Dual-Pump Transversal Phaco for MICS

Benefits include maintaining corneal integrity and controlling postoperative astigmatism.

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Modern phacoemulsification technology aims to reduce ultrasound power and improve its efficiency, thus avoiding the potential ocular risks associated with nonoptimal use. Technical advances such as interrupted phacoemulsification modes, improved pump systems, chopping techniques, and vacuum-assisted phacoemulsification have reduced the amount of energy needed to remove cataracts,1,2 and varying motions of the phaco tip (ie, torsional3,4 and transversal5) have been developed to increase ultrasound efficiency during phacoemulsification. In our experience, dual-pump transversal phacoemulsification has many benefits when used in conjunction with microincision cataract surgery (MICS).

DUAL PUMP AND SWITCH-ON-THE-FLY MODE

Transversal phacoemulsification, which uses simultaneous lateral and longitudinal motion to induce an ellipse-shaped movement,6,7 optimizes ultrasound efficiency by emulsifying lens material in more than one direction. It also maintains the nuclear fragment at the ideal shearing plane—in front of the phaco tip.6 The Ellips FX technology of the WhiteStar Signature phacoemulsification platform (both by Abbott Medical Optics Inc.) is a transversal phaco tip that has a working frequency of 38 kHz, a transversal-to-longitudinal ratio of 1:1, and a threefold greater stroke length compared with a previous version.

In an effort to reduce ultrasound power, dual-pump technology combining a peristaltic and a venturi pump (Figure 1) was recently introduced to the WhiteStar Signature System. This allows the surgeon to instantly switch between pumps and, therefore, optimize the benefits of each system,8 such as the additional vacuum and holding power of the venturi mode.

Our group conducted a study to evaluate the efficacy and safety of combining transversal phaco technology with the dual-pump mode for MICS. Ultrasound and flu-
During surgery, dual-linear footpedal control was used to simultaneously control flow or vacuum and ultrasound power (Figure 2). Specifically, vacuum was achieved by pressing down the footpedal, and ultrasound was delivered in linear mode with the right footpedal switch, at any level of vacuum. The settings used for the peristaltic pump were: bottle height of 95 cm, flow rate of 44 cc/min with nonzero start at 10 cc/min, vacuum of 450 mm Hg, and ultrasound continuous linear power of 25% with nonzero start at 5% (Figure 3). The settings used for the venturi pump were: bottle height of 105 cm, vacuum of 300 mm Hg with nonzero start at 120 mm Hg, variable vacuum rise time set at medium speed, and ultrasound continuous linear power of 20% with nonzero start at 5%. (The term nonzero start was used to define the ability of the phaco platform to start the phaco energy at greater than zero, and the vacuum before the point of occlusion.)

RESULTS
Efficacy. We analyzed the average ultrasound power, the total phaco time, and effective phaco time (EPT) using EFX, denoting the amount of ultrasound delivered not only by transversal motion but also by longitudinal motion. EFX is roughly the EPT with a specific coefficient for transversal movement expressed in seconds. In our study, the efficiency of dual-pump phacoemulsification in switch-on-the-fly mode was indicated by a low mean average ultrasound power (6.8 ±1.85% standard deviation [SD]) and a low mean total ultrasound time (61.4 ±28 seconds SD). Mean EFX was 47.24 ±18 SD.

Safety. Followability and anterior chamber stability were empirically determined. During phacoemulsification, nuclear fragments were exposed to shearing stress from the transversal motion and a jackhammering effect from the longitudinal motion; however, because the repulsion typically experienced with longitudinal phacoemulsification was not present, followability was better with the low levels of ultrasound energy and the dual-pump transversal phaco technology. Additionally, the transversal movement of the phaco tip produced enough influx of new fluid during emulsification that no surge, collapse, or tubing clogs were observed.

Clinical evaluation of endothelial cell density. Automated specular microscopy was performed before and 1 month after surgery. A mean decrease in endothelial cell count of 7.78% was observed at 1 month, which was consistent with the results of previous studies evaluating torsional technology.10 Reuschel et al10 found a mean endothelial cell loss of 7.20 ±4.6% SD through a 2.75-mm clear corneal incision. To date, no published studies have reported endothelial cell loss associated with transversal phacoemulsification, although it is expected to be similar to that of torsional phacoemulsification. Most studies evaluating endothelial cell loss after conventional longitudinal phacoemulsification show larger endothelial losses11,12 than we experienced in our series. Therefore, we concluded that a minimal level of endothelial damage was induced with the phacoemulsification technology tested in this study. Longer phaco time and higher ultrasound power, factors that were reduced with the dual-pump transversal phacoemulsification (Continued on page 23)

TAKE-HOME MESSAGE

- In this study, the efficiency of dual-pump phacoemulsification in switch-on-the-fly mode was indicated by a low mean average ultrasound power and a low mean total ultrasound time.
- Because there was no repulsion, followability was better with the low levels of ultrasound energy and the dual-pump transversal phaco technology.
- With dual-pump transversal phacoemulsification, minimal endothelial damage was induced.
technology evaluated in this study, may be associated with endothelial cell loss.

CONCLUSION

Use of a dual-pump phacoemulsification system and transversal ultrasound technology is effective and safe during MICS. The combination of our fluidics settings and ultrasound parameters in switch-on-the-fly mode, the use of a dual-linear footpedal, and the elliptical motion of the phaco tip not only enhance followability and reduce the amount of ultrasound power delivered into the anterior chamber but also reduce the associated risk of corneal endothelial damage. Our outcomes should be complemented by morphological structural analyses of corneal incisions.

MICS using dual-pump transversal phacoemulsification technology should be considered as a primary option for cataract surgery due to the procedure’s safety, maintenance of corneal integrity, and control of postoperative astigmatism.

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