

## Corneal Endothelial and Central Corneal Thickness Changes after non Complicated Uneventful Phacoemulsification

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### ABSTRACT

**Aim of the work:** this study aimed to evaluate the central corneal thickness and the corneal endothelium by specular microscopy in torsional phacoemulsification versus longitudinal phacoemulsification. **Methods:** in our study we did a comparative analysis of the changes in endothelial cells of the cornea (Central cell density and cell loss) and central corneal thickness after cataract extraction surgeries by torsional phacoemulsification versus longitudinal phacoemulsification. In our study thirty eyes of thirty patients were chosen from Ophthalmology clinic at Bab Al-Shaariah University Hospital for uneventful phacoemulsification surgeries (15 eyes of 15 patients for torsional phaco and 15 eyes of 15 patients for longitudinal phaco). The types and densities of cataract were determined as cortical, posterior subcapsular (PSC), nuclear I, nuclear II and nuclear III. Divide and Conquer technique was used for phacoemulsification using (Infiniti, Ozil technology, Alcon) phaco machine. A noncontact specular microscope Topcon SP-1P (Topcon Corporation, Japan) was used to evaluate the central endothelial cell density (CD) and central corneal thickness (CCT). **Results:** The mean U/S time was lower in the torsional group than in the longitudinal group ( $p < 0.05$ ). On comparing between the torsional Phaco and longitudinal phaco groups, the longitudinal phaco group had higher average central corneal thickness ( $p > 0.05$ ) and higher average corneal endothelial cell losses at 2 weeks postoperative ( $p > 0.05$ ). **Conclusions:** our study suggested a better efficiency by the torsional mode rather than the longitudinal mode.

**Keywords:** Corneal Endothelial, Central Corneal Thickness.

### INTRODUCTION

Phacoemulsification and intraocular lens implantation is the preferred method to treat cataract, however, the quality of surgery is a problem that needs to be addressed<sup>(1)</sup>. Phacoemulsification surgery can be described based on its two components. The first, ultrasound energy is used to emulsify the nucleus of the lens. The second, a fluidic circuit is used to remove the nucleus through a small incision while maintaining the anterior chamber. The circuit is supplied by an elevated irrigation bottle that supplies both the fluid volume and pressure to maintain the anterior chamber hydrodynamically and hydrostatically. The anterior chamber pressure was directly proportional to the height of the bottle. The fluid circuit was regulated by a pump that clears the chamber from emulsion and also provided significant clinical utility. When the phaco tip was unoccluded, the pump produced currents in the anterior chamber which attract nuclear fragments. When a fragment completely occlude the phaco tip, the pump provide holding power or vacuum, which grip the fragment<sup>(2)</sup>. Interrupted phaco mode, improved pump system and vacuum assisted phaco have reduced the amount of ultrasound power needed to remove the cataract. The ultrasound power continue to carry the risk for corneal endothelial cell loss and tissue damage. So, reducing ultrasound power with improving its efficiency was the main targets of

phacoemulsification technology<sup>(3)</sup>. Longitudinal phacoemulsification act by longitudinal stroke direction that produce cutting action during forward stroke. This longitudinal technique benefits from high vacuum to reduce the repulsion with the generated heat being proportional to the phaco power that used<sup>(4)</sup>. Torsional phacoemulsification act by sideways stroke direction that produce cutting action during either right or left directions, this lead to less power needed than longitudinal technique, better efficacy and less phaco time. Also with the torsional technique there is better follow ability with less repulsion and less dispersion of lens matter so we can decrease the vacuum, in addition to better anterior chamber stability i.e. less surge<sup>(4)</sup>.

### PATIENTS AND METHODS

30 patients with cataract were categorized into two groups: the first group was consisted of 15 patients, whose ages ranged from 55 to 70 years for torsional phacoemulsification. The second group was also consisted of 15 patients, their ages ranged from 55 to 70 years for longitudinal phacoemulsification. An ethical approval was obtained from the local ethical committee and all patients signed informed consent for the surgical procedure. All surgeries were performed using the Infiniti Vision System (Alcon Laboratories Inc.). Patients were with nuclear, cortical and nuclear cataract of grades I-II-III. **Exclusion criteria** included

history of previous intraocular surgery, presence of any corneal opacity, corneal endothelial disease, scarring or dystrophies, glaucomatous patients, patients with nuclear grade IV and V senile cataract, pseudoexfoliation syndrome, patients with an Endothelial count less than 1900 cells/mm<sup>2</sup> and age younger than 40 years and older than 70 years.

