THE VISALIS 500 FAMILY PHACO TECHNOLOGY: AN INNOVATIVE ULTRASOUND DELIVERY MODE FOR A NEW CONCEPT OF IMPROVED CATARACT SURGERY

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Summary

The new generation VISALIS 500 Family phaco system from ZEISS combines a dual pump system with an innovative ultrasound modulation technology. The APM™ (Advanced Power Modulation) is a pulse shaping modulation technology which delivers Burst & Pulse ultrasound energy in one modulation pattern, reducing the required phaco energy and enabling improved followabilty with excellent chamber stability. The APM™ technology provides shorter effective phaco time (EPT) and total phaco time with superior cutting efficiency and very good holdability which results in an excellent anterior chamber stability and a faster post operative visual recovery.

Introduction

Technological advances in phacoemulsification have made cataract surgery safer and more efficient by reducing phaco time and duration, and, consequently, with minimal or no impact on corneal and anterior chamber structures [1]. Specifically, lowering the amount of energy entering the anterior chamber during surgery decreases the risk for endothelial cell loss [2] and the chances of damaging the blood/aqueous barrier and therefore has the potential of reducing the level of postoperative inflammation [3]. Interrupted phaco modes, improved pump systems, chopping techniques, and vacuum-assisted processes are some technological optimizations introduced in the currently available phaco systems that allow the clinician to reduce the amount of energy needed to remove cataract and therefore the potential risks associated [1]. One of these advances is the development of phaco systems, designated as hybrids or dual pump systems, which combine a peristaltic and a Venturi pump. These systems have the advantage of both pump options [4, 5], allowing the surgeon to have a maximal control of fluidics and surgical time intraoperatively, and, therefore, of the energy delivered.

The VISALIS 500 Family phaco system from ZEISS is a new-generation dual pump equipment for cataract and retina surgery allowing the surgeons to control aspiration and ultrasound power adjustments independently of each other. One of the innovations incorporated by this phaco system is an ultrasound modulation with APM™ technology. APM™ is a new pulse shaping modulation technology which combines the Burst & Pulse ultrasound energy delivery in one modulation pattern to further improve the level of control of the phaco energy entering the eye and to stabilise the anterior chamber. The objective of the current study was to evaluate the surgical outcomes of phacoemulsification surgery performed 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 modes.

Methods

Patients:

In this prospective consecutive study, 60 cataractous eyes of 47 patients undergoing cataract surgery through 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 of N2-3 according to the Lens Opacification Classification System III (LOCSIII). 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 using a standard 2.8 mm 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 and a group of eyes with ultrasound APM™ mode. In all cases, a corneal incision of 2.8 mm was planned followed by a paracentesis of 1.0 mm. The direct chop technique was used with the Kelman tip, and specific phaco settings are summarized in Table 1.

Settings	Normal Phaco Mode	APM™ Mode
Equipment U/S-1		
IVP (cm^2 H_2O / mmHg)	120	120
Vacuum / Mode / Pump	250FP	225FV
Flow/Mode	40FP	
Rise time (seconds)	0.65	
Power / Mode	50L	35L
Emission	Multi Burst	APM™
Equipment U/S-2		
IVP (cm^2 H_2O/mmHg)	120	
Vacuum/Mode/Pump	250FV	
Power/Mode	40L	
Emission	Pulsed 28.0 Hz Mid	
Equipment U/S-3		
IVP (cm^2 H_2O/mmHg)	120	120
Vacuum/Mode/Pump	180FV	180FV
Power/Mode	30L	30L
Emission	Pulsed 40.0 Hz Mid	APM™
Equipment I/A1		
IVP (cm^2 H_2O/mmHg)	120	120
Vacuum/Mode/Pump	425LV	450LV
Equipment I/A2		
IVP (cm^2 H_2O/mmHg)	120	120
Vacuum/Mode/Pump	10LV	10LV

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

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 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 ($p<0.05$).

Results

Mean EPT was significantly longer ($p<0.001$) with the Normal Phaco Mode (Mean: 3.5; Standard deviation, SD: 1.4; Median: 3.0; Range: 2.0 to 5.0 s) compared to the APM™ Mode (Mean: 1.4; Standard deviation, SD: 0.8; Median: 2.0; Range: 0 to 2.0 s) (Figure 1). Likewise, total phaco time was also significantly longer with the Normal Phaco Mode in comparison with the new APM™ mode ($p=0.031$) (Figure 1). Comparing APM™ Mode with the Normal Phaco Mode, EPT was reduced by 60% with the APM™ mode.

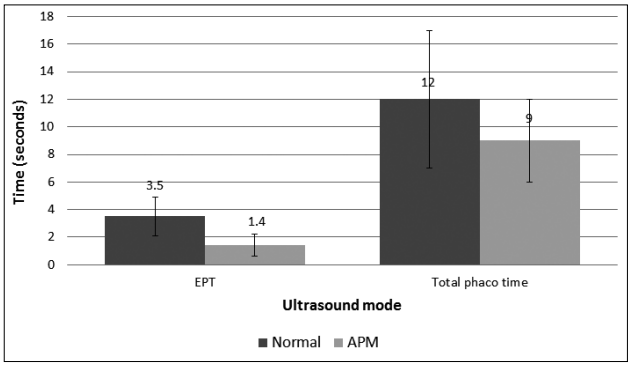

Figure 1. Comparison of effective phaco time (EPT) and total phaco time with Normal Phaco Mode and APM™ Mode of the VISALIS 500 platform.

