Evidence-based Dentistry - Why Do I Need That?

Video Transcript

Evidence-based practice, why do we need that? When we're practicing dentistry, many times we're used to hearing our colleagues say, "It works in my hands," or "I believe in this material," or "This is how I've been doing it for years."

And usually, we feel that it really does work in our hands. So, the question is, why do we need evidence? What is all the fuss around evidence-based practice? One of my first personal experiences with this issue was when I planned to implement in a very large multi clinic, dental setting, posterior resin restorations to be used across the board instead of amalgam restorations.

At that time, I was a part-time clinical instructor at the Department of restorative dentistry and I really believed that posterior resin restorations can be successfully used for all scenarios. But before implementing that, we have conducted a cross sectional study to assess the secondary or recurrent carriers and the restorations from amalgam or resin.

To be honest, with the finding of this cross-sectional radiographic study that checked almost 460 young adults was shocking to me, because I realized that in real life scenarios, the rate of secondary caries underneath resin-based restorations was much higher than under amalgam fillings. This experience taught me that even when I feel it works in my hands, or even when I truly believe those materials are as good as others, or if I'm convinced that some treatments are better for my patients, it's not always the case. We actually need to collect data properly and analyze it in a way that will be unbiased.

This bias, by the way is not something we do on purpose. We all want to make things better for our patients and select the best treatment for them. But sometimes when we're working for a long time, even unconsciously, we seem to prefer specific treatments. And then our perception is that they are more successful. Our mind can sometimes trick us into seeing less failures or complications with treatment we think that are better.

When we're talking about evidence-based practice, there is a pyramid of different levels of evidence that we're usually referring to. This pyramid starts in in vitro lab research and go through different levels of evidence until it reaches the top of the pyramid where systematic previews and meta-analysis are. The idea behind the pyramid is that we need all those levels of evidence in order to develop or support a product or a treatment. But when we move up in the pyramid, we have stronger evidence that is closer, or help us to better bring the evidence to chairside.

There are also different directions of research questions to be asked. For instance, when we did this cross-sectional study, we were actually asking at a certain time point, what is the ratio of secondary carriers under amalgam and resin-based restorations, but there are other studies that has different types of questions. Some of them will follow a group of patients

from now to the future, and some of them will look backwards retrospectively on a cohort of patients to see what happened to them in the past.

If we're starting to look at this pyramid, we can see that at the bottom, or the base of the pyramid, there are in vitro lab research studies. Those are very fundamental research projects that give us the basic understanding of the treatments or the products that we're trying to develop. Then they can help us understand the mechanism behind the proposed treatment. However, the distance between them and the clinical setting is usually very wide.

For instance, in this study, we have analyzed the departure points with chlorhexidine slow release properties. And we saw that there was some inhibition of bacterial growth on a Petri dish. This might give us a hint that they're chlorhexidine coated the departure points can help reduce bacteria in the root canals.

However, the conditions inside the canal with different environment in the root canal, are totally different than what we can see on an agar plate. So basically, this can serve as a proof of concept maybe for an idea like that. But taking it from this level to the clinical use is still very premature. This is, for instance, a good example for a paper that can be presented to you as a dental practitioner advising you to purchase specific products. But it's our role as responsible practitioners to read the paper and to see if it has something in it. It is our role to understand the relevance of this lab test in relation to our day to day practice.

Indeed, in this case, we can nicely see the bacterial inhibition. However, the relevance to our clinical practice is still far from being proved or determined.

Another example is this preliminary study that assessed the ability of antimicrobials and specifically stannous fluoride to bind two bacterial toxins. As we can see, in the graph stannous fluoride showed to be better in binding to E. Coli LPS, which again gives us a very nice idea that stannous fluoride might be more beneficial in fighting bacteria in the oral cavity. But the distance from here to the clinical application is very wide, and especially when we're talking about E. Coli, which as we all know, is not the main pathogen in the oral cavity.

This is why in the conclusion of that paper, we can see a lot of clauses like this resolved, support a potential mechanism of action and potentially render them less toxic or this result may influence homecare recommendations.

This is all because the lab test can help us with the general idea. But there are many factors along the way that might change the composition and behavior of stannous fluoride. The next step in the pyramid is animal research project. When we're using animals to study some research questions, the environment is closer to the reality than of course, the lab work. And it enabled us to control a lot of components and confounding factors like age, medical status, habits, et cetera, et cetera. However, we have to remember that those are still animals and their biology, their dentition and their behavior are totally different than our patients, at least most of the time.

