ORIGINAL ARTICLE

Changes in Corneal Endothelial Cells Following MSICS VERSUS Conventional ECCE in a Tertiary Eye Hospital in North Western Nigeria

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ABSTRACT

Background: This study was undertaken to compare the effect of two surgical techniques of cataract extraction on corneal endothelial cell density in eyes of Nigerian adults with uncomplicated age-related cataract with the view to improving surgical visual function and quality of life. **Materials and Methods:** It was a prospective randomized non blinded hospital based interventional study. Two hundred and seventy-seven (277) eyes of 269 eligible patients with cataract were randomized to either manual small incision cataract surgery (MSICS) or conventional extracapsular cataract extraction (ECCE). The endothelial cell density (ECD), Coefficient of variation (CV), and Hexagonality (%) were measured pre-operatively, at one, four and twelve weeks post-operatively with a non-contact specular microscope (CSO SP 02).

Statistical analysis – Data obtained were entered into microsoft Excel and analyzed using SPSS version 16 software. **Result:** Of the 277 eyes studied, 263 (94.9%) were analysed. The mean age of patients for MSICS and ECCE was 64.03 (SD $\pm$ 11.2, range 40 – 95 years) and 62.69 (SD $\pm$10.48, range 42 – 94 years) respectively. The Male to female ratio was 1.9:1, in the two study groups. Pre-operatively, corneal parameters (mean ECD, CV and hexagonal cells) were similar between the two surgery groups. Postoperatively cataract surgery induced a mean endothelial cell density loss of 5.31% at one week, 7.28% at 4 weeks and 7.06% at 12 weeks in the study population. There was no statistically significant difference in the mean endothelial cell density loss between MSICS and ECCE groups.

Conclusion: Both MSICS and ECCE induced fairly equal moderate and reversible degree of endothelial cell density loss in adults with uncomplicated age related cataract.

Key- words; Endothelial cell density, ECCE, MSICS, Uncomplicated Cataract.

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Introduction

Cataract is a major cause of blindness worldwide and cataract surgery is the most frequently performed ophthalmic surgery[1].In recent decades, ophthalmologists performing cataract surgery have witnessed the successful application of new technology that have increased the efficiency of surgical technique, advanced standard of care and most importantly, given rise to better patient outcomes[2].Surgical techniques have evolved in the last few decades from intracapsular cataract extraction through extracapsular cataract extraction, MSICS,

phacoemulsification to femtosecond assisted phacoemulsification[2].

Damage to the corneal endothelium is induced by surgical procedures and is influenced by various preoperative and intraoperative factors such as, lens thickness, and surgical approach. Improved surgical techniques and instrumentation have led to ongoing improvement in cataract surgery[3].

A functioning endothelium is essential for corneal integrity and transparency. The corneal endothelium can be damaged by many factors during cataract surgery, and its status is an important parameter in evaluating the quality of anterior segment surgery. Since the corneal endothelial cells do not regenerate once destroyed, it is necessary to take all precautions not to destroy the cells during surgical procedures.

Specular microscopy has become a standard technique to determine endothelial cell density and morphology in vivo. Trauma to the endothelium reduces cell density, increases the mean cell size, and disrupts the normal morphological pattern.

Analysis of cell shape and pattern is a more sensitive indicator of endothelial damage than cell density alone[4].

With rapid advancement and sophistication in ophthalmology especially in cataract surgery every precaution should be enforced to reduce damage to the cornea most especially the endothelium.

However, this cannot be achieved without determining both the pre-operative and post-operative corneal endothelial cell density.

The result obtained may represent data on response of endothelium after cataract surgery from people of African origin, because such data is presently lacking.

It will also be important in applying new surgical techniques and monitoring endothelial wound repair in different individuals of African setting. The data obtained will further serve as a guide to having a safe intra-ocular surgery especially in evolving new methods of cataract extraction in blacks.

This study used specular microscope to estimate and clarify the extent of corneal endothelial injury following ECCE with PC IOL and MSICS with PC IOL implantation. Findings from this study will help in predicting visual outcome, prognostication and choice of method of cataract extraction in the reference population.

Materials and Methods

The study was a hospital based prospective, randomized single blinded interventional study. Consecutively, two hundred and seventy seven (277) eyes of 269 patients 40 years and older with uncomplicated age-related cataract that reported to National Eye Centre, Kaduna, Nigeria, from April 2011 to April 2012 were included in the study.