### Preoperative examinations

A complete ocular examination, ultrasonography included A-scan and B-scan. Using a noncontact specular microscope Topcon SP-1P (Topcon Corporation, Japan), analysis of the central endothelial cell density (CD) and central corneal thickness (CCT). Preoperative medications included topical antibiotic (Ofloxacin 0.3% eye drops) five times daily for 2 days before surgery. Pupillary dilatation was started 2 hrs before the surgery and this was achieved with one drop each of 1% tropicamide and 1% cyclopentolate instilled every 15 min.

### Anesthesia:

Surgeries were performed under local peribulbar anesthesia using 5 ml. of 2% Mepivacaine hydrochloride.

### Surgical technique:

A micro vitreo retinal (MVR) incision using a 20-G MVR blade was made at 2 o'clock position. Viscoelastic (Healon) was injected through the side port into the anterior chamber, and a corneal incision using keratome 3 mm was made at the 12 o'clock position. Capsulorhexis was performed using a rhexis forceps, followed by hydrodissection using balanced salt solution. Phacoemulsification of the nucleus was carried out by means of the divide and conquer technique. Irrigation/aspiration (I/A) followed to remove the soft cortex using a bimanual technique. Healon was injected to fill the anterior chamber and a foldable IOL was introduced by an injector into the anterior chamber and placed in the capsular bag. This was followed by irrigation/aspiration to remove the viscoelastic using a bimanual technique and the side port was hydrated. Topical ofloxacin 0.3% eye drops were instilled into the eye.

### Postoperative treatment:

Topical steroid and antibiotic eye drops were administered six times daily for 1 week and then the doses decreased gradually over a month and topical steroid ointment was applied once at bedtime.

### Postoperative follow-up:

Complete ocular examination was carried out after 1 week and 2 weeks postoperatively and included slit-lamp biomicroscopy for corneal edema, anterior chamber flare and cells. Examination of the state of the IOL was done, as well as refraction and specular microscopy 2 weeks postoperatively.

## RESULTS

This study included 30 eyes of 30 patients who were divided into two groups. In group A, 15 eyes of 15 patients underwent torsional phacoemulsification and in group B 15 eyes of 15 patients underwent longitudinal phacoemulsification. On comparison of mean U/S time there was a statistically significant difference ( $p < 0.05$ ) between each two groups, with the longest U/S time in longitudinal group and the shortest in torsional group, as shown in table 1. The mean preoperative endothelial cell count in torsional Phaco was 2786.47 cells/mm<sup>2</sup> with standard deviation (SD) of  $\pm 202.40$  cells/mm<sup>2</sup>. At 2 weeks postoperative the mean count was 2358.53 cells/mm<sup>2</sup>, standard deviation (SD) of  $\pm 185.03$ /mm<sup>2</sup>. The percentage of endothelial cell loss was 15.4%, as shown in tables 2 and 3. The mean preoperative endothelial cell count in longitudinal Phaco is 2847.13 cells/mm<sup>2</sup> with standard deviation (SD) of  $\pm 322.65$  cells/mm<sup>2</sup>. At 2 weeks postoperative the mean count was 2321.80 cells/mm<sup>2</sup>, standard deviation (SD) of  $\pm 392.01$  cells/mm<sup>2</sup>. The percentage of endothelial cell loss was 18.5% as shown in tables 2 and 3.

In torsional phaco group, the **P value** which expressed the change between the preoperative and the postoperative endothelial counts was 0.001 which is statistically significant ( $< 0.05$ ) as shown in table 2. In longitudinal phaco group, the **P value** which expressed the change between the preoperative and the postoperative endothelial counts was also 0.001 which is also statistically significant ( $< 0.05$ ) as shown in table 2.

On comparing between the torsional phaco and longitudinal phaco groups regarding the percentage of endothelial loss, the **P value** was 0.162 which showed no statistically significant difference ( $p > 0.05$ ) between the two groups, as shown in table 2.