For instance, if we're seeing some relationship between heart conditions and gum disease in mice, it could help us explain the relationship or the possible association between oral health and systemic health. But it only refers to this type of animal. We can't really conclude or draw valid conclusions that will be totally transferable to our patient population.

Another example is this study that was evaluating a specific mouthwash for prevention of Peri implant, mucositis and peri-implantitis. Even though we see a difference between the groups that were treated with a test mouthwash and the control mouthwash, we still need to remember that this is a very specific environment in dogs, and it doesn't always easily translate it into our human patients. It is very important to perform those studies at the beginning because it helps us control many confounding factors and behavioral traits in real patients. But still, it is not an environment that is completely similar to the oral cavity in humans.

The next step in the pyramid are ideas, editorials and opinions. Though it's always nice

to have your opinion and maybe even your picture in the magazine. It is important to understand when we're reading those papers, that these pieces are the opinion of the person who wrote them.

They might be partially supported by evidence. And they might be very helpful sometimes at the beginning to understand a topic or to get a nice overview of a topic, but it's still only the view of the writer, and it should be referred to like that. For instance, here we have a very nice editorial written by a dental hygienist in Italy describing a new Oral-B cross action electric toothbrush head. It will be very nice to read what she has to say about the new toothbrush head. However, we have to remember that this is her specific opinion. It may be biased, it may be based on her professional and personal experience. So, we can use it as a nice overview to see what's new out there, but the level of evidence here is still rather low.

The next step are case reports. Case reports are very interesting sometimes, and very important to present because they give the reader information about specific cases that happened in different areas around the world, and sometimes the way they were treated or managed. That can help sometimes to give us ideas about conditions and treatments that we weren't exposed to before.

But again, here, we need to remember that this is only one case that was described by one group, and we can only learn very limited advice from those specific single cases. A very interesting example for that is this case report that we have published a few years ago about surgical intervention and surgical treatment of osteonecrosis of the bone. And it showed a very favorable result. At that time, the case was very interesting and was published in the Journal of the American Dental Association. Even though today, this treatment modality might have been referred to as malpractice. Because we know that today, we're trying to avoid surgical procedures in osteonecrosis of the bone.

This was however, not known at that time. And this is why a few years later, in 2013, we have published this case report in the Journal of the American Medical Association about a non-surgical treatment of osteonecrosis of the bone. So again, those cases are nice to follow, but should be evaluated very carefully and cautiously before we're trying to implement that into treatment.

The next step in the pyramid are case series. In this step, we can describe a few cases, two or three case reports together or even a collection of cases, like in this example, when we reported on almost 1400 single tooth implants. The idea behind those cases series is, is to provide a wide range of examples that have something in common and that might help us learn about a condition or a treatment modality. However, since we do not have any comparison, we cannot really be sure that this treatment modality is better than other treatment, or even better than no treatment at all.

For instance, if we gave 100 patients a new pill to treat headaches, and we saw that 40% of them reported they felt better, we are not sure if those results are better than another treatment for headaches or even not sure that those results are better than placebo.

For that, we need a comparison group and not only a case serious type of report. So, the next level in the pyramid are case control studies. In case control studies, we are thinking and taking a group of cases and matching them with a group of control and then comparing the two groups. Case control studies are usually used to research about rare conditions because they enable us to collect reasonable group sizes for diseased and healthy patients.

For instance, take the example of what was previously called aggressive periodontitis, which was thought to be affecting about 1% of the population. If we will try to collect 10 patients with aggressive periodontitis, we will need to assess about thousand patients in order to get this group of 10. However, if we will collect first all the aggressive periodontitis patients we have in our clinic, and let's say we have 50 of them, then we will match each one of them to a control healthy counterpart, the same age, gender, et cetera. This way by only assessing

100 patients, we will have two nice groups of 50 patients each and we can compare the disease population with a healthy population.

This study will be called a case control study because it takes a group of cases. Let's say in this example aggressive periodontitis cases, and compare them with a group of controls, like the healthy patients in the example. When we're talking about case control studies, the direction of the question is backwards. We are taking a group of cases and a group of control and looking backwards to see if they were exposed or not to, let's say, smoking or other confounders that we're trying to assess.

The next step is cohort studies. In cohort studies, we're actually taking a group of people, a cohort of patients, and we're following them throughout a period of time. This can be done with or without an intervention we're looking to assess. In this cohort study, we have evaluated implant survival over time in a cohort of patients with different levels of periodontal diseases. We can see that patients with more severe periodontal disease showed less implant survival over time.

These studies are getting to the area of the top of the pyramid because they are assessing usually a large number of patients and giving us the opportunity to see the effect of some exposures, like periodontal disease or smoking on the outcomes.

