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Research Article

Left-Handed Overfeeding Maneuvers: A New Approach to Achieve US-Free Phacoemulsification

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Abstract

We describe a straightforward technique to achieve phacoaspiration without ultrasound (US) usage for soft nucleus graded 1 and 2 [1]. Succeeding incisions, continuous curvilinear capsulorrhexis (CCC) and hydrodissection, a nucleus fracture is performed with the Nagahara chopper simply supporting the nucleus with the phaco tip. Then the nucleus is rotated 90 degrees and the same step is repeated to create an additional fracture. The first nucleus fragment is disassembled from the capsular bag and, allied with a high vacuum of 700+ mmHg the chopper overfeeds the aspiration line without contact the phaco tip as the purpose is not to perform multiple fractures but to keep a steady continuous aspiration pattern.

Introduction

Currently phacoemulsification is withstanding as the most accepted technique for elective cataract surgery performed worldwide for its forthright reproduction and good results [2-4]. Many techniques were described to effectively fracture the nucleus over the years and phaco chop became a popular approach. The standard vacuum setting for most surgeons who use the gravity dependent infusion system is 300 to 450 mmHg, as in this setting the postocclusion surge and the possibility of posterior capsule rupture exists [5]. Shi, et al. have reported that higher vacuums may improve the phacoemulsification efficiency with safety by using the monitored forced infusion system available in the Centurion® machine [6]. However, the phaco machine has improved in technology and now is providing a safe anterior chamber environment to higher vaccums of more than 700 mmHg with a minimum risk of surge [7-10].

We describe the left-handed overfeeding maneuvers (LeHOM) considering the surgeon as dexter, the phaco *sine nocere* (a concept for harmless eye surgery) and its advantages in soft cataract cases. By changing the surgery approach in multiple paths (retinal protection filter, nucleus fracture and phacoaspiration) we developed a new technique to achieve a US-free nucleus aspiration (*Sine nocere* approach).

Surgical Technique

The LeHOM technique is operated under topical anesthesia. Using the *sine nocere* concept, we use the retinal protection filter of the microscope as blue light may cause damage to the photoreceptors [11,12]. The procedure commences with a side-port incision and the anterior chamber is filled with Viscoat□ (Alcon Laboratories, Forth Worth, and Texas) viscosurgical device (OVD), then a 2.4 mm clear corneal incision is performed 90 degrees apart.

The machine is set at a ultrasound (US) power of 0% with a peristaltic pump, the vacuum is set at 700+ mmHg and the flow rate at 60 cc/min at Alcon Centurion□ vision system (Alcon Laboratories, Forth Worth, Texas) with the active fluidics mode on and irrigation of 55 mmHg.

A 5.0 mm round CCC is performed and a complete hydrodissection is carried out. The Nagahara chopper is inserted underneath the anterior capsular edge to support the nucleus equator.

The irrigating mini-flared Kelman phaco tip (Alcon Laboratories, Forth Worth, and Texas) enters the anterior chamber and simply supports the central nucleus while a compressive motion is created with the Nagahara chopper to perform the

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first nuclear fracture without vacuum or ultrasound usage. After the first fracture is effectively performed, the nucleus is rotated 90 degrees and the same step is repeated to create a second fracture, then the first nucleus fragment is disassembled from the capsular bag and, in a bevel-toward-fragment position, the nucleus is continuously overfeeded with the Nagahara chopper as the vacuum rises near the highest provided by the machine. The chopper reaches about 0.1 mm of distance from the phaco tip but does not touch it as the purpose is to feed the phaco tip and not to fracture the nuclear fragment. The same steps are repeated with the remaining nuclear fragments. Phacoaspiration is followed by irrigation/aspiration of the cortex and insertion of a posterior chamber intraocular lens in the bag.

While performing a femtosecond laser assisted cataract surgery (FLACS), we recommend a cross-pattern of two chops fragmentation and not the chop-cylinder or the frag pattern as the aim is to maintain a contiguity of the nuclear fragment to reach and maintain the highest vacuums provided by the phaco machine.

Discussion

Effective hydrodissection with free maneuverability of the nucleus is often sufficient to allow phacoaspiration using the LeHOM approach. This technique provides a safe and straightforward way of chopping the endonucleus within the capsular bag without ultrasound or vacuum usage. Ultrasound energy is associated with damage to intracameral structures [3,4,13,14].

This technique represents an antithesis to the conventional phacoemulsification with ultrasound usage. We have tried to phacoaspirate the soft cataracts on a mono-manual phaco approach without success as it is necessary a continuous aspiration motion with the non-dominant hand that can only be provided by the overfeeding maneuvers of the aspiration line with the chopper. This technique was tried in harder nucleus and in other phaco machine devices without success as surge became an issue [10].

