

NEW PHACO TECHNOLOGY REDUCING PHACO ENERGY: THE VISALIS 500 FAMILY APM™ ULTRASOUND MODULATION

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Summary

In the attempt of achieving reduced phaco energy measured in Effective PhacoTime, (EPT), an increased followability and anterior chamber stability, ZEISS has recently developed the APM™ (Advanced Power Modulation). It is a new ultrasound modulation which delivers Burst & Pulse ultrasound energy into one modulation cycle for better control of the energy entering the nucleus. In a study performed in 45 eyes significantly reduced EPT and total phaco time has been observed with this type of ultrasound modulation, with a percentage of reduction of the EPT similar to values reported previously by Dr. Prasad (73%). This study also showed a significantly better level of followability with this new APM™ mode, resulting in a significantly better satisfaction score of the surgeon. The incision was easily closed after surgery and all patients had a clear cornea one day postoperatively.

Introduction

The reduction of the energy delivered into the anterior chamber and the duration of the surgical procedure has led to a safer phacoemulsification cataract surgery, with minimal or no impact on corneal and anterior chamber structures [1]. The reduction of phacoenergy minimizes the risk for endothelial cell loss [2] and the chances of damaging the blood/aqueous barrier [3]. The VISALIS 500 Family phaco system from ZEISS is a new model of dual pump system for cataract and retinal surgery allowing the surgeon an extremely high level of flexibility during the surgical

procedure. It includes a new type of ultrasound modulation with APM™ technology aimed at achieving an even higher level of control of the fluidics and the phaco energy used, and therefore promoting a more significant postoperative stability of the ocular structures. APM™ combines the burst and the pulse patterns in a modulation cycle, with the power of the burst facilitating good impalement of the nucleus and the speed of the pulse for a quick removal of quadrants.

The objective of the current study was to evaluate the surgical outcomes of phacoemulsification surgery performed in cataract eyes with the VISALIS 500 Family phaco system in terms of effective phaco time (EPT), followability, holdability, anterior chamber stability and U/S efficiency using the new APM™ phaco mode.

Methods

Patients:

In this prospective consecutive study, 45 cataractous eyes of 29 patients undergoing cataract surgery through 2.2 mm corneal incision were included. The inclusion criteria of this study were patients of 45 years or older and presence of a senile cataract. Nuclear density was quantified according to a scale from 1 to 5. The exclusion criteria were patients with glaucoma, corneal opacities, cornea guttata, abnormal iris, macular degeneration or retinopathy, previous posterior segment surgery, neurophthalmic disease, or history of ocular inflammation.

Settings	Normal Phaco Mode	APM™ Mode
Equipment U/S-1		
IVP (cm ² H ₂ O/mmHg)	105-110	105-110
Vacuum/Mode/Pump	480-520LP	480-520LP
Flow/Mode	28-30F	28-30F
Rise time (seconds)	0.95-1.8	0.95-1.8
Power/Mode	50L	50L
Emission	Pulsed 40Hz	APM™
Equipment U/S-2		
IVP (cm ² H ₂ O/mmHg)	95	95
Vacuum/Mode/Pump	325LP	325LP
Flow/Mode	28F or L	28F or L
Rise time (seconds)	0,55-0,9	0,55-0,9
Power/Mode	10L	10L
Emission	Pulsed 23Hz	APM™
Equipment I/A1		
IVP (cm ² H ₂ O/mmHg)	105	105
Vacuum/Mode/Pump	480-490LP	480-490LP
Flow/Mode	38-30F	38-30F

Table 1. Phaco settings used in Normal Phaco Mode and APM™ Mode
Abbreviations: U/S, ultrasound; IVP, intraventricular pole; F, fixed; L, linear; LP, linear peristaltic.