In cohort studies, the direction of a study is forward. We are taking a cohort that was selected for this specific study. Some of the participants are exposed and some are not exposed to what we're trying to assess. Then, we look to the future for the outcomes we're evaluating.

The next level, which is almost the highest level in the pyramid, are randomized control studies, these studies where we're taking a group of people, and we're randomizing them to two interventions, then we're assessing the outcomes over time. The fact that we're doing that randomly, but also trying to blind the patients and the examiners to the different groups, gives higher validity to the study results. When we're talking about double blinding, this means that the patient doesn't know if they were allocated to the experimental group or to the control group. And the examiner doesn't know if the patients they're examining are from the experimental group, or the control group.

For instance, in this study, two groups were assessed regarding the reduction of gingivitis and plaque with different electric toothbrushes. One group got a sonic toothbrush, and the other got an oscillating rotating electric toothbrush. The two groups were followed for eight weeks. And as we can see in the graph, the oscillating rotating group in blue performed better in plaque reduction and bleeding sites. Of course, these type of studies patient cannot be blinded for which toothbrush they're using. However, we can definitely blind the examiner from knowing what group the patients are in.

In another study, we can see again, the same study design where 60 patients were allocated to two groups. One was using manual toothbrushes and the other an interactive power toothbrush. As we can see in the title, we're talking about a single center, examiner blind because we cannot blind the patients from the type of the toothbrush, randomized clinical trial. Those type of studies enable us to compare effectiveness of products or drugs or other interventions in a more precise way. And thus, they appear at almost the top of the pyramid. In some of these studies, we are even adding a second stage that is called cross over or repeated measure design.

In this case, we're starting the same way with randomizing patients to the experimental group and to the control group. Then after a while, we're assessing the outcome variables, but in the next steps, we're switching the groups, which means that the patients that were originally in the experimental group are now in the control group. And the controls are now in the experimental group. This is done so we can compare not only the two groups as a whole, like the control group and the experimental group, but we also have an internal comparison within each patient between the time they were in the

experimental group, and the time they were in the control group.

This will be a nice example of a randomized clinical trial that compared power toothbrush to manual toothbrushes in children and was done with a cross over design. So, the kids actually switched after a period of time between the electric toothbrush and the manual one. In this particular study, the conclusion was that oscillating rotating power toothbrush was superior in plaque reduction when compared to manual toothbrush in kids.

The next tier in the pyramid is systematic reviews and meta-analysis. In this level, we're evaluating or analyzing data from a variety of randomized controlled trials, or a variety of studies that were done on a specific topic. Here, we're presenting a compilation of the outcomes in a way that will help us gather the maximum available information from the current literature on the specific topic.

For example, we can see this systematic review, where we analyzed long term studies comparing tooth and implant survival rates, and we found that across the board, tooth preservation might be more successful in the long run than replacing them with dental implants.

Another recent example is this systematic review that we have published in the April edition of the Journal of the American Dental Association together with my colleague Danielle Clark Perry.

In this study, we have evaluated and analyzed randomized control trials, comparing oscillating rotating versus other powered toothbrushes. As we can see, in those graphs that are called forest plots, most of the blue rectangles are to the left of the line, which means that most of the study that compared oscillating rotating to other power toothbrushes found the oscillating rotating ones to provide better results in terms of plaque removal, and bleeding sites.

Forest plots are commonly used in meta-analysis in order to present the compiled results of the selected studies. They take into account the number of participants of each study, the power of the results and the overall integration of the findings from all studies that are selected. This is why we have concluded cautiously that there is some evidence to suggest that oscillating rotating toothbrushes might remove more plaque and reduce the number of bleeding sites better than other power toothbrushes.

As we saw so far, we have a wide pyramid of studies that help us assess the evidence. And it is our role as clinicians and healthcare providers to thoroughly assess the papers that are presented to us in order to understand the level of evidence that we have for a specific treatment or product. The objectives of assessing the evidence, and maybe even objective of conducting the research itself, can vary between different types of research projects. We can have studies that are aimed to assess the disease prevalence or occurrence Like this paper that assess the prevalence of aggressive periodontitis among, uh, young adults. But we can also have studies that assess confounding factors and their influence on specific conditions and treatment outcomes. Like this one that evaluated the influence of smoking on marginal bone loss around dental implants. We can also assess the treatment needs in different populations. Like in the presented study that talks about the treatment needs of adolescence in Georgia.

