract and Refractive Surgery 2016, 22:50–53

Purpose

The aim of this study was to evaluate a new technique for safe phacoemulsification of sizable, tough, leathery nuclear cataracts.

Patients and methods

Thirty eyes of 22 patients with hard cataract, recruited from the Department of Ophthalmology, Faculty of Medicine, Alexandria University, Alexandria, Egypt, were included in the study. Informed consent was obtained from all patients. All surgeries were performed by the same surgeon (K.M.N.). A wide crater around 5.0 mm in diameter was created by down-slope carving up to 90% of the thickness of the nucleus, leaving the peripheral nuclear rim untouched. The phaco probe was applied at one edge of the crater without vacuum, and a spatula was applied at the opposite crater edge. The phaco probe and the spatula were pushed simultaneously in opposite directions toward the lens periphery, dividing the remaining nuclear rim into two halves. Each half, consisting of a thin nuclear rim, was withdrawn with high vacuum and emulsified in the suprabagal space.

Results

Intact posterior capsule was achieved in all cases. Clear cornea was reported on the first postoperative visit in 24 eyes and negligible postoperative early corneal edema in six eyes.

Conclusion

Our novel crater-and-divide phacoemulsification technique permits uneventful phacoemulsification of hard cataracts.

Keywords:
crater-and-divide, hard cataract, phacoemulsification

Egypt J Cataract Refract 22:50–53

1687-6997

Introduction

Phacoemulsification became the gold standard for cataract extraction [1]. It is commonly applied for extraction of nearly all types of cataractous lenses, including immature, mature, white, complicated, developmental, and subluxated cataracts [2–4].

Nonetheless, achieving safe and uneventful phacoemulsification continues to be a challenge in some circumstances, particularly in cataracts with sizable and tough nuclei that lack cortical support [5]. We introduce a method of phacoemulsification of hard cataracts with negligible risk for disturbance to the corneal endothelium and lenticular posterior capsule.

Patients and methods

All patients were recruited from the Department of Ophthalmology, Faculty of Medicine, Alexandria University, Alexandria, Egypt. Informed consent was obtained from all patients. This study was approved by the Ethics of Research Committee, Faculty of Medicine, University of Alexandria, Egypt. All surgeries were performed by the same surgeon (K.M.N.).

All patients were subjected to detailed ophthalmic examination using a BQ 900 Slitlamp (Haag-Streit AG, Gartenstadtstrasse, Koeniz, Switzerland), axial length measurement using the OA-1000 Optical Biometer (Tomey Corporation, Nagoya, Japan) or A-scan ultrasound and corneal topography using Topographic Modeling System TMS-5 (Tomey Corporation). In the next step, these data were exported to OKULIX ray tracing software (Tedics Peric & Jöher GbR, Dortmund, Germany) for IOL power calculation.

All surgeries were preceded by instillation of topical moxifloxacin hydrochloride 0.5% eye drops every 2 h initiated 1 day preoperatively, complete asepsis, perioperative conjunctival sac sterilization with povidone–iodine 5%, topical anesthesia using tetracaine hydrochloride 1.0%, and pupil dilation.

A 2.5 mm clear corneal incision is tunneled at the limbus at 11 O'clock using Alcon steel blade keratome 2.5 mm (Alcon Laboratories, Fort Worth, Texas, USA). The anterior capsule is stained with Trypan blue under air. Viscoelastic material is injected through a self-sealing clear corneal stab incision made at the limbus at 2 O'clock position using Alcon steel blade superblade 15° (Alcon Laboratories). A second clear corneal self-sealing stab incision is made at 10 O'clock position.

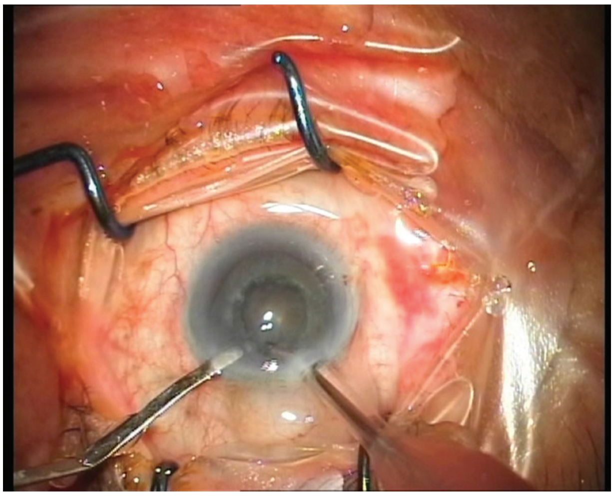
A central circular curvilinear capsulorhexis around 6.0–6.5 mm in diameter is performed. Hydrodissection is performed to free the nucleus from its attachment to the capsule followed by viscodissection to provide more capsular support.

