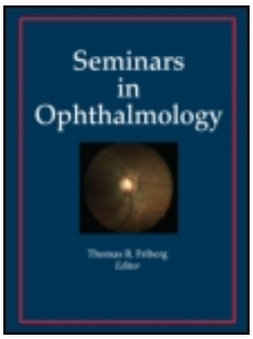

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ORIGINAL ARTICLE

A Novel Capsulorhexis Technique in White Cataract Surgery

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ABSTRACT

Purpose: To investigate the efficacy and safety of novel capsulorhexis technique in white cataract surgery using the irrigation-aspiration system of a phaco device. M*aterials and Methods*: 53 eyes of 50 patients were included in the study. Patients were randomly divided into two groups. To 27 eyes of 27 patients in Group 1, continuous curvilinear capsulorhexis (CCC) was made using an irrigation-aspiration system by a phaco machine. To 26 eyes of 23 patients in Group 2, CCC was made using an ocular visco-elastic device (OVD) and utrata forceps. Surgical results were compared between two groups. R*esults*: No difference in outcome endothelial cell count or central corneal thickness was noted between the two groups. CCC-2 has been completed totally in Group 1 but only 22 eyes in the other group. C*onclusions*: Capsulorhexis with described technique is safe in white cataracts. This technique may be an alternative in capsulorhexis to the other method, which is made using OVD and forceps.

Keywords: Continuous curvilinear capsulorhexis, phaco, white cataract

INTRODUCTION

Surgical removal of white cataracts is responsible for a number challenges to the surgeon.[1,2] In such cases, the capsule is more fragile; leakage of liquefied cortical material and capsulorhexis tears might extend to the periphery because of high intracapsular pressure.[3,4] For these reasons, performing continuous curvilinear capsulorhexis (CCC) is very difficult in white cataract surgery. Here, we described a new technique for CCC to tackle the mentioned problems. In this technique, for CCC, using bimanual irrigation and aspiration system of the phaco machine is utilized without using an ophthalmic visco-surgical device (OVD) and forceps. However, in general, CCC is performed using an utrata forceps and OVD. This study aimed to compare traditional continuous curvilinear capsulorhexis and vacuumed-assisted capsulorhexis techniques in white cataract cases.

MATERIALS AND METHODS

In this clinical study, the patients were divided into two groups. The ''1-CCC group'' received traditional (using utrata forceps and OVD) CCC and the ''2-CCC group'' received vacuum-assisted CCC. Written informed consent was obtained from each patient. Patients with any other ocular disease, such as lens-induced uveitis, or glaucoma, or with a history of ocular trauma, were excluded from the study. Cataracts appearing white on slit-lamp examination were defined as white mature cataracts. Cyclopentolate 1% and phenylephrine 2,5% eye drops were used for mydriasis four times within one hour before the surgery. All cataract operations were performed by an experienced surgeon. Fifteen patients in the 1-CCC group were operated on under topical anaesthesia, while the remaining patients underwent sub-Tenon's anesthesia.

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After anesthesia, the eyes was prepared and draped for surgery. Two side ports were made with a 23-gauge stiletto knife at the 9:00 and 2:00 sites. An air bubble was injected into the anterior chamber using a 27-gauge cannula through a paracentesis. Anterior capsule staining using trypan blue 0.1% was performed under air. Trypan blue solution was aspirated from the anterior chamber with bimanual irrigation and aspiration. Afterwards, in the 1-CCC group, the irrigation hand piece was introduced into the anterior chamber through a 2:00 side port with the irrigation on. The irrigation hand piece was attached to a balanced salt solution with bottle height 90 cm above eye level. A 27-gauge cystotome was introduced through the 9:00 side port. An anterior capsular flap was created with cystotome. The capsular flap was vacuumed with a 25-gauge visco-elastic cannula, which then connected to the phaco machine vacuum (Figures 1–3). The phaco machine vacuum setting at this stage was 400 mmHg. CCC of approximately 5 mm was performed. During this period, the irrigation hand piece, held in the left hand, maintained a deep anterior chamber and stabilized the globe. A clear corneal tunnel incision was made with a 2.75 metal blade under continuous irrigation. Hydrodissection was performed through the main incision. After hydrodissection, 0.1 ml OVD was injected into the anterior chamber for the protection of corneal endothelial cells during phacoemulsification.