They were randomly assigned to either manual small incision cataract surgery (MSICS) or conventional extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens (PC IOL) implantation by balloting. A single surgeon performed all the procedures.

Sampling technique- all consecutive patients 40years and above with age related cataract that present to National Eye Centre who fulfilled the inclusion criterion were selected for the studies. Patients are selected as they come until the desired sample size was obtained.

Sample size determination- the minimal sample size was determined by using the following formula below[5], considering the population of cataract patients that present annually to the centre as < 10,000.

nf=n

1 + n

(N)

Where nf= the desired sample size when population is < 10,000

n = the desired sample size when population is > 10,000

N= the estimate of the population size

$$= \frac{384}{1 + 384}$$

741 (total adult patients with cataract)

= 252, adding 10% of non-response (25) gives overall total of 277.

A Human Research and ethical commitee in the centre granted the ethical approval. Written informed consent was obtained from all participants.

Exclusion criteria: Patients with history or signs suggestive of corneal disease e.g. pterygium, corneal dystrophies, infective keratitis or corneal guttata, acute/chronic uveitis, ocular trauma or surgery, contact lens wear, glaucoma or raised IOP, high myopia in cataract, pseudo-exfoliative syndrome, diabetes mellitus, presence of posterior synechea, evidence of subluxation after dilatation. Also patients that were included but subsequently had posterior capsule rupture ± vitreous loss with or without anterior chamber lens insertion.

Clinical evaluation and surgical procedures- Pre-operatively all eyes had anterior segment examination with slit lamp bio-microscopy and dilated funduscopy using 78D Volk lens. Intraocular pressure was measured using Goldmann-type applanation tonometry (Keeler tonometer, 2401-P- 2698. Serial no.08010448). Measurement of endothelial cell density was performed using Non-contact specular microscopy (SP 02, CSO CostruzioneStrumentiOftalmiciS.r.l.viadegli Stagnacci 12E - 50018 Scandicci Firenze – ITALIA).

All eyes had pupillary dilatation with 1% tropicamide and 5% Phenylephrine. Peribulbar anesthesia was administered using a combination of 2% lignocaine with adrenaline.

For the conventional extracapsular cataract extraction with posterior chamber intraocular lens implantation (ECCE + PC IOL), the index eye was cleaned and draped using 5% povidone iodine. Superior rectus bridle suture using 5/0 silk was put in place with superior rectus holding forceps. Conjunctival peritomy extending from 10- 2 o'clock hour was performed using Westcott's scissors and homeostasis secured with wet field cautery. Partial thickness limbal incision, obtaining about 2/3rd of total sclera thickness from 10-2 o'clock was made. Anterior chamber (A/C) was entered into with the tip of the blade. Viscoelastic was injected into the A/C. Can-opener technique anterior capsulotomy using 27G needle as a cystitome was performed. The partial thickness limbal incision was completed with universal corneal scissors. The nucleus was expressed out with alternating superior and inferior pressure using Vectis. Soft lens matter was aspirated with infusion-aspiration Simcoe cannular. The A/C was reformed with viscoelastics. Intraocular lens (IOL) was inserted into the posterior chamber capsular bag. The wound was sutured using interrupted suture technique with 10/0 nylon. The viscoelastic substance was aspirated from the A/C using the infusion aspiration Simcoe cannular using Ringer's lactate solution. The A/C was then reformed using the same Ringer's lactate.

For the manual small incision surgery with posterior chamber intraocular lens implantation (MSICS + PC IOL), patient's eye was cleaned and draped in supine position