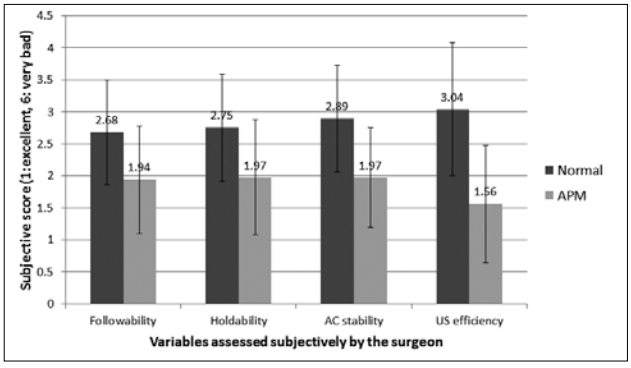

Figure 2. Comparison of followability, holability, anterior chamber (AC) stability and U/S efficiency assessed by the surgeon with Normal Phaco Mode and APM™ Mode of the VISALIS 500 platform.

Figure 2 summarizes the results of the subjective assessment of the surgical procedure. As shown, all variables evaluated were found to be significantly better with the APM™ mode compared to the Normal Phaco Mode (followability $p=0.001$, holdability $p=0.001$, anterior chamber stability $p<0.001$, and U/S efficiency $p<0.001$), 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 significantly better ($p<0.001$) with the APM™ mode (Mean: 1.69; Standard deviation, SD: 0.90; Median: 1.00; Range: 1.00 to 4.00 s) compared to the Normal Phaco Mode (Mean: 2.61; Standard deviation, SD: 0.99; Median: 2.00; Range: 1.00 to 4.00 s).

Discussion

Longer absolute phaco time and higher cataract density have been shown to be independent predictors for endothelial cell loss [6]. Furthermore, 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 [7]. For this reason, new developments in phacoemulsification technology are mainly focused on the reduction of the required phaco energy and time. One of these advancements is the new ultrasound mode APM™ of the VISALIS 500 Family phaco platform. APM™ provides the efficiency of the burst to impale the nucleus and generates the speed of the pulse to remove the quadrant. In the current series, we achieved a significant reduction of the EPT and total phaco time using this specific U/S mode which highlights its superior performance in terms of phaco efficiency. Therefore, phacoemulsification surgery becomes faster by using this new mode of U/S modulation in cataract surgery. This reduction in phaco time promotes a more significant protection of the corneal endothelium. Indeed, higher percentages of clear corneas at the first postoperative day and healthier endothelial cell architecture were observed clinically during the first and 10 days after surgery.

The function of followability is to bring free nucleus fragments close to the phaco tip for continuous and smooth progressive emulsification and aspiration. A high level of followability implies less turbulence in the anterior chamber, less stress on the internal structures of the eye, and an overall increase in phaco efficiency. Free nuclear fragments are better controlled, ensuring the safety of the capsular bag. In the current series, followability was scored on average as very good with the APM™ mode whereas it was scored as good with the Normal Phaco Mode. An optimized modulation of U/S with the APM™ mode is the main reason for this finding. This combination of the burst and pulse U/S mode provides a high degree of lens-disrupting capability in a shorter period of time by controlling the required stroke movements and their frequency for lens material fragmentation and minimizing repulsion. The better followability achieved with the APM™ mode was the main factor leading to the higher level of anterior chamber stability observed in our study. The average anterior chamber stability was scored as very good with the APM™ mode and good with the Normal Phaco Mode.

Besides followability, holdability was also evaluated, which represents the force with which the nuclear fragment is firmly attached to the phaco tip and which depends, among other factors, on the geometry of the phaco tip. Good followability and holdability promotes low levels of turbulence in the anterior chamber. As happened with followability and anterior chamber stability, a better scoring was obtained with the APM™ mode compared to the Normal Phaco Mode. Considering that the same phaco tip was used with both U/S modes, the better holdability of the APM™ mode is the result of the improved followability that contributes to the sticking of the nuclear fragments to the tip and to the lack of chattering of nuclear fragments and good vacuum. The good vacuum control enables an efficient chopping. As expected according to all these outcomes, the U/S efficiency for the APM™ mode was considered as superior than the Normal Mode due to the reduced phaco time, better followability and improved holdability obtained with this new option of U/S modulation.

Conclusion

In conclusion, the APM™ U/S mode of the VISALIS 500 Family phaco platform is a valuable technological advance for cataract surgeons, allowing them to perform faster surgeries with shorter phaco times, superior cutting efficiency better followability and holdability, and therefore promoting a more rapid postoperative visual stability. Total speed of surgery is incredibly quick with the APM™ system in comparison to other leading systems on the market.

References

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Surgeries performed using
ZEISS VISALIS 500 Family system.