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Original Research Paper

Effect of Nd-YAG Capsulotomy on Corneal Endothelium

Authors:

Haider Abdul Kareem Abd Ion Al Janabi, Hanaa Mahdi Mutlaq, Husam Abdulhadi Majeed, Zaid Al-Attar

Senior specialist ophthalmologist, Gazi Al hareeri surgical speciality hospital, FICMS (M.B.Ch.B)
Senior specialist Family Medicine, Ministry of Health
Senior specialist ophthalmologist, Ibn Al-Haitham Teaching Eye Hospital.JMC.CAB.MRCS.FICO
Al-Kindy College of medicine, University of Baghdad

Corresponding Author*:*
Zaid Al-Attar
Al-Kindy College of medicine, University of Baghdad

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ABSTRACT:

Objective: study the effect of Nd -YAG Laser capsulotomy on corneal endothelium using y Specular microscope. **Patients and Methods**: A case control study has been conducted in the ophthalmological department at Surgical Specializations Hospital / Medical City Baghdad in June- 2022. Twenty patients having cataract extraction with posterior capsular opacification were divided into 2 groups, 10 patients for each; first group with cataract extraction and PC IOL (pseudophakic group), the second group with cataract extraction without IOL implantation, (aphakic group). Both groups were treated with Nd-YAG laser with approximately the same laser power used and number of shoots. Non-contact specular microscopy was performed at the center of the cornea for the eyes before and after laser (about one hour after performing laser). **Results**: increase in mean cell surface area and decrease in % of hexagonality occurred in the two groups during examination and it appeared to be significantly higher in the aphakic group. **Conclusion**: the scarcity of lesion following laser capsulotomy in pseudophakic eye suggests that the implant may act as barrier against particulate dispersion.

Keywords : pseudophakic, aphakic , Nd -YAG Laser, capsulotomy

INTRODUCTION:

The corneal endothelium is essential for maintenance of normal corneal hydration, thickness, and transparency (1). This cellular monolayer is highly vulnerable and has only limited regenerative capacity. 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. Specular microscopy has become a standard technique to determine endothelial cell density and morphology in vivo (2, 3). 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, 5). This study used specular microscopy to clarify the extent of corneal endothelial injury in the early period after cataract surgery using different incision sites. The corneal endothelial cell layer cannot regenerate after injury. Repair processes involve enlargement of residual cells, amitotic nucleus division, migration, and the rosette phenomenon, which leads to a reduction in cell density, a proportional increase in mean cell size, and disruption of the normal hexagonal cell pattern.

PATIENTS AND METHODS:

A case control study has been conducted in the ophthalmological department at Surgical Specializations Hospital / Medical City Baghdad in June- 2022. In this study 20 patients with posterior capsular opacification were chosen randomly, 10 patients of them had extraction with PC, PMMA IOL implantation (pseudophakic). The other 10 patient had opacification without IOL implantation (aphakic). The setting of the laser chosen to be nearly the same for all patient i.e. the power between (4-5mj) and number of shoots between (30-40). The laser type used is of NIDEK Company. These surgeries and posterior capsulotomy were done by different seniors and residents in the ophthalmological department at surgical specializations hospital teaching center / medical city Baghdad. Non-contact specular microscopy with TOPCON specular microscope SP-3000 P shown in figure (1, 2 and 3) was performed immediately at the center of the cornea of the eyes that underwent laser photo disruption. Parameters investigated were: the age of the patients, average cell area, percentage of hexagonality and corneal thickness

were evaluated in each patient at time of examination (pre laser treatment), and immediately after laser.

Citeria of Exclusion Included:
Corneal pathology, inflammatory eye disease, glaucoma, previous ocular surgery, intraoperative or postoperative complications and diabetes mellitus, pseudoexfoliation syndrome, uveitis. Data referring to right and left eyes were considered together. Statistical analysis has been conducted using SPSS software by implementing t test and using the $p<0.05$ as a significance level.

