Corneal Incisions in Extracapsular Cataract Extraction Versus Phacoemulsification: OCT Morphological Study

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Abstract

Aim: To evaluate clear corneal incision in manual extracapsular cataract extraction (ECCE) versus phacoemulsification using anterior segment spectral domain optical coherence tomography (SD-OCT).

Setting: Ophthalmology department, Assiut University Hospitals, Assiut, Egypt.

Methods: This prospective study included 40 eyes of 40 subjects who had cataract surgery through a superior clear corneal incision (20 eyes underwent manual ECCE and 20 eyes underwent phacoemulsification). Three months postoperatively each eye was scanned at the corneal incision site using anterior segment SD-OCT. (RTVue-100; Optovue). We compared the corneal incision in both groups considering any changes in the epithelial side; endothelial side, and stromal healing.

Results: Perfect apposition along the epithelial side was achieved in all cases of both groups. Stepping and wound gapping along the endothelial side was detected in 45% of the ECCE group and 10% of the phacoemulsification group. Irregularity of the stromal healing line and double level of stromal entry were recorded in 25% and 20% of the ECCE group respectively compared to no instances in the phacoemulsification group. We reported one incident of anterior chamber fibrous band in growth in the ECCE group.

Conclusion: Clear corneal incision in phacoemulsification is characterized by better reproducibility, more regularity along the stromal healing line, and better sealing at the endothelial side compared to manual ECCE corneal wound. Both ECCE and phacoemulsification clear corneal incisions seal well along the epithelial side.

Keywords: Anterior segment; Cataract extraction; Clear cornea; Extracapsular; Phacoemulsification; OCT

Introduction

Although phacoemulsification through clear corneal incisions is considered now the preferred cataract surgical technique worldwide [1,2], it is much more dependent on machinery than the conventional manual extracapsular extraction (ECCE), and costlier. Manual ECCE is still a popular cataract removal technique in the developing world.

Spectral domain optical coherence tomography (SD-OCT) provided detailed cross-sectional images of structures in biological tissues with an axial resolution of 5 microns and a transverse resolution of 15 microns. It afforded real-time, artifact-free quantitative imaging [3,4].

Although SD-OCT was designed primarily to examine the posterior segment, imaging of the anterior segment was achieved by adjusting the anterior module [5].

The aim of this work was to study the architecture of clear corneal incision in manual ECCE versus phacoemulsification using anterior segment spectral domain optical coherence tomography (SD-OCT).

Materials and Methods

We conducted this study at Assiut university hospital and EL Noor eye center after getting the approval of the ethics committee at the faculty of medicine. The study followed the declaration of Helsinki. Informed consent was obtained from all patients.

This observational prospective cross-sectional study included forty eyes of forty patients with age related cataract with no other ocular co-morbidity (e.g. severe corneal pathology, glaucoma, inflammatory eye disease, previous ocular trauma or surgery). None of the patients had diabetes or other systemic disease which may affect wound healing process. Patients were subdivided into two groups. Twenty patients were incorporated in the phacoemulsification group and 20 patients underwent manual ECCE. All surgeries were performed by the same surgeon.

In the phacoemulsification group, the corneal incision was created superiorly with a 3.0 mm disposable metal keratome. Phacoemulsification was performed utilizing the WHITESTAR Signature System. Stop and chop technique was used to manage the nucleus. A foldable acrylic IOL was injected into the capsular bag without enlargement of the clear corneal tunnel. We used only stromal hydration to maintain apposition of the corneal incision without suturing.

We performed ECCE through a partial thickness groove incision (about 10 mm length) at peripheral clear cornea; the incision was made perpendicular to tissues, approximately two-thirds thickness deep. The anterior chamber was entered with a microsurgical knife and then surgeon injected viscoelastic into anterior chamber. A 360-degree can-opener anterior capsulotomy was created with a cystitome. The wound was extended with corneoscleral scissors angling blades at 45 degrees to tissue to create a biplanar incision. The nucleus was expressed by...
applying careful pressure at 6 and 12 o’clock. The cortical material was removed with manual irrigation/aspiration. Viscoelastic was injected into the anterior chamber and capsular bag, and then a single piece PMMA PCIOL was implanted. The wound was carefully closed using 4-5 interrupted 10-0 nylon sutures, which were removed 2 months postoperatively.

