Comparative Study of Combined Versus Sequential Pars Plana Vitrectomy and Phacoemulsification in Patients with Macular Hole or Epiretinal Membrane and No Clinically Significant Cataract: Analysis of Corneal Parameters and Visual Acuity

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Purpose

To compare corneal parameters and best-corrected visual acuity (BCVA) in patients with no clinically significant cataract treated for macular hole (MH) or epiretinal membrane (ERM) with combined versus sequential pars plana vitrectomy (PPV) and phacoemulsification.

Methods

Eighty-two patients (84 eyes) with MH or ERM and without clinically significant cataract were randomized to PPV with phacoemulsification during the same operation (combined PPV + phaco group) (n = 42) or at two different surgical times (sequential PPV + deferred phaco group) (n=42). Preoperative eye examination included measurement of best-corrected visual acuity (BCVA), applanation tonometry, biomicroscopy of the anterior and posterior segments, cataract classification according to the LOCS III protocol, immersion biometry, retinal mapping, specular microscopy of the cornea, retinography, and spectral domain optical coherence tomography (OCT). The following variables were evaluated: central density of endothelial cells (ECD), optical pachymetry (central corneal thickness-CCT), endothelial cell size variability (CV), BCVA, refractometric error (spherical equivalent), intraocular pressure, and lens opacification score. All analyses were repeated at post-PPV months 1, 3, 6, 9, and 12.

Results

Seventy-eight patients (80 eyes:40 in the combined group and 40 in the sequential group) completed the 12-month follow-up. Baseline characteristics are summarized in Table 1. There was no significant difference between the groups with respect to gender, age, presence of hypertension and/or diabetes, duration of symptoms, duration of visual impairment, and distribution of pathology (MH and ERM).

Table 1: Group characteristics

	PPV / phaco (40)	PPV / deferred phaco (40)	P
Gender (female)	29	30	0,79
Mean age ± (std error), years	67.65 ± 1.05	66.33 ± 0.94	0.14
Systemic arterial hypertension (number of patients)	25	25	0.91
Diabetes (number of patients)	10	4	0.34
Symptoms duration (months)	14.88 ± 2.25	12.55 ± 2.18	0.54
MH	26	25	
ERM	3	5	

Endothelial cell density (ECD)

The mean ECD (cells/mm^2) preoperatively and at 12 months post-PPV was 2408.70 ± 56.60 and 2117.10 ± 77.74, respectively, in the combined group and 2472.85 ± 56.60 and 2105.67 ± 77.74, respectively, in the sequential group. A significant decrease in mean ECD compared to the preoperative examination was observed at all follow-up visits in the combined group ($p<0.05$) and after 6 months in the sequential group ($p<0.05$). No significant difference between the groups in mean ECD was observed at any follow-up visit ($p = 0.707$) (Figure 1).

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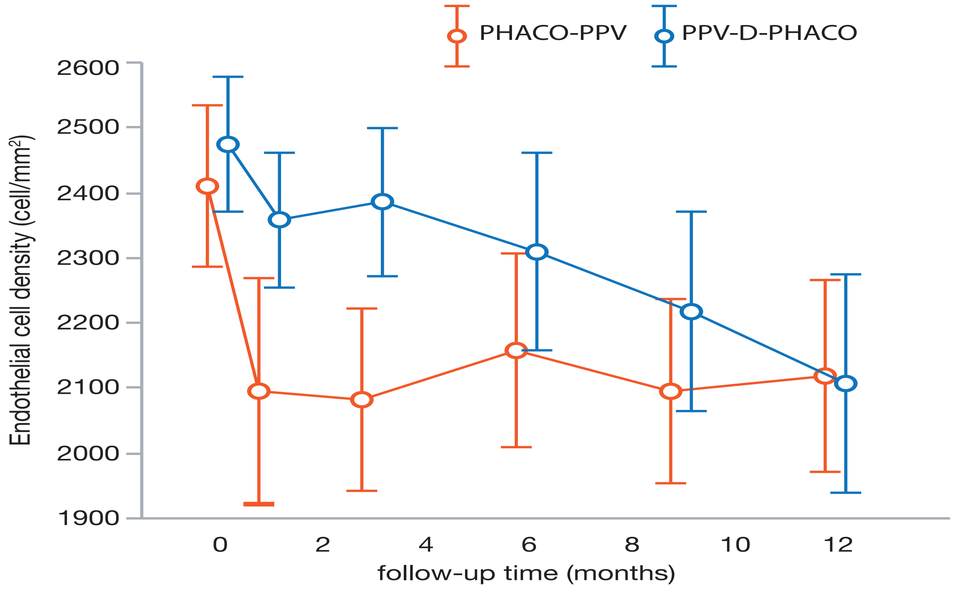

Figure 1: Means and 95% CI of the endothelial cell density measurements before surgery and during the 12-month follow-up for both groups.

