Dr. Dr. Kimberly Ngai - Antimicrobial Dental Material for Bacterial Inhibition and Caries Reduction

Dr. O'Keefe: Today I'm delighted to welcome a pediatric dentistry grad student that I met recently at the annual conference of the Canadian Academy of Pediatric Dentistry, and it's Dr. Kimberly Ngai. She's studying to be a pediatric dentist at the University of Toronto and where I came across her was during the grad student research presentations. It's a program, annual program sponsored by 3M and it brings up to five grad students to the annual conference of CAPD. And Kim won the competition. She was the top presenter. Congratulations Kim on...

Dr. Ngai: Thank you.

Dr. O'Keefe: And you're here to tell us about your project. We'll see a PowerPoint presentation that you gave at the conference a little later. But first, just conversationally, what was the problem you set out to investigate?

Dr. Ngai: So, as many of us know, resin composites is one of the most commonly used restorative materials and this is because patients like white tooth-colored restorations and we're more concerned about the mercury in amalgams. And so, that being said, we also know that resin composites tend to fail prematurely, usually due to secondary caries at the margins of restoration. And so, what our lab group tried to set up to do was create a material that incorporated antimicrobials within it so that we can hopefully inhibit bacteria in secondary caries so we can improve the lifespan of resin composites. And so, this would obviously be a great benefit to patients because restorations are expensive, and patients might not want to get their fillings redone.

Dr. O'Keefe: So, well, what was the nature of your experiment or experiments?

Dr. Ngai: So, there we ran kind of like an in vitro ex-vivo study. There were two main experiments. So, one looked at the kind of bacteria side of things cause we wanted to see if we could inhibit bacteria with our antimicrobial drug. And then our second experiment looked at the clinical outcome that clinicians are interested in, which is preventing recurrent caries. And so, our first experiment, we had these specimens, we incubated it in like, um, something similar to our saliva to try to see short- and long -term effects. So, we looked at zero days, 90 and 180 days. And then we grew a biofilm on the tooth and then analyzed it under confocal laser scanning microscopy to try to look at a couple of measures. So, we looked at biomass, which is the total number of bacteria on the tooth surface. We looked at the ratio between live and dead cells. So we wanted to see how effective or anti-microbial drug was. And we also wanted to see how far into the interface from the surface we're able to detect bacteria, which gives

you an idea of the marginal gap within the interface or what we call depth of bacteria penetration.

Dr. O'Keefe: One thing...

Dr. Ngai: Sorry. I was going to say, then the second experiment looked at secondary caries. So, we just incubated it. We changed the media and the sugar supply and bacteria every 48 hours. And then we analyzed it under micro CT to look at volume of demineralization and cavitation.

Dr. O'Keefe: Right. One of the things that really caught my attention was that in that first experiment, you did it over 180 days. Often there's an issue that therapeutically released components of filling materials, it's like a real short burst at the beginning. So, you were very conscious of that, right?

Dr. Ngai: Yeah. So, we tried to test that because current antimicrobial system, they do have that short release, and it's usually uncontrolled. Versus our material, we've shown through our previous studies to have long-term effect. It was calculated to be well over 30 years. And it was most, it was shown to kind of increase its release when it was under kind of bacterial attack. So it was triggered.

Dr. O'Keefe: Right, right, right, right. Well as an interest to dentist, what did you find?

Dr. Ngai: So, we found that our adhesive was effective. So for our first experiment it did decrease those three biomarkers that we were looking at. So the total number of bacteria cells. There was a reduction in both total-etch and self-etch, cause we tested for both. There was a decrease in that live/dead ratio. So our antimicrobial was effective at all the way through from zero, three and six months. And we also found that there was a decrease in that depth of penetration. So, there was less bacteria being found within the interface. And this complimented our results from our second experiment where we found a reduction in cavitation and demineralization. So, it suggests that our material is promising, but also that it can prevent secondary caries.

Dr. O'Keefe: Right. Well, can I go out and buy the stuff anytime soon?

Dr. Ngai: Unfortunately, not yet. I wish I could say that it's on the market tomorrow. We are still kind of in the very beginning stages of developing the material. We are running multiple experiments right now. One of it which is actually an animal in vivo study. So, with that we're trying to look at the safety as well as the clinical effectiveness of the drug. And then hopefully we can then do trials within humans and then eventually commercialize it.

Dr. O'Keefe: But as a system it clearly has promise to deliver.

Dr. Ngai: Yeah, it definitely looks like it does. So obviously there's still further investigations that need to be done. We tried to mimic the mouth, but obviously it's not completely accurate. But hopefully at least this methodology seems to work and we're actually trying to apply it to other applications as well in terms of fissure sealants, varnishes, like endodontic sealers, and hopefully in the future it's something that can be used in clinical practice.

Dr. O'Keefe: Well, I want to thank you very much for coming here to talk to me today. Let's go and have a look at your presentation now.

Dr. Ngai: Sounds good. Thank you for having me.