Surgical procedure

All surgeries were performed by the same surgeon (Dr. Talal from Sweden) using a standard small-incision sutureless coaxial phacoemulsification technique. The VISALIS 500 Family phaco system from ZEISS was used in all cases for the phacoemulsification procedure. Two different ultrasound modes were utilized and their use was assigned randomly to each eye included in the study. Two groups were differentiated for phacoemulsification: a group of eyes with Normal Phaco Mode (Table 1) and a group of eyes with ultrasound APM™ mode. In all cases, a corneal incision of 2.2 mm was planned followed by a paracentesis of 1.0 mm. The direct chop technique was used. Emission in the Normal mode was Pulse

40 Hz and 23Hz in respective modes, in the APM™ group it was the APM™ set to the surgical technique.

Examination protocol

Intraoperatively, the following parameters were monitored and recorded: total phaco time, effective phaco time (EPT), total surgery time. At 1 day postoperatively, the presence of corneal clarity and intraoperative hydration marks was evaluated. Likewise, the following variables were assessed by means of a subjective scale ranging from 1 to 6 (1: excellent, 2: very good, 3: good, 4: normal, 5: bad, 6: very bad).

Statistical analysis

SPSS statistics software package version 19.0 for Windows (IBM, Armonk, NY, USA) was used for statistical analysis. Normality of all data samples was first evaluated by means of Kolmogorov-Smirnov test. When parametric analysis was possible, the Student test for unpaired data was used for comparisons between groups. On the contrary, when parametric analysis was not possible, the Mann-Whitney test was used for the comparison between groups, using in all cases the same level of significance ($p < 0.05$). Correlation coefficients (Pearson or Spearman depending if normality condition could be assumed) were used to assess the correlation between different variables.

Results

In the analysed sample, mean cataract density was 2.6 ± 0.8 on a scale from 1 (low density) to 5 (high density), with no significant difference between the Normal Phaco Mode and the APM™ groups (2.4 ± 0.7 [range grade 1 - 3] vs. 2.8 ± 0.8 [range grade 2 - 5], $p = 0.11$). The EPT was significantly longer in the normal phaco group compared to the APM™ group (6.0 ± 3.5 vs. 2.6 ± 3.0 seconds, $p < 0.01$) as well as the total phaco time (41.5 ± 14.0 vs. 16.3 ± 13.2 seconds, $p < 0.01$) (Figure 1). Comparing APM™ with the Normal Phaco Mode phaco energy measured as EPT was reduced by 56.7% with the APM™ mode. Weak and no statistically significant correlation was found in any of the groups between EPT and cataract density (Normal phaco, $r = 0.34$, $p = 0.10$; APM™, $r = 0.36$, $p = 0.13$).

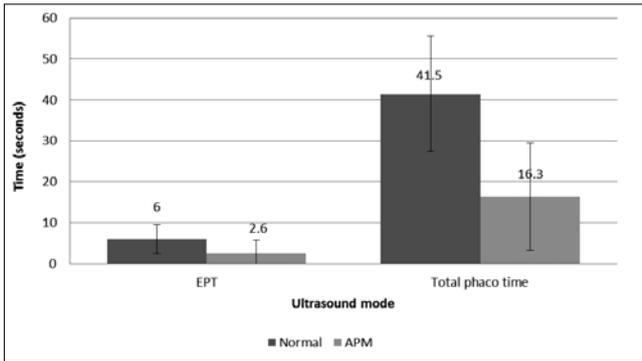


Figure 1. Comparison of effective phaco time (EPT) and total phaco time with Normal Phaco Mode and APM™ Mode of the VISALIS 500 Family platform.

The incision was easily closed immediately after surgery and all patients had a clear cornea one day postoperatively.

The results of the subjective assessment of the surgical procedure are summarized in Figure 2. On a scale ranging from 1 to 6 (1: excellent, 2: very good, 3: good, 4: normal, 5: bad, 6: very bad), followability was significantly better with the APM™ compared to the Normal Phaco Mode (3.2 ± 0.6 vs. 2.3 ± 0.6 , $p < 0.01$). Mean scores for holdability, anterior chamber stability and U/S efficiency in the APM™ and Normal Phaco Mode groups did not differ significantly ($p \geq 0.20$). Mean score for total performance did not differ significantly either between APM™ and Normal Phaco Mode groups (2.1 ± 0.5 vs. 2.3 ± 0.6 , $p = 0.24$).