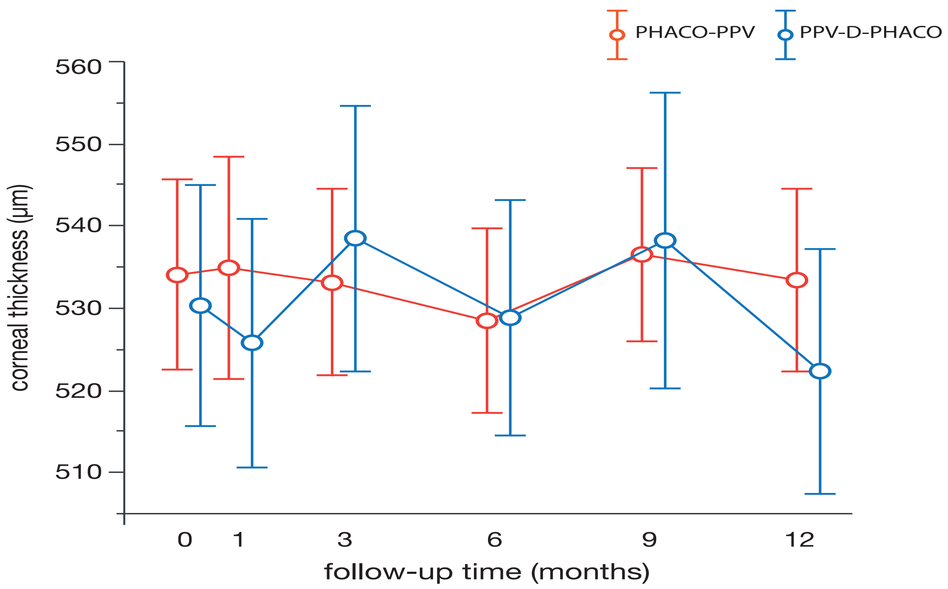

Figure 2: Means and 95% CI of the pachymetry measurements before surgery and during the 12-month follow-up for both groups.

Pachymetry

The mean CCT (µm) preoperatively and at 12 months post-PPV was 533.93 ± 6.55 and 533.3 ± 6.51, respectively, in the combined group and 530.2 ± 6.55 and 522.23 ± 6.51, respectively, in the sequential group, with no statistically significant difference between month 12 and baseline in either group (combined group: p= 0.910; sequential group: p= 0.151), nor between groups at any follow-up visit (p>0.05) (Figure 2).

Cell size coefficient of variation (CV)

The mean cell size CV was similar in both groups, with no significant difference between the groups at any time during the study (p>0.05). Preoperatively, the mean CV was 36.1 ± 1.49% in the combined group and 34.6 ± 1.49% in the sequential group. At month 12 post-PPV, the mean CV was 32.18 ± 1.22% in the combined group and 31.1 ± 1.22% in the sequential group.

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A significant decrease in mean CV at month 12 compared to preoperatively was observed in the combined group (p=0.033) and at months 9 and 12 compared to month 1 in the sequential group (p=0.041 and p=0.019, respectively). (Figure 3)

