

A NEW CONCEPT OF FASTER AND MORE BALANCED CATARACT SURGERY: THE VISALIS 500 FAMILY APM™ ULTRASOUND MODULATION

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Summary

The APM™ (Advanced Power Modulation) from the VISALIS 500 Family phaco platform (ZEISS) is a new ultrasound modulation which delivers Burst & Pulse ultrasound energy in one modulation pattern for better control of the energy entering the nucleus. This new technology is aimed at reducing the phaco energy and shortening as much as possible the effective and total phaco time, and providing fluidics balance that contributes to an increased followability and anterior chamber stability. We found high levels of followability, holdability, anterior chamber stability and cutting efficiency, and a high level of satisfaction with the surgical procedure performed with this new technology.

Introduction

The phaco time in cataract surgery is a factor contributing significantly to the final outcome of the surgery in terms of anterior chamber stability and corneal integrity [1,2]. The reduction of the effective phaco time (EPT) has been shown to be in relation with less endothelial damage [1], higher percentage of postoperative clear corneas and better uncorrected visual acuity [2]. For this reason, new developments in phacoemulsification technology are mainly focused on the reduction of the required phaco time and energy [3].

The VISALIS 500 Family phaco system from ZEISS is a new generation of dual pump equipment for cataract and retinal surgery, allowing the surgeon to have a maximal control of fluidics and surgical time intraoperatively, and, therefore,

of the energy delivered into the anterior chamber. One of the innovations incorporated in this phaco system is an ultrasound modulation with APM™ technology, which is the result of the automatic combination of burst and pulse patterns in a modulation cycle. This supports the chop technique extremely well by impaling the nucleus with the power of the burst and removing the quadrants with the speed of the pulse and allows the surgeon to achieve an even higher level of control of the fluidics balance and the phaco energy used during surgery.

The objective of the current study was to evaluate the effective phaco time (EPT) of phacoemulsification surgery performed in cataracts of different density with the VISALIS 500 Family system using the new APM™ mode as well as to evaluate the subjective perspective of the surgeon in terms of followability, holdability, anterior chamber stability and U/S efficiency.

Methods

Patients:

In this prospective consecutive study, 70 cataractous eyes of 70 patients undergoing cataract surgery through 2.4 mm or 2.8 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.

Surgical procedure

All surgeries were performed by the same surgeon (Prof. Dr. Körber from Cologne/Germany) using a 2.4mm or 2.8mm incision sutureless coaxial phacoemulsification technique. The phaco system VISALIS V500 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 50 eyes with Normal Phaco Mode (Table 1) and a group of 20 eyes with ultrasound APM™ mode. Emission in the Normal mode was Pulse 40 Hz and in the APM™ group it was the APM™ set to the surgical technique. In all cases, a corneal three step incision was performed followed by a paracentesis of 1.0 mm. The direct chop technique was used.

Settings	Normal Phaco Mode	APM™ Mode
Equipment U/S-1		
IVP (cm ² H ₂ O / mmHg)	90	90
Vacuum / Mode / Pump	350LV	350LV
Power / Mode	35-40L	35-40L
Emission	Pulse 40 Hz	APM™
Equipment I/A1		
IVP (cm ² H ₂ O/mmHg)	85-95	85-95
Vacuum/Mode/Pump	350LV	350LV

Table 1. Phaco settings used in the Normal Phaco Mode and APM™ Mode
Abbreviations: U/S, ultrasound; IVP, intraventricular pole; L, linear; LV, linear venturi.

Examination protocol

Intraoperatively, the total phaco time and the EPT were recorded. 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): followability, holdability, anterior chamber stability and U/S efficiency.

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 t 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 3.0 on a scale from 1 (low density) to 5 (high density) in the Normal Phaco Mode and the APM™ groups. The EPT was longer in the Normal Phaco Mode group compared to the APM™ group (4.5 ± 2.5 vs. 3.6 ± 2.9 [range 0.6 to 13.7 seconds] as well as the total phaco time (24.0 ± 9.6 vs. 17.6 ± 11.2 seconds) (Figure 1). Therefore, the APM™ mode reduced the EPT by 20%. Moderate but statistically significant correlation was found in the APM™ group between EPT and cataract density (Normal phaco, $r=0.68$, $p=0.01$).

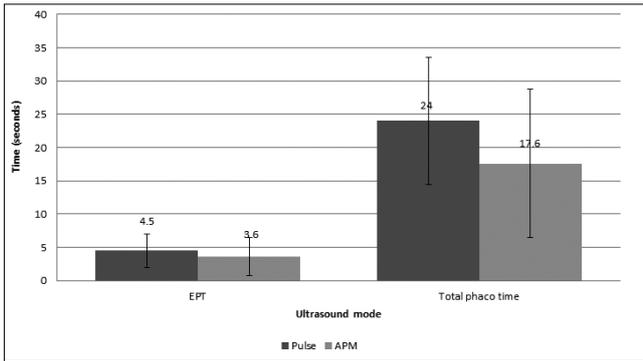


Figure 1. Comparison of effective phaco time (EPT) and total phaco time with Normal Phaco Mode and APM™ Mode of the VISALIS 500 Family phaco platform.

