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## New Techniques and Technologies in Cataract Surgery

Narrator:

Welcome to the CME-certified activity, "New Techniques and Technologies in Cataract Surgery," on ReachMD. This activity is co-provided by Med-IQ and Duke University Health System Department of Clinical Education and Professional Development.

Currently, nearly 30% of cataract surgery outcomes are not meeting the accepted standard target of plus or minus 0.5 diopter. In this segment, Dr. Terry Kim of the Duke Eye Center discusses the role of innovations, such as femtosecond laser, image guidance systems, and intraoperative aberrometry, in helping ophthalmologists better achieve visual acuity targets.

Your host is Dr. J. Michael Jumper from the Department of Ophthalmology at the California Pacific Medical Center, West Coast Medical Group, in San Francisco, California.

Dr. Jumper:

Modern day cataract surgery has continued to evolve and improve with the aid of advanced surgical techniques and innovative technology. One of the primary goals of today's cataract procedure is to provide better visual outcomes. Some of the technological advancements that have been developed to help achieve this goal include the femtosecond laser, image-guided systems and intraoperative aberrometry. Some of these techniques will be addressed in this discussion. I am your host, Dr. Mike Jumper, and we are recording live from the American Academy of Ophthalmology meeting in Chicago. And today with me is Dr. Terry Kim, Professor of Ophthalmology at Duke University Medical Center. He is Chief of the Cornea and External Disease Division and the Director of the Refractive Surgery Service at the Duke University Eye Center.

Dr. Kim, welcome to ReachMD.

Dr. Kim:

Thanks Mike, thanks for having me.

Dr. Jumper:

How has cataract surgery evolved over the years in your practice?

Dr. Dr. Kim:

Well, in general, it has evolved quite a bit, as you know, going from the old 11 to 12 mm incisions and doing in an either intracapsular or extracapsular procedure, now to doing a procedure that requires about a 2 mm incision. Certainly, not only the procedure itself, but the technique and technologies around it have evolved. Now we are using advanced phacoemulsification techniques to remove the lens. We also have now femtosecond laser technology that's assisting with parts of the cataract procedure and then the other, certainly important, component of this has been the intraocular lens development and ability to not only offer distance vision, correct astigmatism, but also to help with near and intermediate vision and then, probably, the last part in terms of the evolution of cataract surgery, are the patient expectations. They have certainly gone up quite a bit now with, I think, most folks considering cataract surgery a refractive procedure because they want the better vision and they want it sooner.

Dr. Jumper:

So, do you think that the cataract surgeries that you are doing have similar outcomes as refractive procedures?

Dr. Kim:

Well, if you look at what's been published in terms of data, Warren Hill has done some work looking at the results of the Swedish National Cataract Registry and if you see their results, we are getting about within half a diopter of our target about 70% of the time. Compare that to refractive surgery where probably over 90% of the time we are getting within half a diopter.

Dr. Jumper:

So, how do you see things moving forward here in the near future that is going to get 70 closer to 90?

Dr. Kim:

I think a few things, certainly refinements and improvements in our IOL calculations in terms of biometry and there is some advances there. And there has been some new technology with image-guided systems to help, not only plan the cataract procedure, but also image the patient and align the eye. And then, also, intraoperative aberrometry systems that actually can take an aphakic refraction to also help fine tune the IOL power.

Dr. Jumper:

So, you mentioned the image-guided systems. Tell me how that works?

Dr. Kim:

So, there are a number of systems out there. All of them are designed to help take away some of the manual parts of the procedure. For instance, you have to mark the eye. You are doing this especially if you are treating astigmatism and, as you probably can imagine, marking the eye with a gentian violet marker with the patient sitting up, is probably not the most accurate way to do it. The marking itself can fade; it can be in a not exactly aligned. The patient's head could be tilted. So, a lot of these image-guided systems, their goal is to actually take what's called the reference image of the eye and the patient would sit in front of a machine much like a corneal topography machine or a biometry machine and get an image of the eye and then the system can actually use iris architecture, scleral blood vessels as landmarks and actually determine really truly what is, for instance, 3 o'clock and 9 o'clock, to help guide where certain things have to go, whether it is an incision, whether it's LRI or AK incision or where to position a toric intraocular lens. Because then, that is connected to either your femtosecond laser and your operating microscope so that you can get those landmarks displayed based on what was captured in the office. The other part of that is the preoperative planning for the patient because a lot of these programs now actually give you the ability to pull up various IOL formulas and the IOL options so you can start to plan the patient's cataract procedure prior.