A wide crater around 5.0 mm in diameter is created by down-slope carving up to 90% of the thickness of the nucleus with a 30° phaco tip using Alcon Infiniti System (Alcon Laboratories) (Fig. 1). Sculpting is started superiorly, continuing in the 6 O'clock direction in an orderly manner. If needed, power adjustments are made when approaching the equator and lenticular posterior capsule. The sculpting is halted when the crater depth is sufficient to allow visualization of the red reflex through the remainder nuclear plate [5] (Fig. 2).

The crater-and-divide maneuver is performed as follows: the phaco probe is applied at one edge of the crater without vacuum, and a spatula is applied at the opposite crater edge. The phaco probe and the spatula are pushed simultaneously in opposite directions toward the lens periphery, splitting the remaining nuclear rim into two halves (Fig. 3) (Video 1, http://www.mediafire.com/file/2n6sj1sr9nrps6u/Crater_1.wmv). Each half, consisting of a thin nuclear rim, is withdrawn with high vacuum and emulsified in the suprabagal space. After the nuclear phacoemulsification is completed, the irrigation/aspiration tip is used to clean residual cortical material, followed by insertion and in-the-bag placement of the intraocular lens (Aqua-Sense IOL; Ophthalmic Innovations International, Claremont, California, USA) using medium viscosity ocular viscoelastic device (OVD) to protect the corneal endothelium.

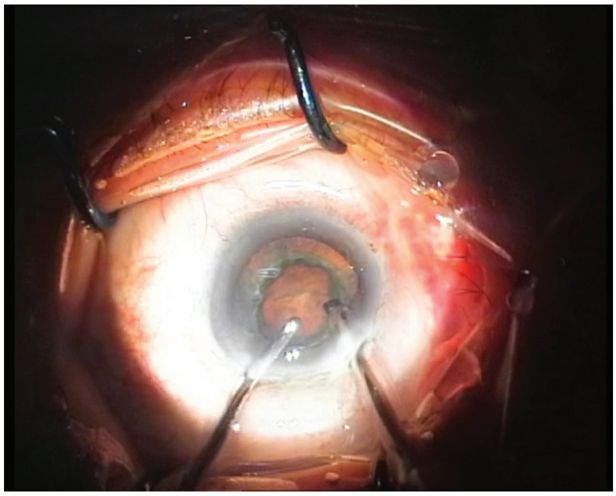
After bimanual irrigation-aspiration (I/A) of the OVD, stromal hydration of the incisions was performed and the eye patched. Postoperatively, topical moxifloxacin (0.5% Vigamox; Alcon Laboratories), corticosteroid (1%

Figure 1



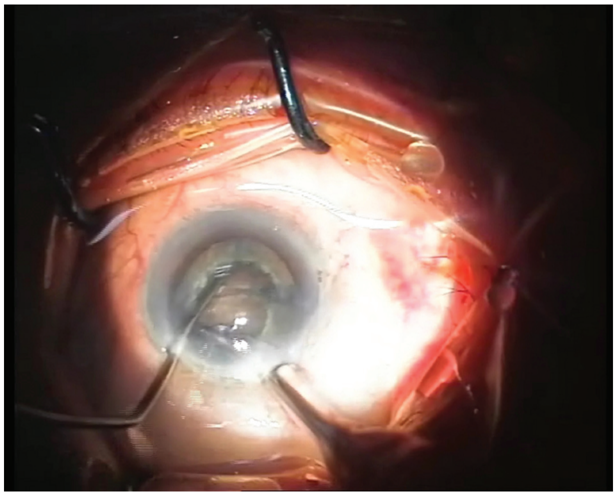
A wide crater around 5.0 mm in diameter is created by down-slope carving up to 90% of the thickness of the nucleus with a 30° phaco tip using Alcon Infiniti System (Alcon Laboratories.