under LA. Superior rectus bridle suture was placed using 5/0 silk with superior rectus holding forceps. A fornix based conjunctival flap was raised using the Westcott's scissors from 10-2 o'clock positions. Conjunctiva and Tenon's capsule were dissected and separated from the underlying sclera. These were retracted to expose about 4mm strip of sclera along the entire incision length. Homeostasis was achieved by applying gentle wet field cautery. External scleral incision obtaining one third to half thickness sclera was made about 2mm from the limbus and 5.5mm in length in straight configuration. Scleral-corneal tunnel was made with the crescent knife and extended about 1.5mm into the clear cornea. Internal corneal incision was made with a sharp 3.2mm angled keratome. Side-port entry of about 1.5mm valvular corneal incision was made at 9 o'clock position using 15^0 side port entry blade. This assists in aspiration of cortex and deepening of the A/C at the end of surgery. The anterior capsulotomy was performed in the same way as described in the conventional ECCE. Hydro-dissection was performed to separate cortico-nuclear mass from the posterior capsule. Corneal wound extended on either side. Nucleus was prolapsed into the A/C and delivered using Vectis by direct pulling. Soft lens matter was aspirated using a two- way irrigation and aspiration Simcoe cannular through the main incision and the side-port entry. A/C was reformed with viscoelastic substance. PC IOL was implanted into the capsular bag. Viscoelastic substance was then aspirated. The wound was closed after deepening the A/C with Ringer's lactate solution, using the two-way irrigation aspiration Simcoe cannula through the side-port entry.

At the end of the two procedures all eyes had Sub-conjunctival injection of dexamethasone 2mg and genticin 20mg and a drop of topical dexamethasone 0.1%, mydriacyl 1%, chloramphenicol 0.5% were instilled and the eye padded.

Postoperative treatment for each of the procedures included-gutt dexamethasone 2hourly for 72 hours then four times daily thereafter, gutt chloramphenicol four times daily, guttmydriacyl twice daily, tabs cataflam 50mg twice daily for 5 days. All ocular medications were given for a minimum of 6 weeks, thereafter steroids were tailed off while others were discontinued.

Post-operatively, central corneal endothelium was assessed serially using the non-contact specular microscope (SP 02, CSO). During each recording, the image quality and the resolution was noted. Only high contrast focused endothelial images with sufficient quality for analysis were recorded. For each corneal area, only one image was analyzedper count by computerized image analysis. Post-operative values were recorded at 1^{st} week,4 weeks and 12weeks intervals. Parameters recorded were cell number / mm^2, total area captured, standard error of mean (SEM), average area (Avg$\pm$SD) nm^2, density cell/mm^2, coefficient of variation (%), percentage of hexagonal cells (%) and corneal thickness (µm). Each time before values were recorded, measures such as good fixation from the patient and clear focusing image of the cornea from the specular microscope were taken to ensure that, the size of the area captured corresponded to equal or closer area captured previously by taking serial photographs. Post-operative assessments included slit lamp bio-microscopy for corneal clarity, anterior chamber reactivity and status of intraocular lens. This assisted in the diagnosis of postoperative inflammations and infections. Eyes that had intraoperative complications such as posterior capsular rupture, vitreous loss or unplanned intracapsular cataract extraction with or

without anterior chamber lens implantation were excluded from the study. Patients were informed on the next appointment date. Those that missed more than one follow up were excluded from the study. A single proforma was filled for each operated eye of patients that had bilateral surgery.

Statistical Analysis

Data obtained were entered into microsoft Excel and analyzed using SPSS software. The following parameters were calculated:

Difference in the mean endothelial cell density loss between the two groups at 1 week, 4 weeks and 12 weeks' postoperative period, pre and postoperative mean coefficient of variation, mean hexagonal cells (%).

One sample t test was used to compare pre-operative and postoperative values within a group, independent t test was used to compare the values between ECCE and MSICS, Spearman correlation analysis to assess relationship between parameters eg Hexagonality (%) versus coefficient of variation. P-value of <0.05 was considered significant and Limits of agreement (LoA), (95%CI) was calculated.

Results

A total of 277 eyes of 269 patients were included in the study. Fourteen eyes of fourteen patients were excluded from the analysis because one was found to have raised IOP >24mmhg after the surgery, two had unplanned intra-capsular cataract extraction with anterior chamber lens insertion following posterior capsular rupture and vitreous loss, while 11 were lost to follow-up. Two hundred and sixty-three (263) eyes were analysed, 8 of them were bilateral (3 males, 5 females); 100 right eyes; and 147 left eyes.

One hundred and forty-six (55.5%) eyes had MSICS with PC IOL while 117 (44.5%) eyes had conventional ECCE with PCIOL. Overall 229 eyes completed the 3 months' follow-up visits, while 34 eyes lost one follow-up visit. Seven eyes were part of the ECCE group and 27 were MSICS group (1 was absent at 4 weeks, 33 were absent at 3 months' follow-up period).