Figure (1) specular microscope

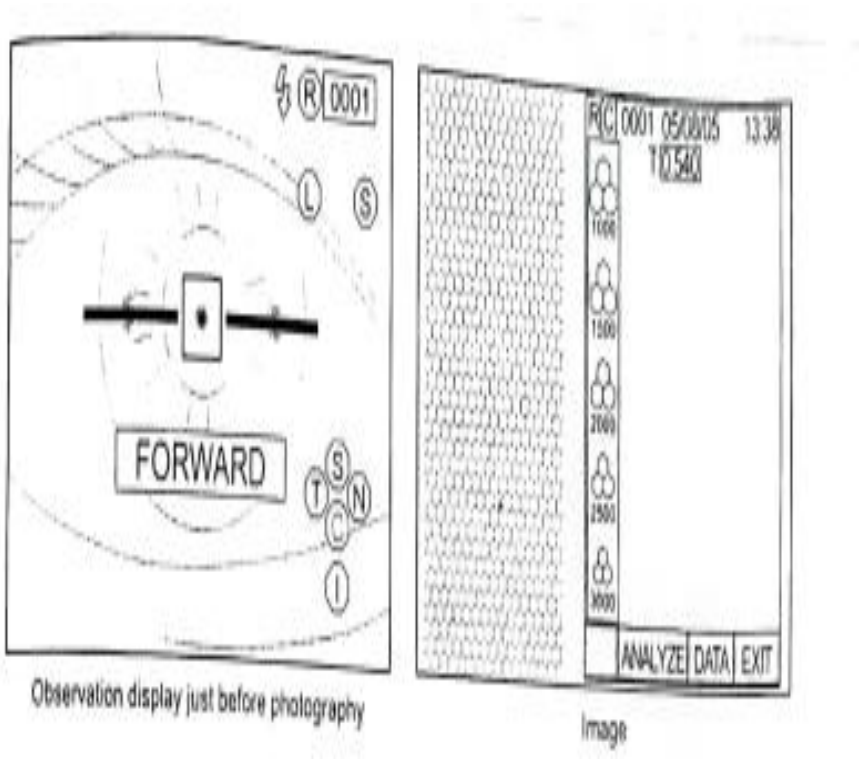

Figure (2) the use of specular microscope

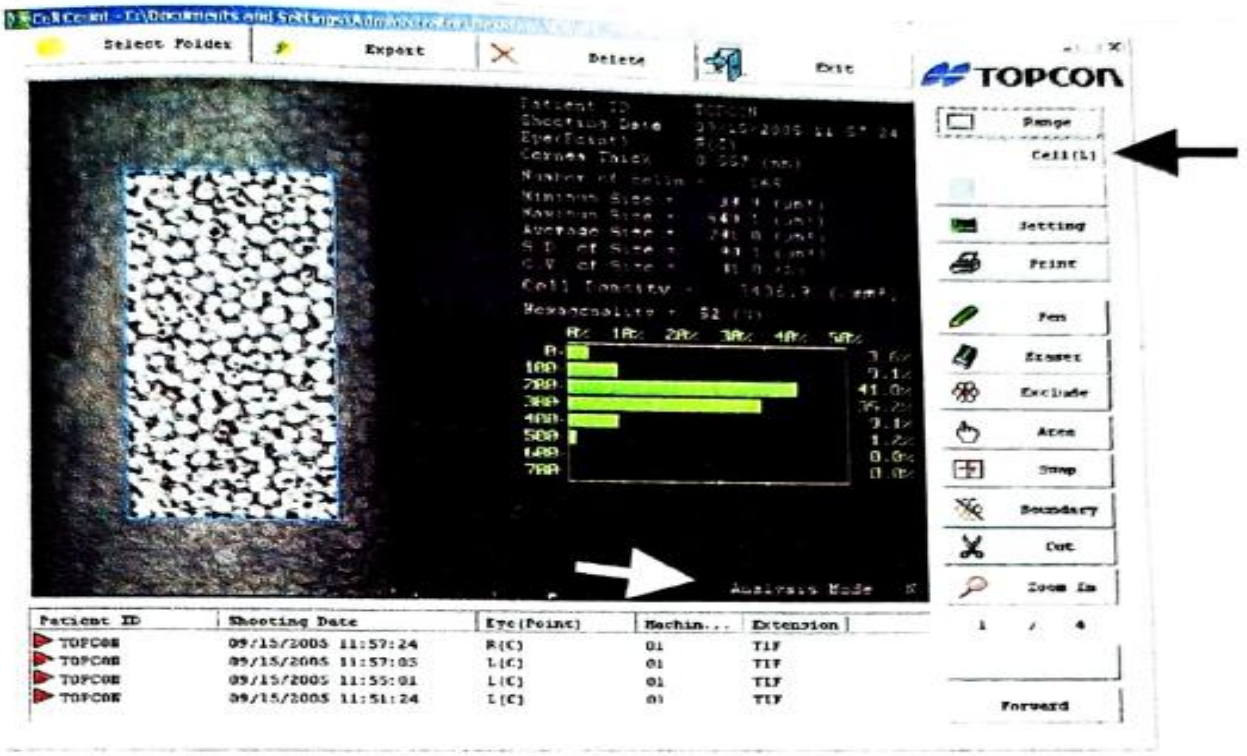

Figure (3) output data of specular microscope

Table (1) patient' Parameter

Parameters	Pseudophakic	Aphakic
Number of patients	10	10
Mean age	55±10	65±13
Sex (MF)	4/6	5/5
Right left eye	7/3	8/2

Table (2) data of pseudophakic patient pre laser:

pat	Age	corneal thickness	Mean cell area	No of hexagonal cells
1	48	439	406	60
2	50	560	448	86
3	52	515	439	54
4	65	522	522	72
5	69	561	1396	55
6	70	566	463	36
7	70	453	1216	87
8	72	478	364	66
9	73	532	536	55
10	75	424	482	33
Mean	64.4	505	527	60.4

Table (3) data of pseudophakic post laser:

pat	Age	corneal thickness	Mean cell area	No of hexagonal cells
1	48	504	557	60
2	50	565	578	85
3	52	525	459	52
4	65	583	608	53
5	69	617	1519	40

6	70	588	463	54
7	70	450	1113	78
8	72	479	370	60
9	73	560	621	58
10	75	540	569	35
Mean	64.4	539.1	685.7	59.5

Table (4) data of aphakie Patient per laser

pat	Age	corneal thickness	Mean cell area	No of hexagonal cells
1	55	560	460	40
2	65	565	650	52
3	66	450	620	60
4	67	588	463	65
5	70	490	420	48
6	72	548	980	23
7	75	520	520	36
8	76	570	1113	50
9	80	560	1104	61
10	82	558	1520	40
Mean	71.4	540.9	785	47.5

Table (5) data of aphakic patient post laser:

pat	Age	corneal thickness	Mean cell area	No of hexagonal cells
1	55	570	501	40
2	65	562	630	50