In the 2-CCC group, CCC was performed using a utrata forceps and OVD. Phacoemulsification was performed in the capsular bag, and cortical lens material was aspirated with a bimanual irrigation/aspiration cannula. The capsular bag was expanded with the OVD, and a foldable IOL was implanted into the capsular bag. The OVD was aspirated from the retrolental space, the capsule fornix, and the anterior chamber using a bimanual irrigation/aspiration cannula. The corneal incision was checked for water tightness and left unsutured. All patients had best-corrected visual acuity (BCVA) slit-lamp examination, applanation tonometry, B-scan ultrasonography (preoperatively), and pachymetry (EchoScan US-4000, Nidek Inc., Japan) for central corneal thickness (CCT) and specular microscopy (Topcon specular microscope, SP-3000P, Japan) for corneal endothelial cell count (CECC). CECC and CCT were performed prior to surgery and one week postoperative. Postoperatively, all patients were prescribed ofloxacin 0.3% and prednisolone acetate 1% eye drops four times a day for one month. The complications of each of the two groups were also recorded. Examinations were carried out by masked observers who were not aware of the patients' assigned group. Postoperative examinations were done at one day, one week, two weeks, and one month.

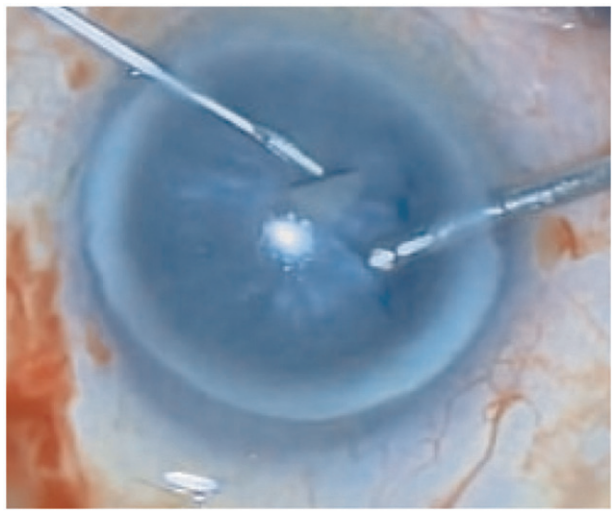

FIGURE 1. Creation of anterior capsular flap with cystotom.

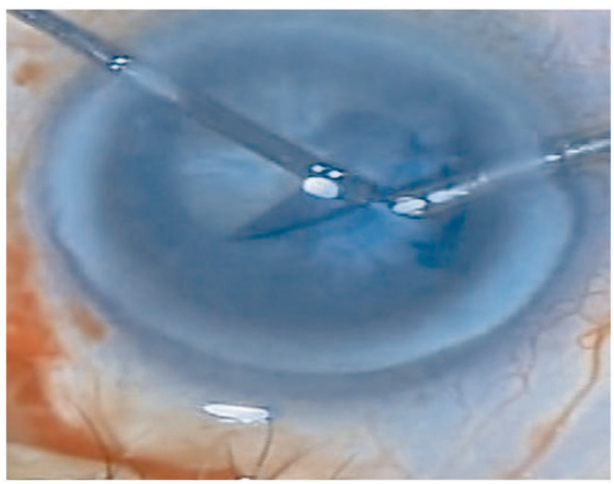

FIGURE 2. Vacuumed capsule with viscoelastic's cannula.

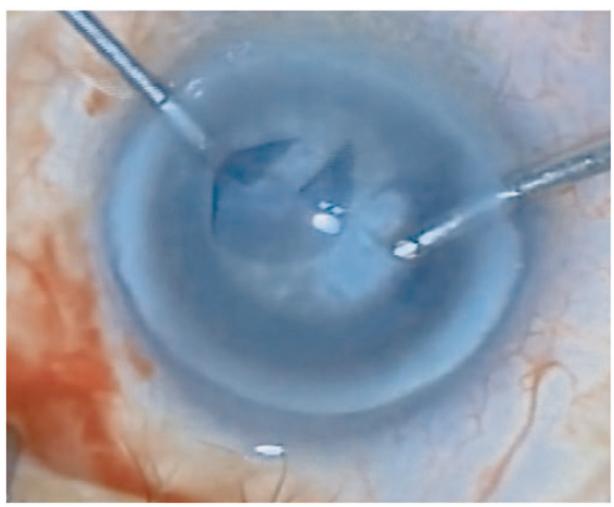

FIGURE 3. Completion of the CCC.