The results of the subjective assessment of the surgical procedure are summarized in Figure 2. As shown, all variables evaluated (followability, holdability, anterior chamber stability and U/S efficiency) were on average better with the APM™ mode than with the Normal Phaco Mode, considering that the subjective scale used ranged from 1 representing an excellent outcome to 6 representing the worst result. Mean score for total performance was also better with the APM™ mode compared to the Normal Phaco Mode (2.06 ± 0.24 vs. 1.57 ± 0.50). No turbulence in the anterior chamber as well as no repulsion or chatter were reported.

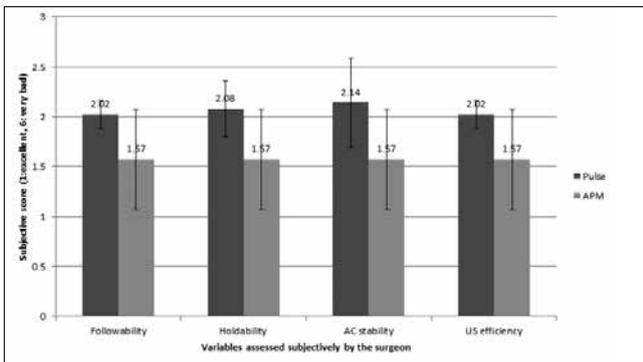


Figure 2. Comparison of followability, holdability, anterior chamber (AC) stability and U/S efficiency assessed by the surgeon with Normal Phaco Mode and APM™ Mode of the VISALIS 500 Family phaco platform.

Regarding corneal clarity, the cornea at 1 day postoperatively was clear in all cases. It should be remarked that on one case of grade 5 hard brown cataract, the patient had a corrected visual acuity of 0.1 LogMAR at one day postoperatively, with a completely clear cornea.

Discussion

The new ultrasound mode APM™ of the VISALIS 500 Family phaco platform provides the efficiency of the Burst to impale the nucleus and the speed of pulse to remove quadrants. This may result in a significantly shorter EPT and total phaco time promoting anterior chamber stability and the physiological respect of the cornea. Although we already use only a very small amount of phaco energy in the Normal Phaco Mode due to our technique, EPT was further reduced by 20% with the APM™ mode. Specifically, a mean value of EPT of around 3.6 seconds was found by using the APM™ mode. Therefore, phacoemulsification surgery became faster by using the APM™ U/S modulation, even with hard cataracts. Considering that shorter absolute phaco time has been shown to be in relation with less endothelial cell loss, early postoperative corneal clarity and good visual outcome [1,2], all these clinical findings would be expected to be found in our sample of eyes. As expected, all corneas remained clear at the first postoperative day and a good visual outcome was present, even in cases of cataract grade 5.

Besides the reduction of phaco time with the APM™ compared to the Normal Phaco Mode of the VISALIS 500 Family phaco platform, other advantages of the APM™ mode were found to be the significantly higher levels of followability, holdability, anterior chamber stability and U/S efficiency. The better followability obtained with the APM™ mode implies less turbulence in the anterior chamber due to the better control of free nuclear fragments which are maintained close to the phacotip for continuous and smooth progressive emulsification and aspiration. The better level of followability also ensures the safety of the capsular bag as a result of the reduced turbulence and a very quick removal of the nucleus ensuring faster procedure.

The combination of Burst and Pulse in this U/S mode provides a high degree of lens-disrupting capability in a shorter period of time by controlling the required stroke movements and the frequency for lens material fragmentation, and minimizing repulsion. The better followability and the reduced phaco time achieved with the APM™ mode were factors leading to the higher level of anterior chamber stability and faster procedure observed in our study, even in the rather dense nuclei found in our patients.

One requirement for an efficient phacoemulsification is holdability which was also evaluated in the current series. Holdability describes how the nuclear fragments are firmly attached to the phaco tip during the surgical procedure minimizing anterior chamber turbulences. This property is highly dependent on fluidics and the geometry of the phaco tip. As the same phaco tip was used with both U/S modes, the better holdability found in the current study with the APM™ mode compared to the pulse mode is the result of the improved followability that contributes to the sticking of the nuclear fragments to the tip, to a lack of chattering and to a good vacuum control enabling efficient chopping. This improved holdability in combination with the above mentioned better cutting efficiency and followability compared to the pulse mode resulted in a reduced phaco time and better scoring of the U/S efficiency in the current series.

Conclusion

The APM™ U/S mode of the VISALIS 500 Family phaco platform allows the cataract surgeon to reduce total and effective phaco time with an improved fluidics management associated to high levels of followability, without chatter/repulsion and holdability, even in the hardest cataracts. This results in a safer surgical procedure providing excellent anterior chamber stability, corneal clarity and consequently an almost immediate visual recovery. This new mode of U/S modulation is a valuable technological advance for cataract surgeons who want to optimize their procedures to improve the clinical outcomes and to maximize patient satisfaction. Minimal loss of endothelial cells is expected with this new phaco mode but this should be addressed in future studies.

References

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