Dr. Jumper:

Okay, so then, the patient arrives to the operating room and now they have the option of traditional more incisional cataract surgery of the femtosecond laser. And how has that changed things?

Dr. Kim:

Well, I think changed things quite a bit. I would consider it disruptive technology and now we are able to do certain parts of the cataract surgery, specifically, the incisions, both the main incision, the paracentesis incision, the capsulotomy, the fragmentation of the lens and lastly, the limbal relaxing or astigmatic keratotomy incisions. And I think it has been interesting, the adoption so far in the United States has probably not been what you would think in terms of immediate adoption. There is a cost associated to it. That's out of pocket and there's whole logistical issues in terms of getting it into the OR and how that affects the OR flow and the efficiency of things. But I do think it is here to stay and it is going to be here for the future as well. Certainly, patients have had a very good reception of it. I have a very high conversion rate to femto cataract surgery in my practice, and I think it is an easy discussion with the patient because there is enough data out there to show that I think it is safer and more precise. Especially for me, the two aspects that I think are particularly relevant are the capsulotomy creation as well as the arcuate incisions to treat the astigmatism. I think it is particularly relevant, especially for the complex cataract patient, where this technology can be beneficial. If you have a mature white cataract, we all know that there is a high risk of what's called an Argentinian flag sign, when you start the rhexis. Now you are creating a capsulotomy in a closed system with the femtosecond laser so that essentially eliminates that risk.

Also for dense lenses I use it to fragment the lens so there is less phacoemulsification energy required to remove it, and Zoltan Nagy has published some studies looking at decreased ultrasound power and decreased ultrasound times with the femtosecond laser.

Dr. Jumper:

So, when is it you decide about doing a laser-guided AK-type incision versus putting in maybe an astigmatic implant lens?

Dr. Kim:

So, basically, when you are trying to decide whether you use a femtosecond arcuate or toric IOL, I think it depends on a couple of factors, one is the amount of astigmatism. For me, if you are roughly over a diopter and a half, you probably want to go with the toric IOL and if you are under that, you can go with a limbal relax incision. However, I will qualify that with the comment that depending on whether the patient is with or against the rule. What we want to do is treat against-the-rule astigmatism more aggressively. And so, I tend to do that with a nomogram that I have created using the LRI calculator.com free access website to do my limbal relax incisions and gauge it depending on whether it is with- or against-the-rule in terms of how much I am correcting.

Dr. Jumper:

Tell me more about this wave aberrometry and tell me how you use that and how that plays into things?

Dr. Kim:

This has been another addition to the operating suite where we now have the ability to do a aphakic refraction in the operating room. So, the first generation systems weren't allowing us to do this and now that's been the critical part of the piece, I think, that was missing because it is very effective to actually have the patient aphakic and have a real live basic aphakic refraction take place in the operating room. Some people kind of mistakenly think this is a biometer or keratometry system. It's not. You still have to enter your preoperative data in terms of the K's and the axial length, but then, you can take the aphakic refraction that really fine tunes that. It's been particularly useful in patients who have had refractive surgery because we all know that it is difficult to predict what lens power to put in these patients. So, right now, we are probably using the ASCRS calculator thanks to the work of Doug Koch and Warren Hill. But even with that, you end of kind of throwing a dart at which formula you want to use, whether it is the Haigis-L or modified Masket, etc. There are a host of them there. Graham Barrett has a great calculator that is available online, on the ASCRS website and also on APACRS.org. He has a universal formula and a post refractive formula and a toric formula. So, these are all formulas that are theoretical. So what's nice, is to actually take measurements in the operating room that give you a true reading and I think that's been extremely helpful. So, Dan Tran and David Chang have published in Ophthalmology, the actual improvement in the results and if you look at some of their data, you can see that they are getting within half a diopter of target, 67% of the time using ORA versus 46% of time with conventional preoperative measurements.