Obtained data were analyzed using the Statistical Program for Social Sciences (SPSS), version 10.0 and Statistica 5.1/97. The statistical analysis was performed using Fisher's test. Results were expressed as means ± SD and a p value of <0.05 was considered statistically significant.

RESULTS

A total of 53 eyes of 50 patients with white cataract were recruited during the study period. All of the cases were done under sub-Tenon's anaesthesia apart from 15 patients underwent topical anaesthesia in 1-CCC group. There were 13 women and 14 men in the 1-CCC group, and 12 women and 11 men in the 2-CCC group. The mean age of patients in 1-CCC group was 69.23 ± 9.5 years, while it was 70.36 ± 5.7 years in the 2-CCC group. There was no statistically significant difference between mean ages, sex, and case numbers of the two groups ($p > 0.05$) (Table 1).

The median preoperative BCVA was hand movement in the 1-CCC group and hand movement in the 2-CCC group. The preoperative mean intraocular pressure (IOP) was 14.42 ± 4.32 mmHg in the 1-CCC group, while mean IOP was 15 ± 2.43 mmHg in the 2-CCC group. There was no statistically significant difference between the two groups in terms of median preoperative visual acuity and mean preoperative IOP ($p > 0.05$). The median postoperative BCVA on the first day after the operation was 0.2, and then improved to 0.4 at one week of postoperative period in the 1-CCC group, and similarly 0.2 and 0.3 in the 2-CCC group, respectively. After one month of follow-up, the final median BCVA was 0.7 (range, 0.3–1.0) in the 1-CCC group, and 0.6 (range, 0.4–0.9) in the 2-CCC group.

TABLE 1. Preoperative clinical characteristics of the study subjects.

	Group 1	Group 2	p Value
Age	69.23 ± 9.5	70.36 ± 5.7	$p > 0.05$
IOP (mmHg)	14.42 ± 4.32	15 ± 2.43	$p > 0.05$
CCT (μm)	531 ± 23.65	525 ± 27.23	$p > 0.05$
CECC (cells/mm^2)	2476 ± 45.69	2443 ± 53.31	$p > 0.05$

Abbreviations: IOP, intraocular pressure; CCT, Central corneal thickness; CECC, corneal endothelial cell count.

On day 1 after the operation, the mean IOP for the 1-CCC group was 20.54 ± 5.16 mmHg and 21.15 ± 4.6 mmHg in the 2-CCC group. The IOP then gradually decreased to preoperative levels by the end of postoperative one week. At the first week after the operation, the mean IOPs for the 1-CCC group and 2-CCC group were 15.14 ± 3.2 mmHg and 16.21 ± 4.1 mmHg, respectively. There was no statistically significant difference in postoperative median BCVA and mean IOP between two groups ($p > 0.05$) (Tables 1 and 2).

The mean preoperative CCT of the 1-CCC group was 531 ± 23.65 μm, and 525 ± 27.23 μm in the 2-CCC group. There was no statistically significant difference in mean preoperative CCT between two groups ($p > 0.05$). At the first week after the operation, the mean CCTs for the 1-CCC group and 2-CCC group were 546 ± 34.21 μm and 543 ± 36.12 μm, respectively. No statistically significant difference was observed regarding the mean postoperative CCT (Tables 1 and 2).

The mean preoperative CECC of the 1-CCC group was 2476 ± 45.69 cells/mm^2, while it was 2443 ± 53.31 cells/mm^2 in the 2-CCC group. There was no statistically significant difference in mean preoperative CECC between the two groups ($p > 0.05$). At the first postoperative week, in the 1-CCC group the mean CECC reduced to 2204 ± 54.85 (−10.98%) cells/mm^2 and to 2195 ± 33.53 (−10.15%) cells/mm^2 in the 2-CCC group. The reduction in the mean CECC after surgery was statistically significant ($p < 0.05$). There was no statistically significant difference in mean postoperative CECC between the two groups ($p > 0.05$) (Tables 1 and 2).

During the visit at the postoperative first day, corneal oedema was observed in 11 eyes in the 1-CCC group and in nine eyes in the 2-CCC group. Oedema was resolved two weeks after surgery in all cases in both groups. There was no statistically significant difference in case number with corneal oedema between the two groups ($p > 0.05$) Phacoemulsification was performed in 48 of the 53 eyes, with four eyes in the 2-CCC group requiring conversion to extracapsular cataract extraction due to a radial tear during CCC. One eye in the 2-CCC group developed rupture of the posterior capsule during cortex removal. Anterior vitrectomy with sulcus IOL placement was performed without further complications.