Table 1- Age – Sex distribution of the study population

Age Group (years)	Sex		Total	
	Male No. %	Female No. %	No. %	
40 – 49	12(6.9)	6 (7.0)	18 (6.8)	
50 – 59	53 (30.6)	21 (23.3)	74 (28.1)	
60 – 69	59 (34.0)	38 (42.0)	97 (36.9)	
70 – 79	30 (17.3)	11 (12.2)	41 (15.6)	
80 – 89	17 (10.0)	12 (13.3)	29 (11.1)	
≥ 90	2 (1.2)	2 (2.2)	4 (1.5)	
Total	**173 (65.8)**	**90 (34.2)**	**263 (100)**	

The mean age of patients who underwent MSICS and ECCE was 64.0, (SD±11.2, range 40-95years), and 62.7(SD±10.48 range 42-94years) respectively. Males accounted for

65.8% and females 34.2%. M : F ratio of 1.9 : 1. The mean IOP was 14.9mmHg in the RE and 15.1mmHg in the LE.

Table 2- Preoperative endothelial cell density of study population.

Age (yrs)	No of eyes	Sex		Mean cell density (cell/mm²)
		M	F	
40 – 49	18	12	6	2387-3997
50 – 59	74	53	21	2200-3390
60 – 69	97	59	38	2002-3302
70 – 79	41	30	11	2264-2996
80-89	29	17	12	1955-2936
≥90	4	2	2	1934-2634
Total	**263**	**173**	**90**	

Table 2 shows the preoperative ECD (cell/mm²) count in different age group. It was observed that there was a progressive decrease in endothelial cell density as the age increases.

Table 3- Preoperative characteristics of the two groups

Group		MSICS	ECCE	P Value	CI
Pre-op Characteristics					
Age (yrs)		64±11	62±10	0.319	-3.98to 1.3
Sex	**M**	97(eyes)	76 (eyes)	0.063	_
	F	49 (eyes)	41(eyes)	_	_
Total		146 (eyes)	117(eyes)	_	_
IOP (mmHg)	**RE**	14.3±2.8	14.8±2.8	0.259	-0.36to 1.4
	LE	14.5±2.8	15.1±2.9	0.194	-0.28 to 1.4
ECC (%)±SD		223±36	223±36	0.824	-11.2 to 8.9
ECD (%)±SD		2712±322	2668±289	0.281	-37.5 to 128
CV (%) ±SD		42.52±6.7	43.97±7.7	0.334	-2.9 to 0.99
Hexagonal cells (%) ±SD		47.94±3.2	46.64±6.5	0.155	-4.44 to 2.7
Pachymetry (μm) ±SD		505±43	511±42	0.272	-17.7 to 5.0

All values in mean ± SD, ECD (endothelial cell density), ECC (endothelial cell count), CV (coefficient of variation).

Table 3 shows the preoperative characteristics of the two groups. It was observed that there was no statistically significant difference in the preoperative mean age (p value 0.319, CI= -3.38 to 1.3), mean IOP (p value 0.259, CI= -0.36 to 1.4), mean ECC (p value 0.824, CI= -11.2 to 8.9), mean CV (p value 0.334, CI= -2.9 to 0.99), mean hexagonal cells (p value 0.155, CI= -4.44 to 2.7) and mean ECD (p value 0.281, CI= -37.5 to 128) between the two groups.

Table 4: Preoperative and Postoperative ECD of MSICS group

	Examination Interval			
Procedure	**Pre-op**	**1wk Post-op**	**4wks Post-op**	**12wks Post-op**
MSICS-ECD	2712±322	2567±402	2491±381	2500±391
Range	2091-3997	2850-3737	1184-3174	1043-3180
No of eyes	146	146	156	119
ECC (%)	223	180(19.3)	177 (20.6)	181 (18.8)
P value	_	< 0.001	< 0.001	< 0.001
CI	-	2502-2633	2429-2554	2429-2571

All values as mean ± standard deviation and range, ECD in cells/mm^2

In the MSICS group the postoperative ECD loss was 5.35% at 1 week, 8.15% at 4 weeks and 7.82% at 12 weeks.

