Update on Dental Caries Risk and Caries Lesion Assessment

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HISTORY OF CARIES DETECTION

Although dental caries is the most prevalent disease in humans, affecting over 95% of the population during their lifetime, the ability to detect either who is at risk for developing numerous caries lesions or to identify a specific caries lesion early in the process are both exceptionally poor. This short report describes the landscape and direction of practice change either in existence or necessary for assessing the risk of caries and for detecting specific caries lesions. Individual products will not be reviewed herein; rather the ideas behind what changes are needed will be discussed.

There are many so-called "caries risk assessment" (CRA) tools. They come in a variety of forms; some use historical and/or environmental surveys—asking, for example, about socioeconomic status as well as family history; some use the addition of chairside (with laboratory cultivation/incubation) microbiological tests; some employ technology. In spite of the recent influx of many different CRA tools, none is specific enough to be effectively used in screening a population where a small minority is at the greatest risk for developing rampant disease, and the majority will develop only moderate or mild disease manifestations. There are too many false positives, and therefore the cost and efficiency effectiveness of available tools is questionable.

DISTINCTION OF RISK ASSESSMENT AND SPECIFIC LESION DETECTION

CRA is the ability to predict, in advance of seeing the clinical manifestation of dental caries in the form of a caries lesion, that one or more lesions will occur if no specific preventive intervention is made. As suggested above, what would be desirable is a tool or device that could reliably sequester those patients who are likely to develop caries lesions in some upcoming period of time and to exclude (as true negatives) those patients who are at little or no risk for developing lesions in the upcoming period.

Because dental caries by definition is the bacteria-produced acid dissolution of enamel and dentin, and occurs in a "dynamic equilibrium" wherein some lesions "heal" via compensatory remineralization, the best predictor of the future occurrence of actual cavitated lesions (which would require restoration if they progressed to that point) would be the very early detection of the lesions themselves. In other words, if a tool—some device or technology—could actually "see" the presence of a caries lesion clinically in a state that would be predicted to progress if no intervention were made, it would not be relying upon *prediction* of dental caries lesions, but actual *detection* of the lesions at a state and form that would progress without intervention. But how might such a device distinguish

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those lesions from ones where the typical host response in the form of remineralization would prevent their manifestation in the form of cavitation in the future?

To achieve this ability, the device or tool should:

1 observe subsurface demineralization clinically in all parts of the tooth at risk, including proximal surfaces
2 distinguish true demineralization from "noise" such as hypomineralization or "dysmineralization"
3 be tested within a large study wherein many small (not clinically visible by traditional means) caries lesions it detected were followed and wherein a characterization of surface demineralization quantity and depth that equates to future cavitation, as evidenced by many lesions being followed in the study is made; and
4 produce a database of lesions that were followed (some) into eventual cavitation where all were predicted to do so by this device with minimal "escapees" (false negatives).

All of this may be possible with careful deployment of some of the technologies under development in various stages.

Various energy forms (including near-infrared, near-ultraviolet, and ultrasound, all with or without the use of fluorescence) have been observed to detect caries lesions in stages much earlier than they can be clinically detected via traditional means such as visual examination, radiography, and transillumination. Yet so far, none of these technologies, including some on the market and used in dental offices around the world as "caries detection tools," has been tested via the kind of prospective analysis of caries lesion detection and prospective prediction of cavitation (without intervention). Therefore, it is difficult to rely upon any such currently available device as a singular method for assessing risk or even for the valid identification of a "caries lesion" that will certainly cavitate if untreated. It is therefore important that we select the right combination of CRA tools along with the most effective technologies based upon laboratory study and employ the type of prospective clinical trial that will provide the needed data to say that the device can "predict" cavitation because of early visualization of disease of a certain form.

WHAT NEW DEVICES WILL BRING IN TERMS OF TREATMENTS AND THERAPEUTIC

It is often correctly stated that there is a dearth of medical therapeutics available for clinical treatment of caries lesions or for the attenuation of caries risk. Although it is true for populations of patients that traditional means of empirical prevention are effective at lowering the caries risk of that population (e.g., diet changes, appropriate dental hygiene, and the proper use of fluorides), the use of those same regimens on an individual patient might not achieve the desired preventive outcome.

But manufacturers of powerful agents that might medically "treat" caries and caries lesions have been understandably reluctant to invest the required large sums of money to test therapeutics clinically with the required tested outcome of cavitation 3 years out, when the investment of time and money may not be effective, and the agent may prove to be ineffective. With new tools/devices/technologies in place, however, I am excited about a new era of discovery and deployment of agents into trials that can actually treat caries lesions and attenuate risk within an individual patient, and which can be tested in a relatively short time period because the aforementioned types of tools/technologies have been shown to be predictive. Indeed, many such developments are underway that will result in reliable methods of identifying caries risk, and assessing and treating caries lesions in advance of restoration, or perhaps called "the earliest and least destructive form of restoration."

SUGGESTED READING

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