Original article:

Effect of power used in phacoemulsification surgery on corneal endothelium in various types of cataract

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Abstract:

Introduction: Phacoemulsification cataract surgery has now been accepted as gold standard surgical procedure for management of cataract. Many variations of phaco technique have been described, the final aim being to decrease overall time and energy needed for nucleus emulsification. Our aim was to study the variation in corneal endothelial cell loss with respect to variations in effective phaco time with constant power used in phacoemulsification surgery in various grades of cataract.

Materials and Methods: In this prospective study 75 patients taken from age groups 40-70yrs with immature senile cataract were chosen randomly and their complete evaluation including pre-operative visual acuity and corneal endothelial cell count were noted. Intraoperatively, all phaco parameters were kept constant and for a constant power the phaco time was noted for each patient. This will be followed by a complete post-operative evaluation including visual acuity as well as endothelial cell count on 2nd day, 7th day and 40th day.

Results: Keeping all the other phaco parameters constant, the mean phaco time used in Nuclear cataract grade 1 was 10 with an endothelial cell loss of about 182. Similarly in nuclear cataract grade 2 & nuclear cataract grade 3 average phaco time used was 14.3 and 23 with cell loss being 225 and 298 respectively. The phaco time used for posterior subcapsular cataract was the least 9.1 and similarly had the least amount of cell loss about 172.

Conclusion: A direct correlation between phaco time and endothelial cell loss was observed.

Keywords: endothelial cell loss (ecl), phaco time, phacoemulsification

Introduction:

Phacoemulsification- gold standard for management of cataract.\(^{(1)}\) Corneal endothelial cell loss is an inevitable complication following cataract surgery and occurs after any cataract technique.\(^{(1-7)}\) The ideal procedure is one that protects the intraocular tissue from surgical damage particularly the corneal endothelium. The mean endothelial count in the normal adult cornea ranges from 2000 to 2500 cells/mm\(^2\), and the count continues to decrease with age. Goal is to perform the surgery in such a way that there is minimal corneal endothelial cell loss or complications, irrespective of the hardness of the cataract, anterior chamber depth and corneal health.\(^{(2)}\)

Factors such as advanced age, increasing infusion volume and increasing the amount of ultrasound energy and phaco time are the main risk factors for corneal endothelial damage. Endothelial changes and alterations of central corneal thickness (CCT) are considered important parameters of surgical trauma and are indispensable in evaluating the safety of new surgical methods.\(^{(2)}\)
Materials and methods:

Study design: Prospective observational study
Institutional ethical committee clearance taken
Study population: The patients coming to GMCH Aurangabad, in the Dept of Ophthalmology for cataract surgeries with no other co-morbid injuries

A total of 75 patients (92 eyes) were included in this cross-sectional study according to the criteria presented in table 1.

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients willing to give informed written consent</td>
<td>Pre-operative endothelial count &lt;1500/mm³</td>
</tr>
<tr>
<td>Age between 40-70yrs</td>
<td>Corneal degeneration, corneal opacity</td>
</tr>
<tr>
<td>Senile cataract</td>
<td>Pupil size less than 7.5 mm after dilatation</td>
</tr>
</tbody>
</table>

Preoperatively, all patients underwent a complete ophthalmologic examination. Preoperatively, endothelial cell density (ECD) was measured using a specular microscope (SP-3000P Topcon) in the center of the cornea and 3 mm from the center in the meridian of the incision. For each eye, three measurements were performed and the average value was calculated; at least 100 cells were evaluated in each measurement. ECD measurement was repeated 1 week, 1 month and 3 months postoperatively.

Intraoperatively, phacoemulsification surgery was performed by a single surgeon, by the same phacoemulsification machine. The site of incision (supero-temporal) size (2.8mm) type (frown incision) were kept same in every case. Similarly, balanced salt solution was used and a constant bottle height on 80cms was kept in each case. Also the machine parameters were constant as in table 2.

<table>
<thead>
<tr>
<th>Phaco 1</th>
<th>Phaco 2</th>
<th>Phaco 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccum (mm Hg)</td>
<td>Flow Rate (cc/min)</td>
<td>Power</td>
</tr>
<tr>
<td>30</td>
<td>24</td>
<td>50</td>
</tr>
<tr>
<td>300</td>
<td>26</td>
<td>40</td>
</tr>
<tr>
<td>300</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
Result:

Table 3

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Grade of Cataract</th>
<th>Effective phaco time (secs)</th>
<th>Endothelial Count</th>
<th>% Cell Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre-op</td>
<td>Post-op D40</td>
</tr>
<tr>
<td>1</td>
<td>Nuc Cat Gr 1</td>
<td>10.12</td>
<td>2468</td>
<td>2275.8</td>
</tr>
<tr>
<td>2</td>
<td>Nuc Cat Gr 2</td>
<td>14.3</td>
<td>2303.8</td>
<td>2076.5</td>
</tr>
<tr>
<td>3</td>
<td>Nuc Cat Gr 3</td>
<td>23</td>
<td>2338.7</td>
<td>2038.5</td>
</tr>
<tr>
<td>4</td>
<td>Mature Cataract</td>
<td>25.75</td>
<td>2298.7</td>
<td>1942</td>
</tr>
<tr>
<td>5</td>
<td>PSC</td>
<td>9.1</td>
<td>2543.3</td>
<td>2353.8</td>
</tr>
</tbody>
</table>

The mean effective phaco time (EPT) used in Nuclear cataract grade 1 was 10s with an endothelial cell loss of about 182. Similarly in nuclear cataract grade 2 & nuclear cataract grade 3 & mature cataract, average phaco time used was 14.3s, 23s and 25.75s with cell loss being 225 and 298 and 307 respectively. The EPT used for posterior subcapsular cataract was the least 9.1s and similarly had the least amount of cell loss about 172. About 6.7% to 13.3% cell loss was observed.

Discussion:

Phacoemulsification is a safe and effective procedure. Nevertheless it is still associated with trauma. One of the complications of trauma is reduction in corneal ECD. In this study, we assessed the effect of constant phaco parameters comparing the effective phaco time on corneal ECL preoperatively and postoperatively. The single most important predictor of good vision and a clear cornea postoperatively is the total amount of phaco energy delivered into the eye. At present, no phaco platform offers surgeons a direct or standard measure of the energy that is placed into the eye during cataract surgery in units. However, all modern machines record the total time spent in foot pedal position 3 (phaco time) and the application of average phaco power.

The absolute phaco time or the effective phaco time (EPT), which is the equivalent phaco time at 100% power

\[ \text{EPT} = \text{phaco time} \times \text{average phaco power} \]

Technological advances and surgical techniques aimed at minimising the surgical effects of phaco energy have evolved rapidly. Basic modulations in the mode of phaco surgery such as burst mode or pulse mode decreases the phaco energy causing less damage. Further study needs to be conducted to get the ideal method to cause least surgical damage.

Conclusion:

A direct correlation between phaco time and endothelial cell loss was observed. Longer effective phaco time and higher cataract density have been shown to be independent predictors for endothelial cell loss. With advances in phaco power modulation, surgeons can dramatically reduce the phaco time and power used in every cataract case.
References:


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