

CASE OF THE MONTH

Automating ultrasound delivery for increased efficiency in my cataract surgeries: Power on Demand with the ZEISS QUATERA 700

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A full year has passed since the QUATERA® 700 phacoemulsification system from ZEISS was launched onto the market (FIGURE 1). This new platform is equipped with novel technologies that in my opinion make it a state-of-the-art device raising cataract surgery safety and efficiency to higher levels.

Specifically, ZEISS QUATERA 700 features a unique pump system – the ZEISS patented QUATTRO Pump® – that based on my personal experience provides extraordinary anterior chamber stability. In addition, when building ZEISS QUATERA 700, ZEISS engineers adopted my vision for automating ultrasound delivery. Tagged Power on Demand (PoD), this one-of-a-kind ultrasound management technology activates ultrasound upon occlusion and deactivates it when there is no occlusion so that energy is used only when needed for lens emulsification (FIGURE 2).



Figure 1. ZEISS QUATERA 700 with ZEISS patented QUATTRO pump and Power on Demand

What distinguishes the QUATTRO pump from the fluidics systems of other phacoemulsification devices?

The QUATTRO pump operates via four syringe-like chambers that directly control infusion and aspiration. Integrated sensors measure real-time irrigation and aspiration flow, and the pump synchronizes irrigation and aspiration while accounting for incision leakage to maintain the stability of the chamber, independent of vacuum or IOP level. This is exactly what I notice when using the device. The anterior chamber is extremely stable without fluctuations in anterior chamber depth and this allows my phaco tip to remain at a safe distance from the posterior capsule, iris, and cornea.

With most other phacoemulsification systems today, air pressure in the bottle is increased via the overflow vessel, and this total pressure must safely compensate for the maximum suction rate. In my experience, this design leads to an increase in IOP when there is no suction. On the other hand, because these systems are set for a certain incision size and do not compensate for fluctuating incision leakage, I have found that the anterior chamber collapses at maximum suction if the incision turns out to be somewhat larger than planned. These situations are eliminated when I am using the ZEISS QUATERA 700.

With its real-time measurement of aspiration volume, ZEISS QUATERA 700 can easily detect upcoming occlusion. This information is used to enable PoD.

What was the genesis of your idea for PoD?

There has been an ongoing evolution in phacoemulsification techniques and technologies driven by aims to continue to improve safety and efficacy. In addition to maintaining a stable anterior chamber, the safety and efficacy of modern cataract surgery is tied to the amount of ultrasound energy delivered during the procedure. Minimizing ultrasound energy consumption results in less postoperative corneal edema and macular edema, which translates into faster visual recovery, and it is also associated with less corneal endothelial cell loss. One key to minimizing ultrasound energy consumption is to use phaco power only when it is needed, and that is when the aspiration port is blocked with lens material. However, when surgeons are working to control ultrasound manually using the foot pedal, it is difficult to switch the power on and off precisely as needed. Consequently, I felt that I was using more than the minimally necessary phaco power because I would activate ultrasound before it was needed and keep the foot pedal depressed when phaco was no longer needed. The need to simultaneously concentrate on what was happening inside the eye and respond appropriately with the foot pedal also added to my stress during surgery.

Automated ultrasound PoD was my idea for addressing these issues. The concept is to have a system where ultrasound turns on automatically when aspiration fluid flow stops because the aspiration port is blocked with a lens fragment and then turns off immediately once the port is open. Because phaco energy repels lens fragments, PoD that activates ultrasound only upon occlusion also leads to higher followability in my surgeries.

How are you using PoD?