The other area that I think it is really helping a lot is toric IOL alignment and power selection. By the way, I want to clarify we do drift from with- to against-the-rule astigmatism with time. Which is why we want to treat against-the-rule astigmatism more aggressively. But for toric IOL placement which applies there as well, the posterior corneal astigmatism plays a large role in the calculation, so now with this aphakic refraction you are taking in the operating room that takes into account posterior corneal astigmatism. Whereas, the Barrett formula is a theoretic formula and he probably does address it, roughly 87% of the time, if you look at some of the work that Doug Koch has published but now you are taking into account 100% of the cases with the aberrometry system. The Wang-Koch formula is great for patients who have an axial length of over 25, but if your... and it's customized for the SN60WF, for instance, with the Holladay formula. If you are going to have to use a lens like, for instance, an MA60MA, which is designed for the high myopic patients, the formula doesn't work well. This is another area where I found that the wavefront aberrometry system really helps. So, we are going to look at that and probably publish our series using that technology.

Dr. Jumper:

Tell me about a case that you think would benefit from this sort of system?

Dr. Kim:

Maybe a hypothetical case that will show you the benefit of using all these technologies. We had a 48 year-old patient with prior Lasik that came in with a mature cataract. So one of these white cataracts and if you look at his preoperative measurements, the IOL calculations were all over the place. So, you kind of prepare for what you think, in terms of the range of IOL powers. We used the femtosecond laser which was great in terms of, again, creating that capsulotomy in a closed system, and then, usually these mature, white cataracts aren't really that dense, so the phacoemulsification part isn't that hard. And then, we did correct... he has some with-the-rule astigmatism about a diopter, so we put some limbal relaxing or arcuate incisions there. And there, what I do is, I will put the K readings into the LRI calculator.com website, which is free and if it is with-the-rule, I take 70% of what it is recommended because the LRI incisions on femto are typically put a little closer in to the limbus. And then, we took a reading and it showed that the power was about 2 diopters off from what we were previously looking from ASCRS calculator formula. So, it ended up changing our power quite a bit and, like I said, it is a little leap of faith, but the patient was 20/25 the next post-op day 1, extremely happy. I mean, removing a white cataract he was extremely pleased, but also have the visual result of 20/25 and these are patients who have had previous refractive surgery, so usually their expectations are pretty high, but they are also patients that understand the benefits of a laser. I think there are some connotations to the laser that most patients kind of understand the precision and the safety. And there has been some recent data,

also, with the femtosecond laser to show that visual outcomes may be improved, so a recent study in JCRS from Conrad-Hengerer show that 92% of their patients achieved visual acuity, or 92% of the patients got within their target compared to 71% with standard phacoemulsification. So there may be actually a role for femtosecond to also get us closer to our intended target of refraction.

Dr. Jumper:

Terry, tell me about what patients would you not consider this sort of system to be useful in or that you would not be using these systems for?

Dr. Kim:

You should refer to the laser manufacturers in terms of the contraindications, but in general, I think you have to be kind of practical and use common sense. I mean, if this is a patient that is going to be difficult to manage whether they are uncooperative; if they have kind of squeezing reflex when you are taking their tonometry and they are a squeezer. If they have dense corneal scars, you may not get the femtosecond penetrating through. If you get an RK patient you should not do the arcuate incisions or limbal relaxing incisions.

Dr. Jumper:

Dense nuclear sclerosis is not a real contraindication?

Dr. Kim:

No, I have a separate dense lens setting and it really goes....what's really nice, is when you do the femto it gives you a nice OCT image of the eye and that's how it's guided. And most of the systems are guided by an OCT image. What's really nice is it shows you anterior chamber depth and, actually, you can see lens thickness too. So, it gives you an idea and mentally how to prepare for that case and what to anticipate. But if you do the settings for dense cataracts, actually I program it fairly deep so that you can get these fragmentation patterns fairly deep into the lens so when you now go to your chop procedure, you already have a fracture plane to follow that makes it much easier, for instance, to crack that posterior plate which can be difficult when you are just doing a regular manual chopping maneuver.

Dr. Jumper:

Dr. Kim, thank you for providing an update on the technological advances for cataract surgeries.

Dr. Kim:

Thank you Mike.

Dr. Jumper:

I'm your host, Mike Jumper, and thank you for listening.