We can use studies to determine treatment efficacy, like the example here that was assessing oscillating rotating technology on plaque removal and gingival health, and we can also compare treatment options like in this case, when we are using the study to differentiate between an electric toothbrush and a manual one. Another aspect that will be interesting to talk about would be the phasing of clinical trials. These phases are internationally used to describe the stages required for a drug, or a medical device to move from the lab work, the initial in vitro and in vivo stages towards becoming a drug in the market.

Every drug you see in the market that is registered and approved as a drug should go

through all the four phases of this process. Phase I of the process will begin after the initial in vitro and in vivo studies were completed, and it evolved mainly in assessing the safety of the proposed drug.

In this phase, the idea is to make sure that the drug is safe for use, to evaluate the dose to be administered to patients and the pharmacokinetics of the drug. Phase I will also help identifying side effects and drug food interactions and is known also as the first in men studies. The patient sample in this phase is usually of healthy individuals unless the drug is very toxic and then a patient group that needs treatment will be used. In Phase I studies typically we have 20 to 50 people that are involved as participants. Phase I is usually open labeled study with no blinding, there is no randomization and no control group, since we're not looking at the efficacy, but on the safety only. In some cases, dose escalation will be used to determine the safe dose to be administered to patients.

Phase II studies are divided into two stages, phase IIA and phase IIB. Phase II A is basically a proof of concept phase. We're interested in the frequency of the drug for the specific indication it was proposed for. The sample size in this phase is ranging typically between 30 and 100 participants. Here, we will usually have a placebo control as a comparison group, and it will be typically a single centered study.

Phase IIB, is a more advanced and comprehensive efficacy determination with about three to 400 participants. In this phase where we still have a placebo control, but also we have an active control of the gold standard treatment currently available when applicable of course. Phase II B will already be a multicenter study performed in different patient populations and different locations.

Now we get into phase III, which consists of confirmatory clinical studies. In this phase, we're actually asking if the drug is safe and effective in a larger population. Those are very rigorous randomized studies with an increased sample size of about one to 3,000 participants. This will be randomized, double blinded, parallel studies with a control that will be an active agent and not a placebo. Multiple centers will be involved in gathering the data for phase III.

This stage is pivotal for the licensing of a drug. And after its completion, the registration of the drug can be submitted and hopefully approved. But this is not the end of the process at all. Even if a drug is finally approved, there is still a mandatory phase IV. Phase IV is a post-market surveillance stage. And it is a legal requirement for every approved drug. It will include thousands of participants and will be assessed after the drug went out to the market. This phase will help in detecting long term and rare side effects, as well as shed more light on the efficacy of the drug in the long run.

The requirement of this phase is for a minimum of four years after marketing, and this phase obviously is observational in nature. It can also help with assessing health economics aspects and cost effectiveness of the drug. The most important aspect in understanding all these phases is to realize how much time and effort and money are being invested in the development and approval of every registered drug. This is an important aspect that differentiate registered and approved drugs from other non-registered supplements sometimes.

It is also important to recognize that even after all those phases, we sometimes see drug withdrawn from the market, as issues may come up with a long term follow up. This really highlights the importance of long term follow up, proper documentation, and continuous assessment of the product after the initial registration and approval. So in general, instead of using feelings and beliefs, like, "It works in my hands," or "I feel, I believe," or "I think that this works," we have to adopt a more thorough method in order to gather the best available evidence for the treatment and advice we give to our patients.

Good practice, good clinical practice will be a practice that is based on evidence. But it's not only about evidence that we're talking about.

It's also open a great avenue of opportunities in our dental offices to report properly, and analyze periodically, the treatment results that we're getting in our own practice. Sometimes, you will be surprised to see how things that you thought were working in an ideal way, are not as good as you believed. Because, as I said in the beginning, our mind can be tricky sometimes, and things that we think are best practices might look like that to us in general. But when we properly analyze the data, we can discover new things even in our own hands.

This leads us to the idea of practice-based research. Research that takes the nature of practice, as its central [focus 00:31:47] and carried out by practitioners is called practice-based or practice-led research. Practice-based research is aimed to create opportunities for communication and collaboration among practitioners and researchers. The main goal is to promote and encourage investigation into the methods and techniques for the conduct of research in a practice-based setting.

So actually, we can collect data from a group of clinicians and learn about what are the results of different treatments in a real-life scenario, in various clinics. Practice-based research enable us to conduct observational, investigational and translational research in the practice of dentistry and to provide an international and cooperative forum to present and discuss practice-based evidence. There are some networks for practice-based research that you can join and take part of this utmost important initiatives. It does add a lot of rigor related to data collection, and planning the structure of the research, but eventually it provides a very valuable result. So next time you feel something works in your hands, try to look at the evidence first.