While performing the LeHOM-FLACS technique it is necessary to create whole fragments, hence the cube fragment pattern may break in discontiguity during the nucleus aspiration reducing the capability to maintain a high steady vacuum. The cubic fragments may handicap the surgery as through dissemblance they may lodge behind the iris, within the paracentesis or in the anterior chamber (Figures 1 and 2).

The main factor for achieving phacoaspiration by the LeHOM technique concerns the singular characteristic of Centurion®, in this machine, the anterior chamber IOP fluidics control acts independently of the vacuum used, the flow rate or the variation of the flow rate, as previous studies have demonstrated [15,16]. In a post-occlusion break situation the variation of the surge area obtained with Centurion® ActiveFluidics® *vs* Infiniti® with a vacuum of 600 mmHg is about 3.3 times lower [15]. With a post-occlusion break, the variation of the IOP is about 2 times lower in the Centurion® with ActiveFluidics® in relation to the Infiniti®. In the situation of flow rate variation between 0-60 cc/min, the intraocular pressure variation with centurion active fluidics was 2.5%, while in Infiniti®, this variation was 53.75% [16].

Our study group has performed this technique in more than

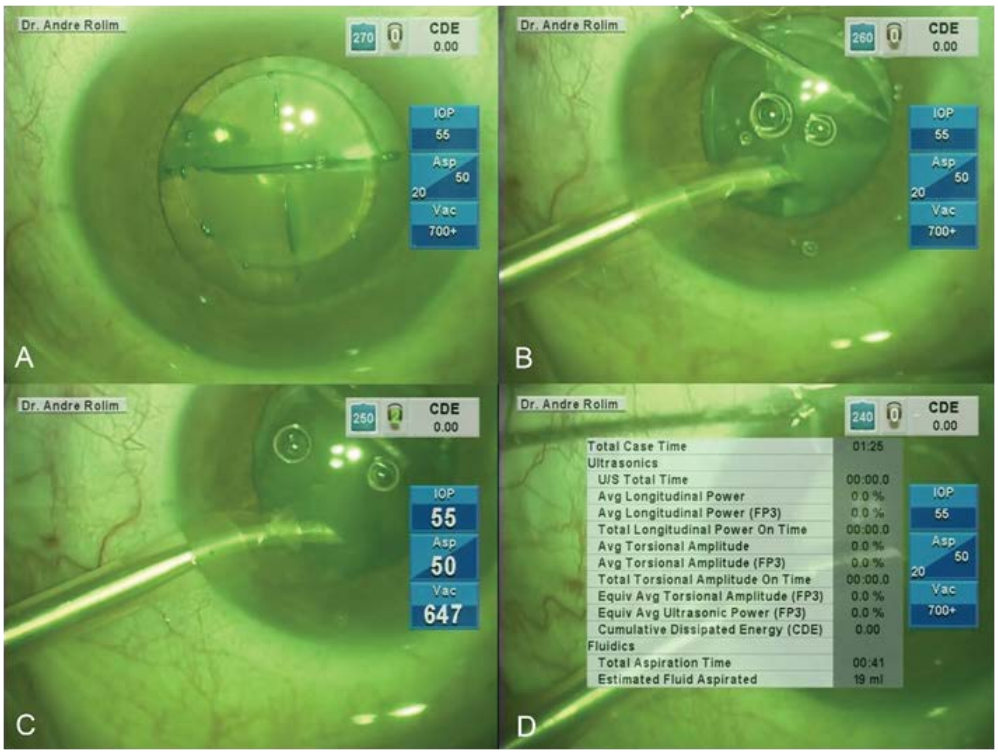

Figure 1: ***A*****:** A FLACS case with free floating capsulotomy. **B:** The fracture is confirmed with a Nagahara Chopper and the phaco tip simply by supporting the nucleus without irrigation. **C:** High vacuum is obtained. **D:** Low estimated fluid aspirated and low aspiration time with no use of ultrasound at the end of the nucleus treatment.