3	66	580	628	61
4	67	562	464	60
5	70	550	412	49
6	72	588	950	23
7	75	592	542	38
8	76	575	1120	48
9	80	598	1220	55
10	82	578	1604	38
Mean	71.4	584.5	807.1	46.2

RESULTS:

In this study the mean corneal thickness in the pre laser state of pseudophakic group was (505um), and post laser state was (539.1um), with an increase of (35.1 um). And in the aphakic group pre laser mean was (540.9um) while in post laser state was (584.5 um), with an increase of (43.6 um). There is a significant increase in the mean corneal thickness in both groups but more in aphakic group as shown in table (6). The mean endothelial cell surface area in the pseudophakic group pre laser state was (527 um^2) and in post laser was (685 um^2), with an increase of (158.7).and the mean surface area in aphakic group pre laser state was (785 um^2).and post laser was (807.1 um^2), with an increase of (22.1). There is a significant increase in the mean endothelial cell surface area in both group but more in pseudophakic group as shown in table (7). The mean of % hexagonal cells in the pseudophakic group pre laser state was (60.4) and in post laser was (59.5) with a decrease (-0.9). And in aphakic group pre laser state was (47.5) and in post laser was (46.2) with a decrease (-1.3) so each group was associated with a decrease in the % of hexagonality but more with aphakic group, as shown in table (8).