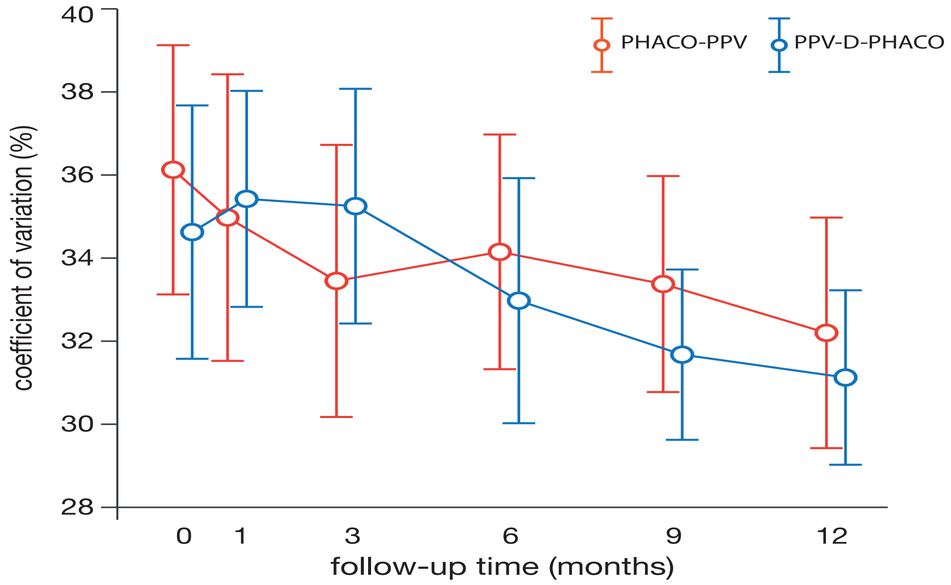

Figure 3: Means and 95% CI of the cell size coefficient of variation measurements before surgery and during the 12-month follow-up for both groups.

Best-corrected visual acuity (BCVA)

Preoperatively, the mean ± standard deviation of the BCVA (logMAR) was 0.92 ± 0.04 and 0.90 ± 0.04 in the combined and sequential groups, respectively. No statistically significant difference was observed between the groups (p=0.870) when only patients with MH were analyzed. Similarly, when comparing only patients with ERM, the mean ± standard deviation of the BCVA preoperatively was 0.72 ± 0.09 for the combined group and 0.68 ± 0.08 for the sequential group. No statistically significant difference in preoperative BCVA was observed between groups for the patients with ERM (p=0.326).

When comparing the two groups over time, without distinguishing between the macular pathologies, a significant improvement in the BCVA post-PPV compared to baseline was observed at all study follow-up visits (ANOVA for repeated measures) in both the combined and sequential groups (p<0.05). A significant difference in BCVA was observed between groups only in the sixth month after surgery (p=0.049). At all other follow-up visits, there was no statistically significant difference in BCVA between the two groups (Figure 4).

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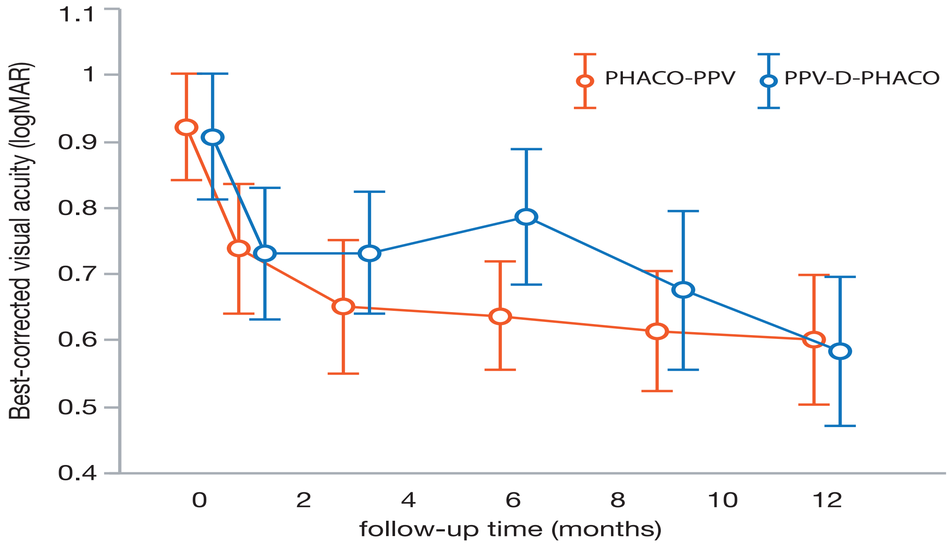
Figure 4 - Progression of visual acuity over time in both groups. Circles represent the means, and error bars indicate the 95% confidence intervals of the differences in visual acuity measured during the follow-up.