Figure 2



The sculpting is halted when the crater depth is sufficient to allow visualization of the red reflex through the remainder nuclear plate.

Figure 3



The phaco probe and the spatula are pushed simultaneously in opposite directions toward the lens periphery, splitting the remaining nuclear rim into two halves.

Econopred Plus; Alcon Laboratories), and nonsteroidal anti-inflammatory eye drops (0.1% Nevanac; Alcon Laboratories) were prescribed five times daily for 1 week, and then corticosteroid and nonsteroidal anti-inflammatory eye drops were used alone for the following 3 weeks.

Statistical analysis

All descriptive statistical analyses were performed using IBM SPSS software (version 20.0; SPSS Inc., Chicago, Elenoi, USA).

Results

The crater-and-divide technique of phacoemulsification was performed in 30 eyes of 22 patients with sizable tough cataracts without complications. Table 1 shows preoperative, intraoperative, and postoperative data of the studied patients.

Intact posterior capsule was achieved in all cases. Clear cornea was reported on the first postoperative visit in 24 eyes and negligible postoperative early corneal edema in six eyes, which cleared within 2 weeks of follow-up. Visual rehabilitation was speedy in all cases.

Table 1 Distribution of the studied patients according to different parameters (*N*=30)

Parameters	Value
Age (years)	
Mean±SD	63.9±2.7
Median (range)	65.5 (58–71)
Sex	
Male	14 (46.6)
Female	16 (53.4)
R1 (mm)	
Mean±SD	7.7±0.3
Median (range)	7.8 (7.5–8.2)
R2 (mm)	
Mean±SD	7.6±0.4
Median (range)	7.6 (7.2–7.9)
Axial length (mm)	
Mean±SD	22.5±0.8
Median (range)	23.4 (21.7–24.9)
Biometry (D)	
Mean±SD	21±4.4
Median (range)	22 (16–28)
ECCE conversion	
No	30 (100)
Yes	0 (0)
Posterior capsule rupture	
No	30 (100)
Yes	0 (0)
Dropped nucleus	
No	30 (100)
Yes	0 (0)
Vitreous loss	
No	30 (100)
Yes	0 (0)
IOL implantation	
No	0 (0)
Yes	30 (100)
Postoperative persistent corneal edema	
No	30 (100)
Yes	0 (0)

Qualitative data were described using *n* (%). ECCE, extracapsular cataract extraction; IOL, intraocular lens; R1, radius of curvature of the flat corneal meridian; R2, radius of curvature of the steep corneal meridian.

Discussion

Phacoemulsification became the gold standard for cataract extraction. Technological innovations in phaco devices and enhanced microsurgical techniques have made phacoemulsification of nearly all cataracts feasible [1]. Endocapsular phacoemulsification gave the technique broader access [4].

Nonetheless, undergoing uneventful endocapsular phacoemulsification remains a challenge in situations where the cataract has a sizable tough nucleus with minimal cortical support [6]. It is hard to chop a sizable tough nucleus using existing phacoemulsification means without complications. The posterior plates of these nuclei are difficult to break and, because of the potential posterior capsule rupture, it is difficult to perform full-thickness chopping in cataract with no cortical support. In addition, the sizable nucleus does not leave adequate room within the capsular bag [7–11].

The manipulations needed for the stop-and-chop and divide-and-conquer techniques do not permit intrabagal emulsification of nuclear chunks, and the majority of the maneuvers are undertaken in the anterior chamber or pupillary plane. The surgeon inadvertently faces recurrent prolapse of the tough nuclear pieces into the anterior chamber, transforming endocapsular phacoemulsification into a nonachievable goal. This may result in excessive application of phaco power within the anterior chamber and can seriously harm the corneal endothelium [5].

Our novel crater-and-divide phacoemulsification technique permits uneventful phacoemulsification of sizable tough cataracts. The carving of a primary crater of large width and depth permits easy and safe breaking of the remaining posterior nuclear plate and the peripheral nuclear rim, protecting the posterior capsule from potential damage.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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