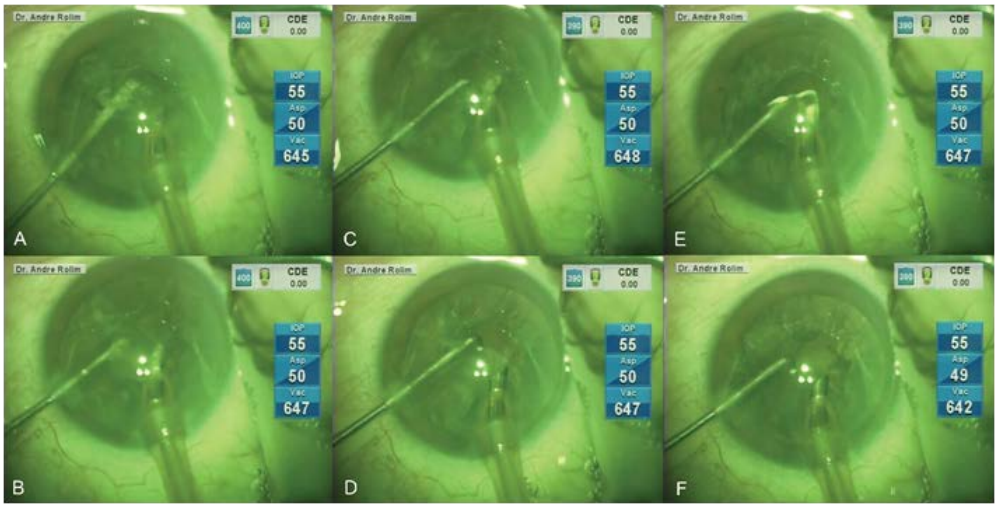

Figure 2: *Left-Handed Overfeeding Maneuvers.* A. A quadrant is disassembled from the capsular bag and presented to the phaco tip by the Nagahara chopper. B and C. The nucleus is pushed through the aspiration line with a overfeeding maneuver. D, C and E. The nucleus is aspirated and high vacuum is maintained with the repetition of steps B and C.

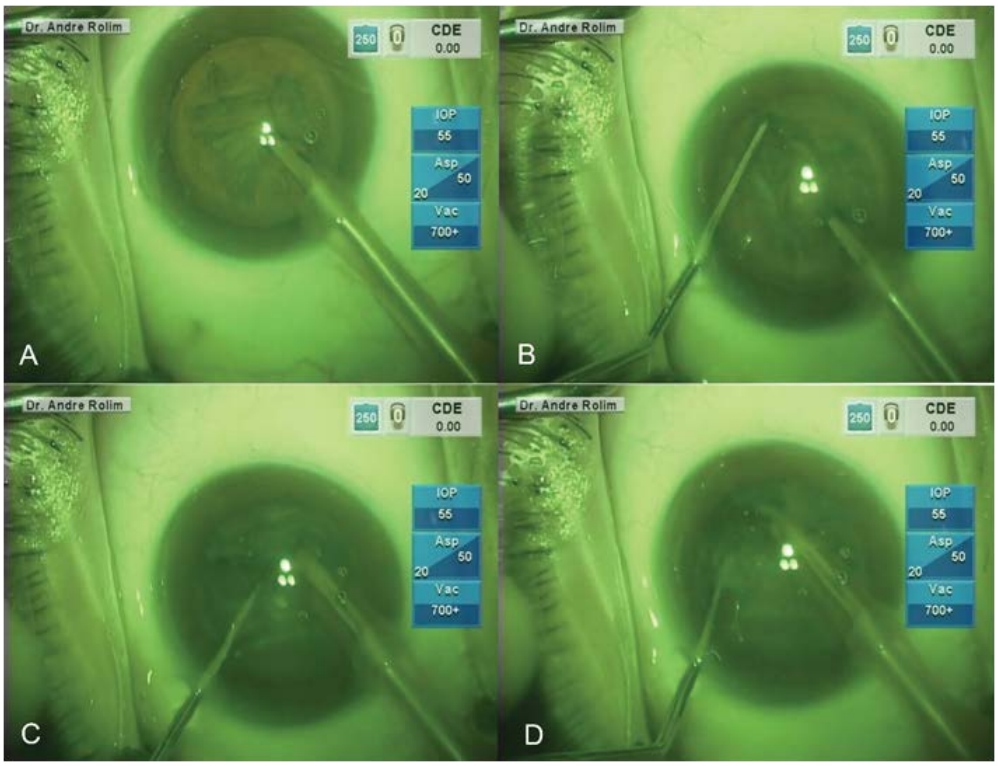

Figure 3: *A Nagahara chopper prefracture technique is performed for nucleus graded 1 and 2.* ***A:*** *The Phaco tip supports the nucleus.* ***B:*** *The Nagahara chopper holds the lens equator.* ***C:*** *A compressive force is made to disrupt the lens.* ***D:*** *The fracture is completed without use of ultrasound or vacuum.*

a thousand patients, as we have been developing it since 2016, with no complications regarding posterior capsule rupture/vitreous prolapse reported. We have also developed a pilot study using this technique with 18 patients in which we evaluated the corneal endothelial changes after surgical treatment comparing femtosecond laser assisted and nonassisted phacoaspiration.

In this study, 5 of them (27.7%) were male and 13 (72.2%) were female. The corneal density was measured by the specular microscopy and the central corneal thickness of the cornea by the Oculus Pentacam. The patients were evaluated preoperatively, at the first postoperative day and three months after the surgery (Figure 3).

