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Introduction to Hi-Lo Phacoemulsification

Dr. Scott:
Greetings to everyone. Today I want to talk about the concept of Hi-Lo phaco, and we will be talking about that in relation to laser cataract surgery, or SLACS, as I prefer to call it, in the way that we use it here at our facility here at Mercy.

Hi-Lo phaco refers to high vacuum in low phacoemulsification energy. SLACS is a term that stands for sterile laser-assisted cataract surgery, and I say sterile because it's performed in the operating room. Of course a lot of laser-assisted cataract surgery is performed prior to the patient going into the operating room, but this is really, I think, the next generation of robotic surgery.

More and more people are recognizing that indications for SLACS include really difficult types of surgeries, but less time has been spent really talking about routine cataract surgery and how optimizing our laser and phacoemulsification settings can improve outcomes.

So new phaco systems and platforms have really improved and really helped us with maintaining chamber stability. Understanding how to efficiently use the maximum vacuum and to use the lowest phaco power necessary can improve our outcomes and decrease complications.

One of the basic choices in phacoemulsification is Venturi versus peristaltic vacuum. So the vacuum is created in different ways, and these are things that make a difference in how they actually are applied within the eye. Venturi vacuum's created by gas flow across an opening, and so the pressure is in a rigid cassette. In peristaltic vacuum it's created by a peristaltic pump.

Software helps prevent the post-occlusion surge with both systems, but your settings matter. Maintaining chamber stability is dependent on in your settings, the inflow, which is really via the sleeve, bottle height, and forced infusion, and outflow fluid through the tip and near incisions. Understanding the vacuum effect is critical for the safety and efficiency.

To better understand how this works with routine cataract surgery, we did a clinical study comparing Venturi and peristaltic-based phacoemulsification at our institution. This was presented at ASCRS and also published in the *Canadian Journal of Ophthalmology*. So this study involved 995 eyes, so a large study, and these were all patients with just moderate nuclear sclerosis, no other pathology, and equivalent settings for Venturi and peristaltic.

We also did a randomized controlled trial, and this is also presented at ASCRS and published in the *Journal of Cataract and Refractive Surgery*. In this study, there were 111 patients and a total of 222 eyes, and they were randomized.

So both studies really showed that Venturi was more efficient, if you want to look at it that way, but it's also interesting to note that the procedure and the efficiencies can be gained with either Venturi or peristaltic using the Hi-Lo phaco settings. Also significant is that the complication rates were very low. Out of the clinical study of the 995 eyes, you can see there were 2 posterior capsule ruptures without vitreous loss, 1 in each group, and there were 3 anterior capsule tears, 2 in the Venturi, 1 in the peristaltic group.

So this is the kind of complication rate we want for routine cataract surgery, and I think it's important to separate out those complex surgeries that we do from these when we want to try to analyze both the efficiency and the complication rates.

Here the phacoemulsification settings have been used in both of the studies, and you can see that this is maximum vacuum at 600, this is 1% power, the lowest power possible, and the bottle height is actually at a moderate level of 100 cm.

Next will be videos of a Venturi case and a peristaltic case and you can see how they compare. So watching this, you'll see that the first thing we do is to basically crack the nucleus along the fracture line in half and rotate it, bringing it into position where I can lift it and vacuum at the same time. So if you'll watch on the lower right-hand part of the screen, you'll see the vacuum level and the power. So now we're bringing that piece, the second half, into the same position using maximum vacuum, and you'll see the power going on and off, but just at 1%. So the idea really is to maximize the vacuum and to use the minimal amount of power necessary. The chop instrument serves as a protection of the posterior capsule by the angulation between the chop and the phaco tip. We use Betadine irrigation throughout the surgery and now the irrigation and aspiration of the cortical material also follow the vacuum, and see this is also in Venturi mode. And you'll see the truncated edge of the cortex being brought into the vacuum, and using the vacuum just as needed to do that. I also used the Venturi vacuum for the polishing. Of course you can preset the amount of the vacuum, but it's maintained at a lower level as well.

This case, we're using peristaltic settings, and this lens is a little bit softer. It's firm enough to crack into the hemi split but soft enough that the aspiration flow is really enough to engage it, which really helps keep it at the tip to apply the maximum vacuum. And so I think that in a case like this, it is helpful to prevent the post-occlusion surge that you might see, and so it is one of the reasons why some people prefer the peristaltic setting because you see the interplay of the vacuum and the aspiration flow and just going to 0.

This slide compares studies in which we have information on peristaltic settings for conventional and FLACS and then for EPT and Venturi conventional and FLACS. One of the things that I think makes sense for like why peristaltic can be perhaps not as efficient is because the aspiration flow rate attracts the lens material to the tip, but the occlusion is really necessary to reach the preset vacuum levels. The femtosecond-treated lens creates fragments and may not fully occlude the phacoemulsification tip. This prevents the vacuum from further increasing and there's, as we'll see in some other videos, this interplay between going between aspiration flow rate and peristaltic.

The other thing that we've noted is that a lot of surgeons tend to use the same technique that they have used for non-femto-treated lenses, and they just don't work as well because they're really used to depending on that occlusion of the tip. And you see that on the left side of the graph there, where the studies are peristaltic conventional and peristaltic FLACS, and you don't see that much difference. But if you look at the studies where we do have EPT comparison data for Venturi and conventional, you can see that the Venturi FLACS is lower for all those studies. And when you compare our Hi-Lo phaco settings, which is on the far right of the graph, you can see that those are very low in comparison.

For some of you, this slide will be something you don't want to really pay that much attention to, but for persons who are really into this and comparing phaco power, I wanted to include it because there's not another good reference in the literature that kind of pulls this all together. So I won't just read the slide to you, but I think you just have to realize that different platforms record different things, and to make sense of this, you have to have a way to know what the mathematical relationship of those things are.

The other aspect of comparing platforms, as you see like the EPTs, the energy used when 100% of the ultrasound power is applied for 1 second, okay, but there is not a standardization for what 100% of ultrasound power is, so that is a variable that also has not really been transparently used to compare units. But for those interested, please note this is a way that you can think of what power you're using, in comparison to others, who are using other platforms.

To end this session, let's look at one more video using the peristaltic mode. I think that it might be good to look at the settings and how they interplay and think about how this Hi-Lo phaco works.

This Hi-Lo technique of phaco surgery where it's high vacuum and low power can also be used with the peristaltic mode. The thing to watch as we're reviewing the peristaltic cases is to watch the aspiration in the vacuum in the lower right-hand corner. So the aspiration is helping you pull that lens into position, and when the tip becomes occluded, you'll see the vacuum rise and the aspiration fall. That is

really intended to try to help you not have any residual vacuum once the piece flows into the phaco tip. So we've removed one half, going for the second half. Again, we're looking for lens purchase, and when you see the aspiration drop and the vacuum rise, that's when the tip's occluded, when you have good lens purchase. And so this dance between the two is what you watch for and try to understand with the peristaltic settings.

Thank you for your interest. We have more to get into with really looking at the details and how you personally can become more acquainted with the concept of the Hi-Lo phaco.