Cataract occurrence and progression

The absolute rate of cataract development in the sequential group was 82.5% during the 12-month study period. The mean ± SEM time post-PPV at which phaco was performed in the sequential group was 8.52 ± 0.46 months. When analyzed by pathology, the mean ± SEM time post-PPV at which phaco was performed was 8.43 ± 0.54 months for patients with MH and 9.00 ± 0.55 months for patients with ERM (p=0.942).

The timing of cataract surgery in the sequential group was divided into four phases: first trimester (1-3 months); second trimester (>3-6 months); third trimester (>6-9 months), and fourth trimester (>9-12 months). The highest frequency of phacos occurred in the third and fourth trimesters, with 33% and 35% of the phacos performed, respectively (Figure 5).

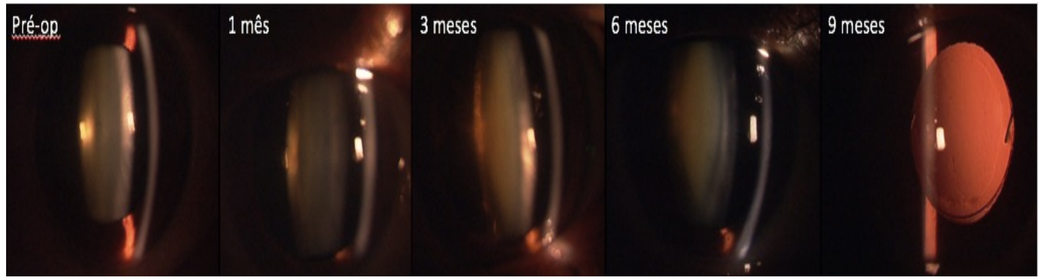


Figure 5: Progression of cataract in a patient from the sequential group.

Discussion

In the present study, a significant decrease in mean ECD compared to the preoperative examination was observed at all follow-up visits in the combined group and after 6 months in the sequential group. The reduction in ECD in the sequential phaco group occurred later in the study, as more patients underwent phaco during follow-up; that is, and as expected, the ECD decreased significantly only after cataract surgery, not after PPV. The reduction in ECD did not differ significantly between the two groups throughout the 1-year post-PPV follow-up period, and the decrease in each group was similar to that reported after isolated phaco.[1,2,3,4,5]

Pachymetry usually reveals short-term changes after phacoemulsification associated or not to PPV.[6,7] In the present study, the first postoperative assessment was carried out at 1month post-PPV, when the corneal edema induced by surgical trauma has usually regressed.

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Our study concludes that there is no serious damage associated with either surgical strategy that would lead to a significant and long-term increase in corneal thickness in patients with MH and ERM undergoing combined or sequential PPV and phaco.

In our study, we observed prospectively similar disorganization of endothelial cells in the first month post-PPV in both surgical groups, followed by remodeling with stabilization, which is consistent with what has been reported in previous retrospective studies.[5,8,9,10] A clear correlation between changes in ECD, CV, and CCT was not found. However, the usefulness of CV is not yet well-established,[11] and the ECD is still the widely accepted parameter in the assessment of surgical damage to the corneal endothelium.[12]

In the current study, no difference was observed between the two groups in mean BCVA at one year post-PPV. Other authors have reported that combined PPV and phaco surgery is associated with similar BCVA results when compared to PPV alone in eyes with MH and cataracts.[13,14,15] In our study, BCVA improvement in the combined group was significant and stable throughout the follow-up period of 1 to 12 months post-PPV, while in the sequential group, there was significant worsening in BCVA at 6 months after PPV. This was possibly due to the progression of cataract after PPV, as reported by Muselier *et al.*,[16] who observed a shorter recovery time for the combined surgery group compared to the sequential surgery group in terms of visual acuity improvement after MH surgery. In phakic patients, cataract progression is a common postoperative complication of PPV, with a high incidence reported in several studies (70%-84%).[17,18] In the current study, the rate of cataract development in the sequential group was 82.5% in the 12-month follow-up period.

In conclusion, combined PPV + phaco in patients with MH or ERM and without significant cataract was associated with similar changes in corneal parameters (ECD, CCT, and CV reduction rates), as well as BCVA throughout 1 year of follow-up when compared to sequential PPV and deferred phaco.

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