The mean age in group I (femto-assisted) was 57 years ± 6.4 and in group II was 55, 1 years ± 11.55. The density of corneal endothelial cell at the third month postoperative was 2406 ± 315, 91 in group I and 2317 ± 441, 27 in group II. No statistical

significance was found between cases and controls. The mean corneal thickness at the end of the first month was 543 ± 47, 07 in group I and 546 ± 25, 21 in group II, and no statistical significance was observed when the groups were compared. The analysis of figure 4 exhibits a shorter time of nucleus aspiration in group I when compared to group II. The standard deviation is higher in Group II due to two extreme times occurring in this group.

Figure 5 presents the volume of BSS used during the nucleus treatment, regardless of the next surgical steps. We can observe that the volume of BSS is lower in group I. Femtosecond laser pretreated group presented with a reduction of aspiration time and BSS volume used during the nucleus treatment and aspiration.

Supplementary data

Video

We show a series of 5 cases with the LeHOM approach. After a 5.0 mm round CCC and an effective hydrodisection are carried out, the Nagahara chopper is inserted underneath the anterior capsular edge to support the nucleus equator. The phaco tip is introduced in the anterior chamber and while it simply supports the central nucleus, a compressive motion is created with the Nagahara chopper to perform the first nuclear fracture without vacuum or ultrasound usage. After the first fracture is successfully accomplished, the nucleus is rotated 90 degrees and the same steps are repeated to create a second fracture, then the first nucleus fragment is disassembled from the capsular bag and, in a bevel-toward-fragment phaco tip direction the nucleus is continuously aspirated with left handed repeated maneuvers and the highest vacuums of the phaco machine are achieved.

https://www.dropbox.com/s/1m4jgva5s5lkwl1/Left%20Handed%20Overfeeding%20Manouvers%20-%20A%20New%20Technique%20to%20Achive%20US%20Free%20Phacoaspiration.mp4?dl=0

What Was Known

- To date, many techniques were described with the use of choppers and ultrasound for fracturing and removing cataracts.

What This Paper Adds

- The LeHOM technique presents a new way to fracture and to aspirate nuclei graded 1 and 2 without ultrasound usage.

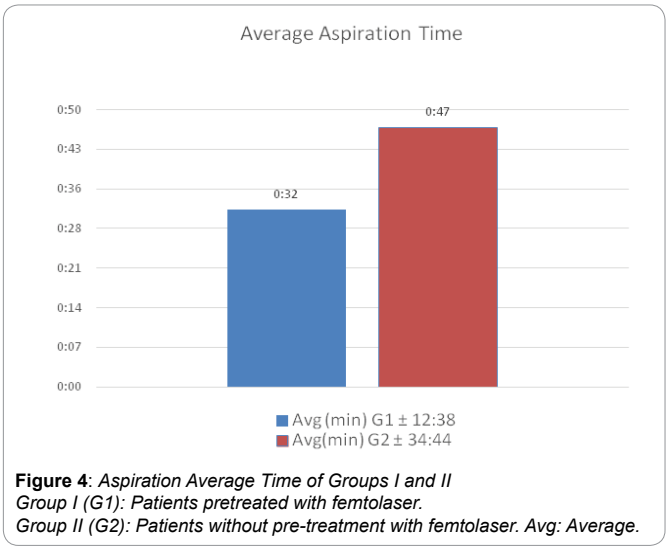

Figure 4: *Aspiration Average Time of Groups I and II*
Group I (G1): Patients pretreated with femtolaser.
Group II (G2): Patients without pre-treatment with femtolaser. Avg: Average.

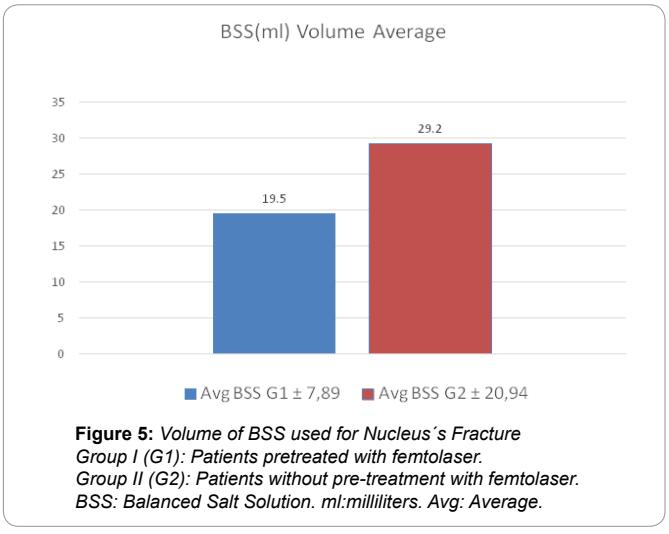

Figure 5: *Volume of BSS used for Nucleus´s Fracture*
Group I (G1): Patients pretreated with femtolaser.
Group II (G2): Patients without pre-treatment with femtolaser.
BSS: Balanced Salt Solution. ml:milliliters. Avg: Average.

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