I like to operate with high vacuum because I feel it reduces surgical time and increases efficiency. Because the QUATTRO pump works so well to maintain anterior chamber stability, I feel confident operating with the maximum vacuum setting available on

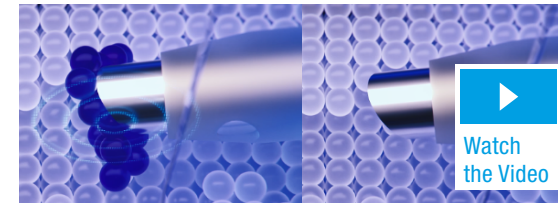


Figure 2. With PoD, ultrasound is only activated upon occlusion (left) and directly deactivated when there is no occlusion (right)

ZEISS QUATERA 700, which is 700 mmHg. In my opinion, PoD is especially helpful when operating with high vacuum where the change from occlusion to no occlusion happens very quickly, making it even more challenging to precisely regulate ultrasound with the foot pedal. By using such a high vacuum, I can remove 3+ and softer cataracts with aspiration only. Therefore, I am using PoD almost exclusively in cases with a 4+ nucleus where fragments require emulsification for removal.

That is not to say, however, that PoD likely only has value when operating on 4+ cataracts and using a high vacuum setting. I assume, surgeons can work with lower vacuum and still find PoD useful. Ultrasound is activated when there is occlusion that will occur sooner when operating with vacuum set at 300-400 mmHg. Because the phaco power remains on only until the fragment has passed through the needle and flow resumes, I expect reduced phaco energy output in this surgical setting as well.

Does PoD affect total procedure time?

Once surgeons complete what I believe will be a quick learning curve for PoD, I expect they will find that the total operation time using PoD will be the same or shorter than for similar cases done without it. In my surgeries, PoD can help reduce the total procedure time because it allows me to concentrate better on directing lens fragments to the phaco tip.

What differences has using PoD made for your patients and for you as a surgeon?

So far, my experience with PoD includes approximately 200 cases, and I found that the effective phaco time was significantly lower compared to procedures done without PoD. I also noted that the eyes operated on with ZEISS QUATERA 700 using PoD had clearer corneas on postop day 1, and the percentage of eyes with 20/20 vision was higher too. For me, PoD definitely makes my surgical days less stressful because it frees me from having to think about turning phaco on and off.

Instead I only have to concentrate on bringing lens fragments to the aspiration port.

Do you have any advice for surgeons as they begin to use PoD?

First, I would repeat to my peers that I expect they will have a short learning curve for using PoD. I believe that surgeons should feel comfortable after just 10 to 15 cases. Based on my experience with the technology I would also reassure surgeons not to worry that using PoD will compromise safety. Because of ZEISS QUATERA 700's fluidics system, surgeons can keep the phaco tip in the center of the anterior chamber away from the posterior capsule, iris, and corneal endothelium, and ultrasound is only activated when the aspiration port is blocked by lens material.

With regard to my specific tips for surgeons when they begin using PoD, I suggest for the first few cases choosing eyes with a wide pupil for maximum visualization and a 3+ nucleus because I think that surgeons who are unfamiliar with PoD will find it is somewhat easier to block the aspiration port with lens fragments when operating on a 3+ cataract compared to a harder lens. In addition, and just to get a sense of how POD works, I think it might be helpful performing the first one or two cases with a maximum vacuum between 300 and 400 mmHg because I think that it will make the intraocular environment especially conducive for bringing lens fragments to block the aspiration port. In general, however, I would recommend using high vacuum and high aspiration flow because those settings allow occlusion to build more quickly and therefore can enable surgeons to experience the greatest benefits of PoD.

Do you have final thoughts to share?

The road to further optimizing safety and efficiency of cataract surgery depends on developing technology innovations that automate components of the procedure so as to eliminate the performance variability that is inherent to surgeon-dependent functions. The QUATTRO Pump and PoD technology on the ZEISS QUATERA 700 are advances along the road towards a future of fully automated phacoemulsification surgery. To my surgeon colleagues, I offer my encouragement to try PoD because based on my experience there are benefits to gain and no causes for hesitation. Using PoD in my cataract cases where ultrasound is needed allows me to feel more relaxed during surgery, and on the next day I am seeing happy patients with clear corneas and good vision.

Dr Wolfram Wehner is in private practice, Maxi Augenärzte, Nuremberg, Germany. He is a paid consultant to Carl Zeiss Meditec. Dr. Wehner is joint inventor of the patent US 9,144,517 B2 enabling the adaption of ultrasound energy to the hardness of the lens fragment during an occlusion event.



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