The mean value of the central corneal thickness (Pachymetry) in torsional phaco was 484.67  $\mu\text{m}$  preoperatively with SD  $\pm 33.03$ . After 2 weeks the mean number was 512.60  $\mu\text{m}$  with SD of  $\pm 28.26$

as shown in table 4. The mean value of the central corneal thickness (Pachymetry) in longitudinal phaco was 512.27  $\mu\text{m}$  preoperatively with  $\text{SD} \pm 33.02$ . After 2 weeks the mean number was 532.73  $\mu\text{m}$  with  $\text{SD} \pm 33.22$  as shown in table 4. On comparing between torsional Phaco and longitudinal phaco as regard the central corneal thickness (Pachymetry) the P value preoperatively was 0.030 and after 2 weeks 0.085 with no statistical significant difference between the two types of surgery as regard central corneal thickness as shown in **table 4**.

**Table 1:** Comparison between torsional phaco and longitudinal phaco according to phaco power

	Group A S. D $\pm$ Mean	Group B S. D $\pm$ Mean	P. value
U/S Time / seconds	19.56 $\pm$ 8.3	26.25 $\pm$ 6.5	0.001

**Table 2:** The change in endothelial cell count (according to preoperative and postoperative values at 2 weeks compared to the torsional Phaco and longitudinal phaco and among each group

Cell Density	Group A Mean $\pm$ S. D	Group B Mean $\pm$ S. D	P. value
Endothelial Count Preop.	2786.47 $\pm$ 202.40	2847.13 $\pm$ 322.65	0.542
Endothelial Count Postop.	2358.53 $\pm$ 185.03	2321.80 $\pm$ 392.01	0.745
P.value	0.001	0.001	

**Table 3:** Comparison between torsional phaco and longitudinal phaco according to % of endothelial loss

	% of Endothelial loss
Endothelial loss group A	15.4 %
Endothelial loss group B	18.5 %
P. value	0.162

**Table 4:** The change in pachymetry (according to preoperative and postoperative values at 2 weeks) was compared in the torsional Phaco and longitudinal phaco and among each group

Pachymetry	Group A Mean $\pm$ S. D	Group B Mean $\pm$ S. D	P. value
Central Corneal thickness Preop.	484.67 $\pm$ 33.03	512.27 $\pm$ 33.02	0.030
Central Corneal thickness Postop.	512.60 $\pm$ 28.26	532.73 $\pm$ 33.22	0.085
P.value	0.019	0.102	

## DISCUSSION

In the current study, there was no statistically significant difference in endothelial cell loss between the two groups at 2 weeks postoperatively. However, there was difference in endothelial cell loss between the two groups, with the torsional group showing less endothelial cell loss with the percentage of endothelial cell loss was 15.4 % in torsional phaco group and 18.5 % in longitudinal phaco group. **Kim et al.** <sup>(5)</sup> compared mean central corneal thickness and central endothelial cell counts on 7 and 30 days postoperative in 102 eyes of 85 patients, 51 eyes in longitudinal phaco group and 51 eyes in torsional phaco group were enrolled in their study. They found that, in patients with moderate cataract the percentage of endothelial cell loss at 1 week postoperatively was 13.18% in the longitudinal group and 5.12% in the torsional group, which turned out to be not significantly different 1 month postoperatively (7.92% in the longitudinal group and 3.19% in the torsional group) and the increase in central corneal thickness at 1 week postoperatively was 7.09% in the longitudinal group and 6.18% in the torsional group, which turned out to be not significantly different 1 month postoperatively (4.18% in the longitudinal group and 3.92% in the torsional group), whereas in the hard cataract group the percentage of endothelial cell loss at 1 week postoperatively was 19.38% in the longitudinal group and 24.02% in the torsional group and at 1 month postoperatively was 13.45% in the longitudinal group and 23.52% in the torsional group, which is statistically insignificant, and the increase in central corneal thickness at 1 week postoperatively was 7.62% in the longitudinal group and 11.34% in the torsional group, which turned out to be not significantly different 1 month postoperatively (1.78% in the longitudinal group and 4.98% in the torsional group). They reported that it is possible that the shearing effect might not be as effective as the jackhammer effect in hard cataract, because U/S power in torsional phaco does not act on the nucleus perpendicularly. A clinical study was done by **Fakhry et al.** <sup>(6)</sup> on 98 eyes of 63 patients, 49 eyes in mixed longitudinal and torsional group and 49 eyes in torsional group. All eyes had nuclear cataracts of grades III and IV. In patients with