Table 5: The Preoperative and Postoperative ECD of ECCE group

	Examination Interval			
Procedure	**Pre-op**	**1wk post-op**	**4wks post-op**	**12wks post-op**
ECCE-ECD	2668±289	2529±325	2505±295	2507±315
Range	1995-3391	1691-3290	1830-3250	1838-3723
No of eyes	117	117	117	110
ECC (%)	223	177 (20.6)	172 (22.9)	176 (21.1)
P value	_	< 0.001	< 0.001	< 0.001
CI	_	2469-2588	2450-2559	2447-2566

All values as mean ± standard deviation and range, ECD in cells/mm^2

In the ECCE group the postoperative ECD loss was 5.21% at 1 week, 6.11% at 4 weeks and 6.03% at twelve weeks.

Postoperatively, there was a statistically significant decrease in mean cell density in both groups compared to the preoperative values (tables 4 and 5). At 1 week, the decrease was 5.35% in the MSICS group ($p < 0.0001$, 95%CI = 2502 to 2633, t =77.1) and 5.21% in the ECCE group ($p < 0.0001$, CI = 2469 to 2588, t = 84.0). At 4 weeks, the decrease was 8.15% in the MSICS group ($p < 0.05$, CI= 2429 to 2554, t= 78.9) and 6.11% in the ECCE group ($p < 0.05$, 95% CI= 2450 to 2559, t =91.4). At 12 weeks, the decrease was 7.82% in the MSICS group ($p< 0.0001$, 95% CI = 2429 to 2571, t = 69.7) and 6.03% in the ECCE group ($p< 0.0001$, 95% CI = 2447 to 2566, t = 83.4). There was no statistically significant difference between the two groups, (at 1week p = 1.131, CI = -42.14 to154.4, at 4 weeks' p = -0.142, 95% CI = -99.3to 86.1, and at 12 weeks' p = 0.620, 95% CI = - 73.4- 139.8).

Comparism of ECDBetween the Groups Post-operatively

The mean pre-operative endothelial cell density was 2712±322 (SD) in the MSICS group and 2668±289 in the ECCE group, the difference (44cells/mm² was not statistically significant p= 1.083 (95% CI- 37.36 to 127.9). Postoperatively, there was no statistically significant difference between the two groups, (at 1 week p = 1.131, CI = -42.14 to154.4, at 4 weeks p = - 0.142, 95% CI = -99.3to 86.1, and at 12 weeks p = 0.620, 95% CI = -73.4- 139.8).

Mean Cell Loss of Endothelial Cell Count

The difference in the mean cell loss between the two groups was 3cells/mm2 at 1wk and 5cells/mm2 at subsequent follow-up visits (4 and 12weeks) respectively. It was not statistically significant (p = 1.765, 95% CI: -1.15 to 19.3).

Figure 1 compares the ECD of the patients between the two groups. There was progressive decrease in the mean ECD during the postoperative period of follow up in the two groups