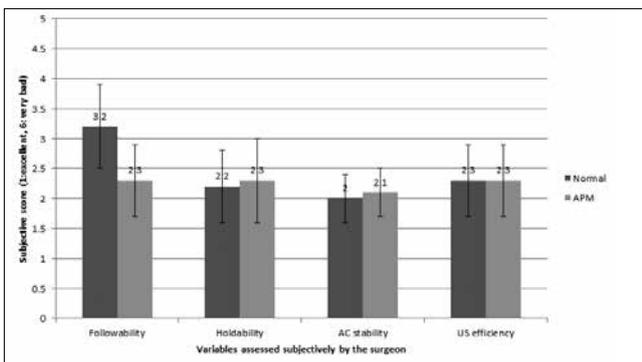


Figure 2. Comparison of followability, holdability, anterior chamber (AC) stability and U/S efficiency assessed by the surgeon with Normal Phaco Mode and APM™ Mode of the VISALIS 500 Family platform.

Discussion

Most of the latest developments in phacoemulsification technology, such as the new ultrasound mode APM™ of the VISALIS 500 Family phaco platform, are aimed at reducing the required phaco energy and time [1]. Longer absolute EPT and higher cataract density have been shown to be independent predictors for endothelial cell loss [4]. Likewise, the reduction of the EPT has been shown to be in relation with a higher percentage of postoperative clear corneas and better uncorrected visual acuity [5]. In the current series, we obtained very short EPT and total phaco time using the VISALIS 500 Family phaco platform for both types of ultrasound modes, however the EPT was 56.7% shorter with the APM™ mode. This should promote a more significant protection of corneal endothelium and anterior chamber stability, as suggested by previous works evaluating the effect of phacoemulsification hydrodynamic parameters on corneal physiology [6]. Furthermore, no significant correlation was found between phaco time and cataract density with any of the two ultrasound modes evaluated. This confirms that the phacoemulsification VISALIS 500 Family technology performs efficiently even with the hardest cataracts, [APM group range from 2 to 5] not always requiring a significant increase in the surgical time with the consequent side effect on corneal endothelium, as happens with other phaco platforms [7]. This is confirmed by Prasad [8] who found extremely short EPT and total phaco time in his series using the APM™ modulation in very hard cataracts.

A significantly higher level of followability was also found with the APM™ system compared to the Normal Phaco Mode. A better followability should result in less turbulence in the anterior chamber because the free nuclear fragments are better controlled when they are kept close to the phacotip. The reduced turbulence due to the better followability contributes further to the safety of the capsular bag.

The combination of the Burst and Pulse provides a high degree of lens-disrupting capability in a shorter period of time by controlling the required stroke movements, for lens

material fragmentation, and their frequency, and minimizing repulsion. Indeed, followability was scored as very good on average for the APM™ compared to the mean score obtained for the other ultrasound mode evaluated. Holdability, anterior chamber stability, U/S efficiency and total performance were scored as very good for both types of ultrasound modulations which confirms the excellent performance of the VISALIS 500 Family phaco platform, even with Normal Phaco Modes. The APM™ program on the VISALIS 500 Family has proven to deliver very good efficiency, high stability of the chamber and a reduction in the amount of energy needed for each cataract surgery that was included in the current series. We could also observe that the incision was easily closed immediately after the surgery and that the patients had a clear cornea one day postoperatively.

Conclusion

In conclusion, the APM™ U/S mode of the VISALIS 500 Family phaco platform improves U/S cutting efficiency to a level that it significantly reduces EPT across all grades of cataract and improves followability. The APM™ ultrasound modulation is a valuable technological advance for cataract surgeons, allowing them to perform faster surgeries with better followability, and consequently safer procedures which should result in a more rapid visual stability.

References

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