nuclear cataracts of grades III and IV they found that, CCT change at first day and 1 week postoperative between the two groups was statistically significant in favor of the torsional group ( $P < 0.001$ ), however it was insignificant at 1 month ( $P < 0.068$ ) and endothelial cell density change was statistically significant in favor of the torsional group in all follow-ups for both grades ( $P < 0.001$ ). The corneal thickness returned nearly to baseline 1 month after surgery, while endothelial loss persisted, being compensated by the remaining endothelial cells. They conclude that both U/S modes are effective in management of grades III and IV cataracts. However, the pure torsional group uses less U/S energy and time. On the other hand, **Vasavada *et al.***<sup>(7)</sup> compared the central corneal thickness on first day, one month and 3 months postoperatively, and endothelial cell density at 3 months postoperatively. The study included 360 eyes randomly assigned to torsional and longitudinal phacoemulsification. They found that, the change in central corneal thickness and endothelial cell loss was significantly lower in the torsional ultrasound group at all postoperative visits ( $P < 0.001$ ) compared to longitudinal ultrasound. Torsional ultrasound demonstrated quantitatively superior intraoperative performance and showed less increase in corneal thickness and less endothelial cell loss compared to longitudinal ultrasound. **Liu *et al.***<sup>(4)</sup> reported that the torsional mode may provide more effective lens removal with less endothelial cell loss compared with the longitudinal mode. In randomized comparative study including 525 eyes were assigned to phacoemulsification by torsional mode (263 eyes) and conventional mode (262 eyes). The change in the central corneal thickness and central endothelial cell counts compared to 1, 7, and 30 days postoperatively. At 1 day and 7 days, the central corneal thickness was significantly greater in U/S group than in the torsional group ( $P < 0.001$ ). At 30 days, the central corneal thickness was significantly greater in U/S group than in the torsional group ( $P > 0.01$ ). At 7 days and 30 days, corneal endothelial cell loss was significantly greater in U/S group than in the torsional group ( $P < 0.001$ ). **Reuschel *et al.***<sup>(8)</sup> in their study on senile cataract endothelial cell loss was 7.2% in the torsional group (72 eyes) and 7.1% in the longitudinal group (76 eyes) at 3 months postoperatively, with no statistically significant

differences ( $P = 0.342$ ). This was in contrast to our results, which may be attributed to the larger sample size in their study (72 eyes in the torsional group and 76 eyes in the longitudinal group). Our results are similar to those of **Bozkurt *et al.***<sup>(9)</sup>, There were 47 eyes in conventional group and 53 eyes in torsional group with mean nuclear grade was not different in the 2 groups. The torsional mode appears to cause less loss of corneal endothelial cells at 1 week postoperatively (4.2% in the torsional group and 6.7% in the longitudinal group), although not statistically significant ( $p = 0.56$ ). There is no significant increase in central corneal thickness at first day ( $p = 0.47$ ) and 1 week ( $p = 0.71$ ) postoperatively between longitudinal group and the torsional group. This is also in contrast with our results, which may be attributed to restriction of the follow-up to only 1 week postoperatively in their study. **Zeng *et al.***<sup>(10)</sup> showed that the U/S group had greater average central corneal and incisional thickness on days 1, 7 ( $p < 0.0001$ ) and 30 ( $p > 0.01$ ), and higher average corneal endothelial cell losses on day 7 and 30 days ( $p < 0.0001$ ). The difference of baseline central and peripheral corneal thickness was not significant between groups ( $p = 0.824$ ). The central corneal thickness were significantly greater in U/S group than in the torsional group on postoperative day 1 ( $p < 0.0001$ ) and day 7 ( $p < 0.0001$ ), there was no significant difference among the groups on postoperative day 30 ( $p = 0.732$ ). The difference in central endothelial corneal cells counts among the groups was not significant before surgery ( $p = 0.351$ ), but it was significant 7 days and 30 days after surgery. The U/S group caused more central endothelial cell losses than torsional group. The difference of average endothelial cells between the U/S group with fixed torsional group was statistically significant ( $p < 0.0001$ ).

## CONCLUSION

On comparing the two types of phacoemulsification as regard the postoperative corneal endothelial cell, we found that the torsional mode provides an effective and safe method for cataract removal with lower energy usage as compared with longitudinal traditional phacoemulsification. Our study suggested a better efficiency by the torsional mode rather than the longitudinal mode. It has been demonstrated that endothelial cell loss in torsional mode was lower than that in the conventional mode in cataract surgeries.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

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