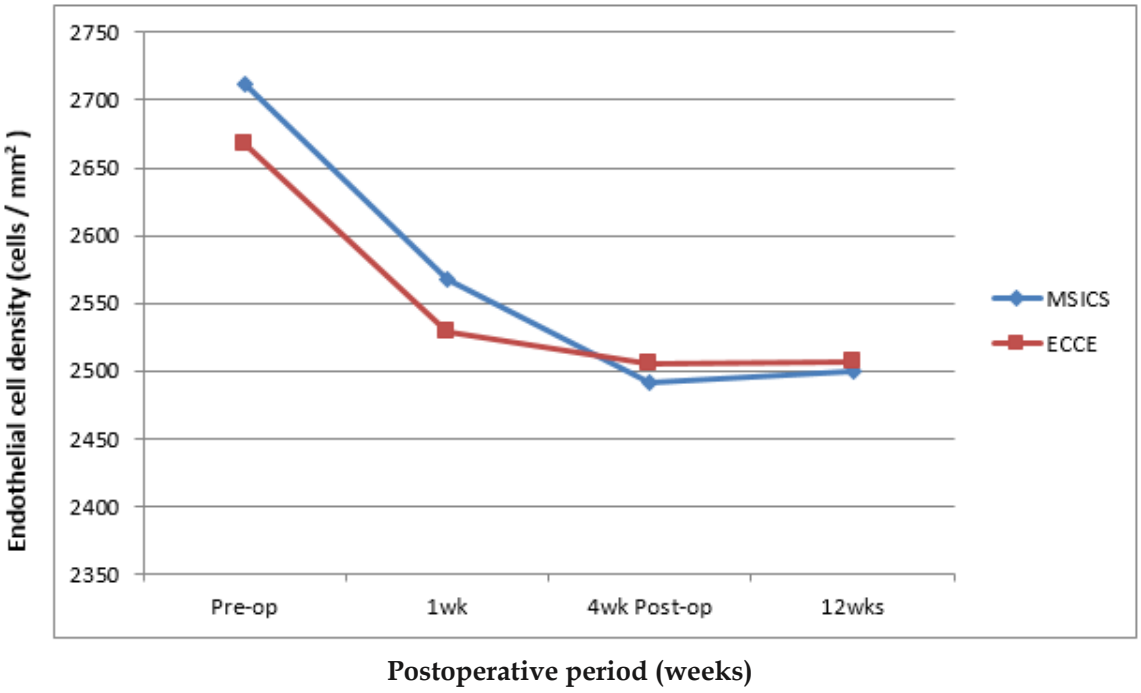

Figure 1: Comparison of Postoperative ECD of patients in the two groups

The preoperative mean hexagonal cells was 47.9%+5.2SD in the MSICS group and 46.6%+6.5SD in the ECCE group. No statistically significant difference was observed in the two groups (p =1.430, 95% CI: -0.44 to 2.75).

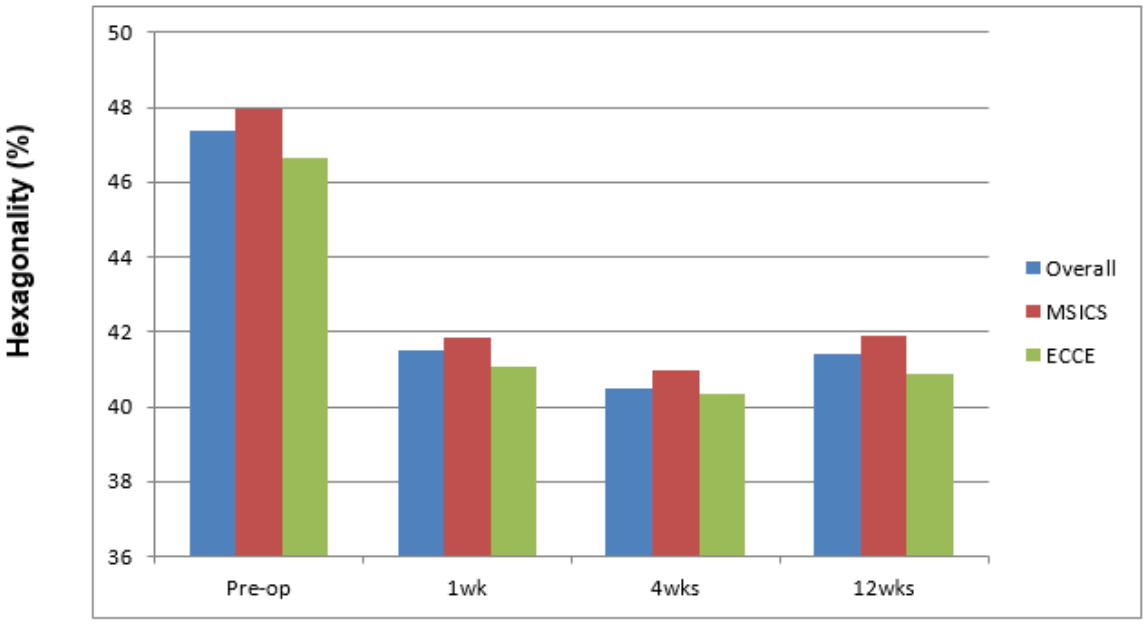

Figure 2: Frequency of Postoperative hexagonal cells in the two groups

Figure 2 shows the frequency of hexagonal cells during the follow up period. A progressive decrease in % of hexagonal cells was observed. However, there was no statistically significant difference between the two groups (P = 0.260, 95% CI-1.75 to 2.28) during the follow up period.

Using the Spearman's correlation, it was observed that negative correlation exists between coefficient of variation and hexagonality in the overall study population, MSICS and ECCE groups. (overall r = - 0.685, p = < 0.0001, MSICS r = - 0.633, p =< 0.0001, ECCE r = - 0.745, p = < 0. 0001).

