

AADC Positions Committee *
Position Statement
Laser Fluorescence in Caries Diagnosis
May 28, 2007

Introduction:

Throughout the history of dentistry, technology has played a crucial role. From early developments such as anesthesia, vulcanite for dentures, x-rays, and amalgam to more recent developments in the twentieth century that include improvements in dental materials and the introduction of ‘the high-speed’ drill powered by compressed air, advances in dentistry have resulted from a combination of increased scientific understanding of oral diseases and their treatments and technological improvements. The pace of technological change has continued to accelerate and has significantly impacted dentistry with the recent development of digital imaging of teeth, understanding of the concept of osseointegration with dental implants, development of software for computer-generated tooth restorations, and the use of lasers (Light Amplification by the Stimulated Emission of Radiation) that cuts both hard and soft tissues. There have historically been setbacks with some of the more notable being the TMJ Proplast implants, early filled polymer crowns (Artglass), and Caridex to name a few. These disappointments are good examples of technologies that did not meet the dental community’s expectations, thereby falling into disfavor.

In most cases associated with the newest technologies and their most recent innovations, an evolutionary path of development has been followed resulting in professional acceptance. For example, while dental implants are now considered standard of care and, in some cases, the preferred technology to replace missing teeth, researchers in the 1980s and 1990s were still building, reviewing, and validating the body of evidence generated from clinical trials and outcome studies.

In the case of Laser Fluorescence, a new technology used in the detection of dental caries, the development of clinical evidence and outcome studies is in its early stages. Yet in many cases this method is often perceived as superior to current, proven methods of detection and used as the primary means of diagnosis.

Background- Summary

For years dentists have been trying to devise new methods for increasing the accuracy of diagnosing fissure caries within intact teeth. In a study by Lussi et al., it is suggested that when using traditional clinical methods, as few as 20% of teeth with fissure caries under intact surfaces were correctly recognized. Alternatively, “lesions” are often identified as positive in cases of normal anatomical variants such as deep and/or stained fossa. This has led to the search for new techniques to improve diagnostic reliability including Laser Fluorescence and other technologies.

Laser Fluorescence (LF) as defined and redefined in the articles reviewed for this position paper is the measure of fluorescence of a tooth that is induced after light irradiation to discriminate between carious and sound enamel. It is accepted that the induced fluorescence of enamel is lower in areas of reduced mineral content and that there is a relationship between mineral loss and the radiance of the fluorescence.

Current diagnostic methods for fissure caries detection exhibit high specificity but low sensitivity, where specificity in this context refers to the number of teeth which test negative for dental caries (*Stedman's Medical Dictionary*), and sensitivity is the correct recognition of decayed teeth. Lussi et al. again noted that, in most studies, the specificity for the correct recognition of sound teeth appears to be greater than 80% for all traditional methods. This means that only a few sound teeth (i.e. without dentinal fissure caries) are diagnosed incorrectly and are erroneously treated by operative intervention. The sensitivity of conventional diagnostic methods, (i.e. the ability to correctly recognize teeth with dentinal caries), has been shown to be between 62% and 90% for teeth with visible cavities in fissures. The correct clinical diagnosis of teeth with dentinal caries under macroscopically intact surfaces (often called hidden caries), however, has been shown to be significantly lower, with reported sensitivities as low as 12%. It has also been found that additional probing with an explorer did not improve diagnostic performance. Regular probing with commonly applied force may, in fact, disturb areas of demineralized enamel to the point of disrupting the surface, which, in turn, may lead to more rapid progression of the carious process.

LF is being marketed for caries detection on intact occlusal surfaces. It is a chair side, battery-powered quantitative diode laser fluorescence device that emits light at 655-nm wavelength from a fiber optic bundle onto the occlusal surface of a tooth. A second fiber optic bundle receives the reflected fluorescent light beam. Changes caused by demineralization are assigned a numeric value, which is displayed on a monitor. The system is calibrated to a provided standard and to reference (sound) enamel.

Despite the apparent technological advances, the literature reviewed also noted concerns that include:

- False positive readings, possibly due to false biases or resins and calculus being present on the tooth
- Inadequate training leading to misdiagnosis and inadequate test results
- A lack of research correlating measurement readings to the degree of tooth demineralization
- A lack of evidence correlating a numeric device reading to the severity of the carious lesion
- Postulations that the device does not reach the deeper dentinal layers, thus causing an inability to distinguish between superficial and dentinal decay in vivo
- The device was not statistically significantly better at detecting caries in non-cavitated teeth when compared to visual examination

Many of the studies and articles reviewed for this paper suggested that it is advisable to initially carry out a meticulous visual inspection of a tooth for the presence of caries. If

there is any doubt as to the tooth's condition, the laser device could then be used as a valuable adjunct for aid in diagnosing caries. Many articles suggested that the device facilitates the diagnostic process, as it combines the advantages of higher specificity and speed of clinical visual inspection with the higher sensitivity of the new device. Most importantly, the abstracts and articles reviewed made the point that diagnosis of a carious lesion in the early stages of the process **must not** be used as an excuse for early operative intervention.

Position Statement

In its recent paper entitled "Evidence Based Clinical Recommendations on Pit and Fissure Sealants", the ADA noted that "There are many technologies that detect caries. Recent reviews suggest that these devices should be used only as adjunctive devices to assist in caries diagnosis. These devices should serve primarily as a support tool for making preventive treatment plan decisions in conjunction with caries risk assessments, and sole reliance on these devices to detect caries may result in premature restorative intervention." In addition, recent literature such as the 12 and 24 month studies of early treatment of incipient carious lesions by Hamilton et al, questions the merits of early intervention for questionable lesions, noting that these may not conserve tooth structure. This would seem to support traditional "watchful waiting" protocols for the right patient based on their age and caries risk.

"Premature restorative intervention" has significant impact which can last a lifetime, as noted in a report produced by Delta Dental's Data Analysis Center. This paper looked at the long term potential financial impact caused by treating a tooth – whether correctly or incorrectly. The lifetime expenditure of tooth excavation on a per-tooth basis using restorative, endodontic and extraction costs, limited to age 79, produced lifetime costs for a molar of \$3117 (2003 dollars), which translates to an approximate equivalent of \$3500 in 2008 dollars. The model described by the report underscores the need for careful diagnosis and the potential risks of relying solely on a technology with uncertain specificity.

The AADC Positions Committee concurs with the ADA and at this time strongly advocates that LF be used as an *adjunct* to traditional caries detection methods and not used as a primary diagnostic tool. Surprisingly, despite the literature and the ADA suggestion that the role of LF be one of an 'adjunctive device' or 'supplemental assessment', there has been an increase in the number of practitioners relying upon LF as their sole method for caries detection. Despite the potential drawbacks noted in this paper, and the overwhelming majority of studies advising against the practice at this time, some practitioners continue to diagnose suspected caries solely using this technology. Additionally, many of these same dentists are billing for this procedure separately, using the ADA codes 'D0425' or 'D0199' in addition to the standard exam codes. The Committee again notes that LF is a method designed to *aid in the diagnosis of dental caries*, and while the final decision whether or not to benefit this procedure remains with each individual carrier, it should be considered an integral component of the existing exam codes.

Recommended Next Steps

The next steps that support the Committee's position include the following:

- Present the proposed Position Paper to the AADC Board of Directors for revisions and legal review, as needed, and for final approval
- Share with AADC Membership
- Share with Key Stakeholders as appropriate and as identified by the Board
- Post on the AADC website and in the *Beacon*

Sources

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