TABLE 2. Postoperative clinical characteristics of the study subjects.

	Group 1	Group 2	p Value
IOP (mmHg) (on day 1 after)	20.54 ± 5.16	21.15 ± 4.6	$p > 0.05$
IOP (mmHg) (at week 1 after)	15.14 ± 3.2	16.21 ± 4.1	$p > 0.05$
CCT (μm) (at week 1 after)	546 ± 34.21	543 ± 36.12	$p > 0.05$
CECC (cells/mm^2) (at week 1 after)	2204 ± 54.85	2195 ± 33.53	$p > 0.05$
Final median BCVA	0.7	0.6	$p > 0.05$

Abbreviations: IOP, intraocular pressure; CCT, Central corneal thickness; CECC, corneal endothelial cell count.

DISCUSSION

In the last decade, phacoemulsification has become the standard management procedure for cataracts in developed countries. However, phacoemulsification of a white cataract is responsible for particular challenges to the cataract surgeon, as the continuous curvilinear capsulorhexis (CCC) is more difficult to complete because of an increase in intralenticular pressure and occasional leakage of lens matter from the anterior capsule puncture site.[1–6]

Gimbel et al., in a prospective observational study dealing with intumescent white cataracts, mentioned the advantage of a small continuous curvilinear capsulorhexis, which is secondarily enlarged after aspirating the liquefied milky lens contents (two-stage continuous curvilinear capsulorhexis); it was advocated that this might be a safer approach compared to one-stage capsulorhexis.[7] However, two-stage continuous CCC may prolong the duration of operation. Furthermore, intruding a cannula into the eye for several times might cause OVD to escape out of eye, displacement of the iris-lens diaphragm, and peripheral radial capsular tears. In addition, an additional OVD will be needed for the anterior chamber. Contact with the iris during entry and exit to the anterior chamber might lead to pupil contraction, which might cause complications and prolongation of the duration of surgery.

Postoperative measurements, including BCVA and IOP, did not reveal statistically significant differences between the two groups ($p > 0.05$).

Sallet reported that a continuous anterior chamber infusion using an anterior chamber maintainer and omission of OVD during phacoemulsification and IOL implantation did not cause a significant difference in corneal swelling or endothelial cell loss during the early postoperative period of up to one month.[8] In the present study, we used 0.1 ml of OVD after hydrodissection and applied a small amount of OVD for protection of the endothelium during phacoemulsification. This was preferred in order to avoid damage of corneal endothelial cells during phacoemulsification. We have not experienced any corneal oedema due to endothelial cell loss. In our study, no differences were observed between the two above-explained different techniques of CCC in terms of CECC and CCT ($p > 0.05$).

Our results suggest that the proposed method will be more useful in white cataract surgeries, a situation known to involve higher risks and complications compared to those in white cataracts. Four eyes in the 2-CCC group required conversion to extracapsular cataract extraction due to a radial tear during CCC. The higher success rate was achieved for CCC with the vacuum-assisted CCC technique.

Intracapsular pressure is increased in white cataracts.3 The OVD placed into the anterior chamber does not completely flatten the lens capsule. Therefore, uncontrolled capsular radial tears occur during CCC procedure. Furthermore, the milky lens material leaked into the anterior chamber, during CCC, impairing vision. This milky material needs to be aspirated repeatedly and OVD should be added to the anterior chamber. Due to these facts, capsular complications might occur. In the presented series, no complications were observed during CCC procedure in Group 1. In the procedure, performed in Group 1, the fluid given to the anterior chamber flattens the lens capsule and prevents leakage of milky lens material to the anterior chamber. Even if the milky lens material passes to the anterior chamber, it can be aspirated during the procedure.

Fifteen patients in CCC-1 group were operated under topical anesthesia and no complications occurred in these cases. This observation suggested that this technique can be performed with topical anesthesia, as well. On the other hand, during CCC using utrata, the eye should be fixed with forceps, which might cause conjunctival hemorrhage and conjunctival laceration. However, these complications are not seen in the recommended technique, since the eye is fixed with an irrigation handpiece.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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