Discussion

Specular microscopy is a standard technique used to determine a qualitative and quantitative morphometric analysis of the endothelial cells in vivo[6].The two groups studied (MSICS and ECCE group) were found to have similar pre-operative characteristics with respect to age, sex, mean IOP, endothelial cell count and endothelial cell density. Ninety-four percent (94.9%) of the study participants completed two or more follow up visits, which probably was due to the effort made to contact them on phone as a reminder for their appointment. Sixty-five percent (65.8%) of the patients were males, probably due to gender inequality where female patients have poor access to cataract surgical services particularly in this part of the developing world[7-8]. Sixty-five percent of the patients (65%) were in the age range of 50yrs to 69yrs.

Human central cornea endothelial cell density decreases at an average rate of approximately 0.6% per year in normal corneas throughout adult life, with gradual increases in polymegathism and pleomorphism[9]. After cataract surgery, endothelial cell density

decreases at a greater rate than in healthy, non-operated corneas. The reported[10] loses varies between 4% and 25%, and the period of increased post-operative endothelial cell loss remains unknown.

In this study, the overall average pre-operative corneal endothelial cell density (ECD) was found to be 2693 cells/mm^2 ±308 SD. Similar figures were reported by Mihai et al[11] from Canada, North America (2631 cells/mm^2). Kenji etal[12]reported 2605 cells/mm^2 from Inouye Eye Hospital Tokyo, in Japanese eyes. Sabineetal[13]reported 2666 cell/mm^{2}in 70 eyes that were examined at a German University Eye Hospital. Similarity was noted in the above studies. This might be a reflection of similarity in age range of the patients recruited into the study as well as having similar uncomplicated age related cataract. Some other studies[3,14] however, reported lower values (2397 cells/mm^2,2430 cells/mm^2) of preoperative ECD. A possible explanation for the dissimilarity may be in technique, equipment used to measure the ECD and its calibration at different precision values.

However, studies have reported that the Endothelial cell density of age-matched normal population varies from one country to another. In Iranian eyes[15] a range of 1030 and 3341 cells/mm^2 was reported. Snellingeet al[16] from South Asia reported 2634cell/mm^2 in Nepal, 2783cells/mm^2 in Bangladesh and 2714cells/mm^{2}in South India. In American and Japanese population Mamoru[17] reported ECD ranges of 2431-2619 cells/mm^2 and 3298-3749 cells/mm^2 respectively, signifying racial differences. To the best of the researcher's knowledge, no such normative data is available for either Nigeria or any African country to make comparison with.

Thus, as cataract develops it seems the ECD equally reduces to certain level as reported by Kraff et al[18] from USA, who reported lower corneal endothelial cell densities in white race patients who presented with cataract, than in age-matched normal population, which might be an indication that cataract itself may be a risk factor for lower endothelial cell density. This observation will need to be elucidated in future by a controlled study in Nigeria.

In this study, cataract surgery was found to induced mean central corneal endothelial cell density loss of 7.06% at 12 weeks post operatively. A study by Tony et al[3] in a Berlin University, Germany, reported ECD loss of 8.5%. The slightly higher value obtained in the Berlin study[3] may probably be due to racial differences rather than surgical techniques, where phacoemulsification was performed in all eyes, a much more refined surgical procedure. A study by Christopher et al[13] also in Germany, a higher percentage loss of 11.4% was reported, where corneal sclera tunnel incision was performed in all eyes. However, in their study measurement of endothelial cell density was obtained using 2 different methods; Fixed Frame Method (FFM) and Automated Center Method (ACM) which might explain the differences in the results. In another study by Sabottkaet al[19] who examined 30 eyes of white race patients from Switzerland, a 16% loss was reported in eyes that had phacoemulsification, however detailed surgical procedure was not indicated.

Also, Barisetal[20] from University of Ophthalmology Istanbul, Turkey reported 11.9% loss in patients with uncomplicated senile cataract who had phacoemulsification. The differences of these findings with the present study, might also be due to differences in surgical techniques and demographic characteristic of the patients especially the age groups.

The postoperative mean ECD loss was (MSICS 2500±391 SD cells/mm², ECCE 2507± 315 SD cell/mm², p value 0.620, CI -73.4 to 139.8 at 12 weeks' postoperative period)

This difference was not statistically significant between the two groups, even though a slightly higher preoperative mean ECD count was observed in the MSICS group (p value = 1.083, CI -37.36 to 127.9).