Anterior segment imaging was performed using SD-OCT (RTVue-100; Optovue, Freemont, CA, USA). This device uses two lens attachments, the corneal adaptor module (CAM) to get anterior segment images. One of these lenses was short (CAM-S) and provided a high-magnification view, while the other was long (CAM-L) and provided a wider viewing angle but at a slightly decreased resolution. In our study, we used the long attachment (CAM-L) to obtain vertical and horizontal raster line scans 6.0-mm in length to study the center of the incision. Image analysis was performed using the built-in analysis program.

In the present study, SD-OCT scan was obtained three months post-operatively to compare between the corneal incisions of the two studied groups. We evaluated any changes along the epithelial side, stromal healing line, and endothelial side.

Results

In this study, we examined 40 eyes of 40 patients (26 men and 14 women). The patients’ mean age was 52 years (ranging from 48 to 67). Perfect wound apposition along the epithelial side was achieved in all cases of both groups. Phacoemulsification clear corneal incision either one-step or two-step was reported to be more coopted, smoother and more regular (Figures 1 and 2) compared to the irregular pattern of ECCE incision (Figure 3). Stepping and wound gaping along the endothelial side was seen in 45% of the ECCE group and 10% of the phacoemulsification group (Figure 4). Irregularity of the stromal healing line was seen in 25% of the ECCE group while was not seen in the phacoemulsification group. Double level of stromal entry was observed in 20% of ECCE group (Figure 5) and was not reported in the phacoemulsification group. One case of fibrous band ingrowth into the anterior chamber was reported in the ECCE group (Figure 6).

Discussion

OCT imaging is a fast and precise method to study cataract surgical
incisions. Several authors have studied clear corneal incision integrity and healing. Most of these studies evaluated phacoemulsification incision. In our study, we compared the corneal incision architecture between manual ECCE and phacoemulsification using OCT imaging modality. To our knowledge, this study is the first SD-OCT report about ECCE clear corneal incision.

Torres et al. used a retinal OCT system with adjustments to image the cornea. They found no correlation between the structural integrity of the phacoemulsification wound and the incision angle [6].

In 2007, the profile of phacoemulsification clear corneal cataract incisions on the first postoperative day was examined by Fine et al. using Zeiss Visante OCT anterior segment imaging system. They found that the clear corneal incisions had an accurate configuration rather than a straight-line configuration and described stromal swelling lasting for at least 24 hours [7]. Five architectural features of the phacoemulsification clear corneal incisions were noted: epithelial gaping (12%), endothelial gaping (41%), endothelial misalignment (65%), local detachment of Descemet’s membrane (62%), and loss of coaptation (9%) [8].

In their study of clear corneal incisions, Schallhorn et al. did not observe either external or internal wound gaping in OCT images [9].

Fine et al. found that phacoemulsification corneal wounds without stromal hydration may develop internal gaping and incisions with external groove (biplanar) develop both internal and external wound gaps [7].

In our study, both groups demonstrated perfect wound apposition along the epithelial side which might be explained by the long interval between surgery and time of anterior segment OCT imaging.

Using Fourier-domain OCT, Teixeira et al. noted a higher incidence of epithelial imperfection at the corneal incision site of the wounds (36%) at first postoperative day with spontaneous resolution on follow-up [10]. This higher incidence may be explained by very early evaluation of the incision.

On the other hand, imperfect apposition of the endothelial margin in the form of stepping and wound gaping was seen in 45% of the ECCE group and only in 10% of the phacoemulsification group. Stromal healing was perfect with no detectable irregularities in the phacoemulsification group while irregularity of the stromal healing line was seen in 25% of the ECCE group.

Using optical coherence tomography, internal gaping of uniplanar incisions was reported by Torres et al. in 25% of cases at 24 hours and 10% at 1 month [6].

In their study, Peng and Liu reported gaping at the endothelial side of the corneal phacoemulsification wound in 62.2% and gaping at the epithelial side in 11.1% at 2 days postoperatively. 15.6% more of the eyes had a gap at the endothelial side at 1 week postoperatively, and 5.6% more at 1 month postoperative [11].

Conclusion

We think that the large incision length, the technique and the multiple instruments used to create corneal incision in manual ECCE were responsible for the difference between both groups. Surgeons should pay attention during creation of the ECCE corneal incision to avoid incision complications such as imperfect endothelial apposition and irregularity of the stromal healing line which may compromise the integrity of the incision.

The limitations of this study included the relatively small number of cases, short follow-up period and lack of evaluation of post-operative corneal astigmatism and its relation to OCT findings. Further studies may be needed to address these issues.

References