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Vitreous Sensing Vitrectomy

Maria Berrocal, MD:
Hello, and welcome to this episode of Clinical Minute. I am your host, Maria Berrocal. Today, I'm joined by Dr. Jordan Deaner, who recently articulated a new surgical technique for sensing vitreous during surgery. Dr. Deaner, thank you so much for joining me.

Jordan Deaner, MD:
It's a pleasure. Thanks for having me.

Maria Berrocal, MD:
So, tell us about your technique.

Jordan Deaner, MD:
Yeah. I probably have to start by saying I have to give Frank Brodie a lot of credit here. This was his brainchild, and he really invited me on to do the statistical wizardry and to correct all of his grammatical errors. So, I will give him full credit. But I think it's a very important topic. And so when we choose to do a vitrectomy, we usually like to remove as much of the vitreous as safely possible, right? That's the entire goal of the surgery. But the vitreous is optically clear, and so it can be challenging at times. It's certainly challenging for our novice trainees, but it can be challenging even for well-seasoned surgeons. And so, we thought, wouldn't it be a very cool idea or feature to have a way of sensing that we're actually moving vitreous from the eye when we wanted to be removing vitreous, and maybe even more importantly, when we're not removing vitreous from the eye, when we're not completing the goal of surgery?

And so the theory here is that the vitreous gel, again, we talked about it, it's optically clear, but it's a hydrogenated collagen matrix. And so it has a viscosity to it that is higher than the BSS that we put into the eye, right? And because of the way that our CONSTELLATION, which is the vitrectomy platform that we used in our study, works, it tries to keep a constant intraocular pressure. And so when we remove something from the eye, it fills the eye back up. And this is going to be the inflow, and this was the measure in our study. When you try to remove vitreous, which is viscous, a little tongue twister there, it's a little harder or slower to remove, and therefore, the inflow will then be slower, as opposed to BSS, which is less viscous, which then the inflow is a little bit quicker.

And so that's really what we saw in our study. So, we took six porcine eyes filled with vitreous, and six porcine eyes that were filled with BSS, and we performed vitrectomies on them across all vitrectomy gauges, across all vitrectomy cut rates, across all vitrectomy vacuum rates. And we saw, very consistently, across all of these vitrectomies, that the inflow rate when we were removing vitreous from the eyes was slower than when we were removing BSS from the eyes. And that was true across all of these metrics except for a single one, and that was probably due to noise and then our small sample size, and I believe that was at 27 gauge and 20,000 cuts per minute and 200 millimeters of mercury. And so it really showed us that using inflow as a metric to determine whether we are in vitreous or not is possible here. It's quite consistent, again, across all the gauges, the cut rates, and the vacuum.

Some other interesting things that we found is that certainly as we increased the size of the vitrectomy gauge and we increased the radius of that lumen, the inflow rate was higher, both in BSS and in vitreous. Certainly as we increased the vacuum, we were pulling and trying to remove more things from the eye, that inflow rate was higher. And then as we increased the cut rate, and we chopped those vitreous pieces up into smaller pieces that were less viscous, that also increased the flow rate. And so, that's all very much in line with our classics physics laws of fluidics.

Maria Berrocal, MD:
So, clinically, for the surgeon out there, it makes it possible to have a sensor that can give you an audible sound when you're in vitreous, which I think some companies are doing with their new machines now. And also, clinically, it would help the surgeon to remove vitreous

more efficiently just by using higher cutting rates. The highest cutting rate will be able to actually remove vitreous more efficiently.

Jordan Deaner, MD:
That is correct.

Maria Berrocal, MD:
Which may be counterintuitives to what people think that lower cutting rates would get bigger chunks-

Jordan Deaner, MD:
Correct.

Maria Berrocal, MD:
... but it actually is not that way because of the viscosity issue.

Jordan Deaner, MD:
That is correct. I think it's a unique opportunity. As you said, Alcon's next-generation system, the UNITY, actually has a mechanism to detect flow rate. Not just inflow rate, which was what we were testing in this study, but actually flow rate through the vitrectomy handpiece. And so it kind of makes this knocking noise when you are in vitreous or when you are not, and so I love that audible cue. I also think there's an opportunity to make visual cues as well. We could integrate them into the microscope or perhaps on our 3D heads-up displays. So, we have a lot of opportunities to have this information help guide us, perform better, quicker, more efficient vitrectomies.

Maria Berrocal, MD:
Yeah. I agree with you completely. Well, thank you so much, Dr. Deaner, for introducing us to your findings. We'll be back soon with another key paper and another expert voice. Until then, this is Maria Berrocal signing off from Clinical Minute.