This finding was supported by several other similar studies, Noel et al[21] compared phacoemulsification and conventional extracapsular cataract surgery but found no significant difference in endothelial cell loss in the two groups (10.7% cell loss for extracapsular and 10.0% cell loss for phacoemulsification). In another study by Bourne etal[22] from United Kingdom who randomized 500 cataract patients, age 40yrs and above into two groups (ECCE group and phaco group). No significant difference in overall corneal endothelial cell loss was found between these two procedures; (16.2%) in phaco group and (14.1%) in extracapsular group). However, the authors[22] reported an increased risk of severe corneal endothelial loss with phacoemulsification patients with dense cataracts (52.6% with phaco versus 23.1% with extracapsular extraction). Also a randomized controlled trial in India[23] revealed similar endothelial cell loss in phacoemulsification and the small incision extracapsular cataract surgery (SICS) 6 weeks after the procedure (15.5% in the phaco group and 15.3% in the SICS group), with comparable final visual results in both groups. Similar findings were reported by Rita et al[24] who compared micro-incision versus standard technique of phacoemulsification.

In each of the studies reported by Noel et al[21], Bourne et al[22], Gogate et al[23] and Rita et al[24], it confirmed that all the surgical techniques induced some degree of corneal ECD loss, but there were no statistically significant differences in the percentage of ECD loss in the surgical procedures. Giorgio et al[4] from Italy, compared phacoemulsification using clear corneal incision versus scleral tunnel incision and observed that sclera tunnel incisions were associated with a lower post-operative endothelial damage; when compared with clear corneal incisions. The authors[4] concluded that the scleral tunnel is more posterior and therefore induced less direct and indirect trauma to the cornea (mechanical corneal striae). While other studies[3,25,26] reported lower figures, estimating the rate of endothelial cell loss with phacoemulsification to be between 1.2% and 12%. The variation in the results of all these findings with the present study, might be explained in terms of different surgeons who carried out the surgical techniques, differences in racial group as well as different equipment and methods used to measure corneal ECD count.

Negative correlation was observed between the coefficient of variation and % hexagonality. This means that as the % of hexagonal cells is decreasing following surgery (which constitute 60% of the normal functioning endothelial cells), the remaining cells expand to compensate for the lost ones, thus increases cell variability which is expressed as the coefficient of variation.

Duration of the two surgical techniques did not differ significantly, suggesting that overall technique had no significant effect on the changes of corneal thickness with time (average time for ECCE was 22min and for MSICS was 18min). Similar findings were reported by Rita et al[24].These similarities might be due to the fact that all the surgical techniques where performed by the most experienced ophthalmologists in both

studies. MSICS may be a more preferred technique for age related cataract in our environment because it is less time consuming, particularly in this part of the world where high burden of cataract exists, however ECCE can also be performed in situations where surgical facilities for MSICS are not available.

It was observed in this study that significant cell loss occurred within the 1st week postoperative period, (MSICS 5.35%, p value < 0.0001, 95% CI = 2502 to 2633, ECCE 5.21%, p value < 0.0001, CI = 2469 to 2588), with minimal changes in the 4th week (MSICS 2.8%, p value < 0.05%, CI = 2429 to 2554, ECCE 0.9%, p value < 0.05%, CI = 2450 to 2559), and 12 weeks (MSICS 0.33%, p value < 0.0001, 95% CI = 2429 to 2571, ECCE 0.08%, p value < 0.0001, CI = 2447 to 2566) post-operative period. These figures were observed to be much lower in the ECCE group than the MSICS group. This confirms that after 4 weeks the central corneal endothelium had stabilized, suggesting that wound healing is complete by this time. Similar findings were reported by Kohlaaset al[27] and Christopher[14]. The similarities in these findings might be due to the fact that, similar response of healing process occur in human corneal endothelium following cataract surgery.

Conclusion

Cataract surgery induced moderate degree of corneal ECD loss, however there is no difference in the rate of endothelial cell loss between the two groups (MSICS and ECCE). These endothelial morphological modifications after either ECCE or MSICS are transient. In both groups, a progressive decrease in cell density was observed, which was more marked between first and 4th week post-operative period. Most of the morphometric indices (CV, hexagonal cells and CCT) either normalized or stabilized at 3 months' postoperative period.

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