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Ultrasonic energy application in cataract surgery: evaluation and comparison of two phacoemulsification systems

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In this prospective clinical study we have evaluated and compared the safety of delivered phacoemulsification energy into the eye using two modern phacoemulsification units to perform cataract surgery. One hundred - ten patients were enrolled at Ophthalmology Clinic Heidelberg assigned to have ultrasonic phacoemulsification. They were divided into two groups according to the phacoemulsification system we used. In Group A cataract surgery was performed with Infiniti Vision System (Alcon) and patients from Group B were operated with Sovereign System (AMO). The mean patients age in Infiniti group was 71,7 +/- 9,94 (range 44-86) and 71,9 +/- 8,43 (range 49-83) years in Group B (Sovereign group). Clinical examinations were undertaken one day before the operation, on the first postoperative day and 3 months after surgery.

In this study pre-operative assessment of cataracts density was objectively evaluated with Scheimpflug rotating camera, incorporated in Pentacam Oculus System. Scheimpflug camera has aloud objectively evaluation and grading of cataract density in both groups. Cataract density measured in four meridians showed mean value of 23,17+/-5,54 (range 9,4-39,4) in Infiniti group and the same mean value of 23,18+/-5,88 (range 11,4 - 35,8) were measured in Sovereign group. There was no statistical differences between this two groups ($p=0,9971$). Cataract density has been accurately correlated with the amount of phacoemulsification energy required to remove it.

In our study, US energy required to emulsify the cataract didn't correlate with cataract density in both groups. This implies than even a hard cataracts could be handled with less US energy consumption when better surgical techniques and instrumentation are applied. Examples of this might include situations such as sculpting, where the phaco needle tip is in full contact

with the nucleus and instead of use mainly US energy to emulsify nuclear material, the greater levels of vacuum and small quantities of ultrasonic energy are used.

To evaluate the difference in US energy required with Infiniti versus Sovereign, the patients from each group were divided into three subgroups (Group A,B,C) according to the cataract density.

For denser cataracts in all three subgroups (A,B,C), US consumption was significantly less with Sovereign than with Infiniti. In all three subgroups (A,B,C), there was no statistically difference in the EPT between Infiniti and Sovereign groups.

To evaluate whether this lower energy is clinically significant or not, BAB, as a sensitive measure of surgical technique, and corneal endothelial cell loss 3 months after surgery, were recorded and correlated to the phaco energy utilisation during surgery.

On the first postoperative day the mean flare value in Infiniti group was 18,5 (SD 8,1) photons/ms and in Sovereign group was 21,23 (SD 11,2) photons/ms. The damage of postoperative blood-ages barrier was calculated like a difference of the first postoperative day values and the basic preoperative values. In Infiniti group the difference of the first postoperative day mean value and the basic preoperative mean value was 9,82 ph/ms (SD 6,63), and in Sovereign group 9,59 ph/ms (SD 9,68).The differences between postoperative and preoperative flare values were related to the average phaco power (US energy) and EPT. There was no significant correlation between postoperative BAB damage and average phaco power in both groups. In Infiniti group there was no significant correlation between BAB damage and EPT, but in Sovereign this correlation was significant.

The overall mean endothelial cell loss in Infiniti group was 4,80% (SD 4,94) and 7,78 % (SD 6,89) in Sovereign group. Higher cataract density, longer US time and longer effective phaco time were significantly associated with endothelial cell loss in Infiniti group and only longer US time and longer effective phaco time were significantly associated with endothelial cell loss in Sovereign group. In general, phacoemulsification today is an effective and safe technique with an estimated mean endothelial cell loss of under 10% what our study also showed.

Continual improvements in phacoemulsification technique and technology have made cataract surgery more safe and efficient than in the past. These improvements stem from the use of smaller incisions facilitated by new phacoemulsification technology. The use of lower amounts of energy delivered by means of power modulations has resulted in improved outcomes and safer surgery.