Table (6) mean central corneal thickness (um)

Exam	pseudophakic	aphakic
Pre laser	505	540.9
Post laser	539.1	584.5
Differences	35.1	43.6

Table (7) average endothelial cell surface area (um^2)

Exam	pseudophakic	aphakic
Pre laser	527	785
Post laser	685.7	807.1
Differences	158.7	22.1

Table (8) Percentage of hexagonal cells (mean)

Exam	pseudophakic	aphakic
Pre laser	60.4	47.5
Post laser	59.5	46.2
Differences	-0.9	-1.3

DISCUSSION:

The normal thickness and transparency of the cornea are maintained by the barrier function and the active fluid pump of the corneal endothelium (6). Although a qualitative description of the corneal specular image suffices for many applications, more quantitative information is desirable for others. The aim of quantitative analysis is to assign a number (or set of numbers) to the specular photomicrograph that can provide a measure of the endothelial status. Several of morphological parameters that can be quantified. These include cell size (cell area or cell density), polymegathism (variation of cell size such as coefficient of variation of mean cell area), pleomorphism (variation of cell shape such as percent of hexagonal cells or coefficient of variation of cell shape), cell perimeter, average cell side length, cell shape, and so forth. Histograms or frequency distributions of these quantities can also be determined. To date only cell size, pleomorphism, and polymegathism and several variables related to these parameters have proven useful in determining endothelial status.

The main aim of the study was to determine which pre-operative assessments on patients attending for Nd: YAG capsulotomy would correlate with eventual visual function outcome of the Patient, and thus be useful clinical measures. It is well established that the central endothelium changes as a function of age. In most individuals the cell density decreases (or mean cell area increases) from birth to death 20 through approximately age 50, endothelial cell density seems to be relatively stable. After the age of 60 cell density decreases significantly in most people although there is a great deal of individual variability. Since at this age the globe does not change in size, this observation seems to represent a true loss of endothelial cells with age, the average cell area increases, the cellular pattern becomes distinctly pleomorphic, and the cell size distribution becomes skewed toward larger cell. Endothelial alterations are considered important parameters of surgical trauma and are essential in estimating the safety of surgical techniques (7). Mishima showed that endothelial damage diminishes cell density, increases corneal thickness, and alters the normal morphometric endothelial pattern (8). It has been demonstrated that analysis of endothelial size and shape provides a more sensitive indication of endothelial cell damage than cell density alone (4). Therefore, alterations in the polymegathism (expressed by the coefficient of variation in cell size) and pleomorphism (expressed by the percentage of hexagonality) may indicate endothelial trauma (9). Posterior capsule opacification (PCO) is the commonest cause of diminished visual acuity following cataract extraction. Visually significant PCO may occur in up to 25% of patients over a 5-year period. PCO is readily treated by the use of the neodymium yttrium aluminum garnet (Nd YAG) laser to cause photo disruption of the thickened posterior capsule, and thereby clear the visual axis.

Nd YAG capsulotomy is generally a safe and successful method in relieving the symptoms of posterior capsular opacification. Documented complications include, transient rise in intraocular pressure, retinal detachment, lens subluxation or dislocation. Lens pitting and exacerbation of local endophthalmitis. Fee floating fragments have previously not been documented.

Several techniques for NAYAG laser delivery have been described. These include cruciate, circular horseshoe, or spiral delivery. Each technique has its own advantages and disadvantages. Specific corneal endothelial damage after YAG laser capsulotomy has not been described previously, yet in this study all capsulotomies in both groups but more in aphakic eyes. The explanation for this that the explosive nature of Nd/YAG photodegradation and the post particulate dispersion throughout the anterior chamber born in mind, the specular microscopical changes suggest a high velocity impact injury to the endothelium with maximal damage in the center of the lesion and graduated centrifugal changes. The scarcity of lesion following laser capsulotomy in pseudophakic eye suggests that the implant may act as a barrier against particulate dispersion.

Ethical Approval:

The ethical approval for the research was provided by

College of Medicine, Baghdad University with the registration number EAC: 1458.

CONCLUSION:

In summery increase in mean cell surface area and corneal thickness and decrease in the % of hexagonal cells, occurred in the 2 groups during examination and it is significantly higher in the aphakic group.

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