

Everything you didn't want to know about dental caries

We would all like to believe dental caries is becoming a disease of the past, but the latest public health data indicates we may be on the verge of a new epidemic. I don't believe any dentist knows how to effectively treat it 100% of the time. This list of research articles will provide more evidence for my philosophy on dental caries. Please note this "annotated bibliography" of sorts contains article assessments, my own synopsis of the study, and the implications to modern caries management as I see it. The opinions I share are just that. I am not against fluoride, or the dental establishment, I just have a unique way of looking at things. While I have a faculty appointment at an accredited dental school, and consult for numerous dental manufacturers, the ideas I share may not necessarily agree with principles of the organizations I appear to represent.

Caries management is the ultimate in science ironies. Researchers sometimes seek answers from non-dentists before they will ask a clinician for their opinion...and, dentists often believe everything they hear before looking into the most scholarly journals in the world for an answer. The bottom line is that tooth decay is getting worse. You can believe the public health data if you'd like or you can simply consider the fact that fifty years ago there were fewer dentists and decay was rampant. Today there are a lot more dentists and decay is still rampant, yet we don't stop to try and control it. If you're as bothered as I am by this, go down to your local dental school and read the good old journals like *Caries Research*, *Dental Clinics of North America*, *Critical Reviews in Oral Biology*, *Quintessence*, etc, and learn about modern cariology. If that's too boring for you, tell your local and regional dental societies you want more opportunities to learn about medical caries management. There are a lot of really great speakers on the topic, and they're the ones who taught me most of what I know.

Medical treatment of dental caries

Understanding the microbiology of dental plaque for each individual patient is paramount to successful treatment of the disease. Not all patient biofilm will respond to treatment in the same way. Responses to Listerine and chlorhexidine differ between patients with differing plaque biology. **Plaques from different individuals yield different microbiota responses to oral-antiseptic treatment. FEMS Immunol Med Microbiol. 2008 Oct;54(1) 27-36.**

Full mouth disinfection results in long term decrease in oral strep mutans levels. Recolonization of the mouth with strep mutans occurs 3-6 months later. Therefore, it can be argued that high caries risk patients will benefit from an in office full mouth disinfection (or biofilm transformation) every three months - and this may significantly decrease their risk of future cavities. **Recolonization of the oral cavity by Strepto-coccus mutans after a combined mechanical/chemical antiseptis protocol. Minerva Stomatol. 2009 Jun;58(6):247-61.**

Chlorhexidine combined with essential oil is more effective than plain old chlorhexidine rinses in controlling cariogenic bacteria. The only product with both chlorhexidine and essential oil available in the US is Cervitec Plus. This paper describes why it's more effective than chlorhexidine mouthwash. **Antimicrobial effects of essential oils in combination with chlorhexidine gluconate. Oral Microbiology Immunology 2005; 20:221-225.**

Clinical dentistry does nothing to stop Early Childhood Caries. When 2-7 year olds are treated for severe caries they don't always get better, in fact more than a third of them relapse with more lesions. This disease is out of control! **Clinical outcomes for Early Childhood Caries (ECC): the influence of salivary mutans streptococci levels. Eur J Paediatr Dent. 2004 Sep;5(3):143-6.**

Orthodontic patients can significantly benefit from the use of MI Paste during orthodontic treatment. When RMGI is used as orthodontic cement, the effect of MI Paste is increased. Based on these research findings, one may extrapolate that restorative materials containing glass ionomer and a patient's use of MI Paste would benefit high caries risk patients. This study also evaluated NaF varnish. **Prevention of demineralization around orthodontic brackets in vitro. Am J Othod Dentofacial Orthop. 2007 Jun;131(6):705.e1-9.**

MI Paste has quickly become one of the most widely used anti-caries agents and has much better patient compliance than other at-home treatments. Some researchers won't jump on the bandwagon and recommend MI Paste because of a "lack of clinical trial evidence." While it's understandable to hesitate before recommending a "remedy" for tooth decay, it's difficult to dispute the large body of literature showing MI Paste has beneficial effects. **Clinical efficacy of casein derivatives: a systematic review of the literature. JADA 2008 Jul;139(7):915-24.**

A more recent analysis of data on CPP-ACP (MI Paste) stating "promising in vivo randomized clinical trial results suggest a caries preventing effect for long term clinical CPP-ACP use." A worthwhile read for anyone claiming there is little evidence to support the use of MI Paste in treating dental caries medically. This paper is from a very highly respected journal among academicians. **Caries preventive effect of casein phosphopeptide-amorphous calcium phosphate (CPP-ACP): a meta-analysis. Acta Odontol Scand 2009 Aug 21:1-12.**

If a patient has occlusal lesions, there is a pretty good chance they will "spread." Some may read this article and find substantial evidence to recommend placement of sealants (in my opinion, glass ionomer is the material of choice. You can disagree if you want - my feelings won't be hurt) on all the teeth in caries prone individuals. This paper describes the predictive quality of lesion discovery. **Modelling the Bilateral Symmetry of Caries Incidence. Caries Res 2008;42:291-296.**

Salivary diagnostics & microbiological monitoring

The best microbiological test we have for caries can only measure very high bacteria levels, but we know the real threshold for caries is only 500 CFUs. The more patients you test, the more you begin to see that not everyone is as safe as you think they should be. You start seriously looking at the numbers and you feel like you've failed your patients. Wouldn't you like to know what the bacteria levels are in the mouths of those patients who have never had a cavity...and aren't in your office because they don't need a dentist? Where can this article be found? Not in Reader's Digest, but in Oral Microbiology and Immunology (another great vacation must-bring). **Mutans streptococci in saliva and dental caries in children living in a high and a low fluoride area.** *Oral Microbiol Immunol.* 1990 Jun;5(3):169-71.

A positive correlation exists between salivary buffering capacity and loss of tooth mineral, especially related to patient's cariogenic potential. **Relationship between quantitative assessments of salivary buffering capacity and ion activity product for hydroxyapatite in relation to cariogenic potential.** *Aust Dent J.* 2008 Jun;53(2):167-71.

Levels of bacteria within saliva (and other salivary parameters) are positively correlated with the caries experience in children of all age groups, but the correlation to different factors varies with age. **Caries experience in relation to oral hygiene, salivary cariogenic microflora, buffer capacity and secretion rate in 6-year olds and 12 year olds in Riga.** *Stomatologija.* 2008;10(2):76-80.

Plaque samples obtained via alginate impressions and salivary characteristics are good predictors of future caries activity in most people. **Microbiological impressions of teeth, saliva, and dietary fibre can predict caries activity.** *J Dent.* 2008 Nov;36(11):892-9.

Salivary flow rates directly affect the physio-chemical microenvironment at the tooth-plaque interface. This has consequences for delivery of antimicrobial agents to deep layers of the plaque such as in cases of low plaque control. **Biofilm plaque and hydrodynamic effects on mass transfer, fluoride delivery, and caries.** *J Am Dent Assoc.* 2008 Sept 139(9):1182-90.

Strep mutans cells communicate distinctly and do so best in biofilm conditions. This has distinct implications in understanding microbial dynamics and possible polarization of the cells within the matrix. **Effect of biofilm formation on virulence factor secretion via the general secretory pathway in Streptococcus mutans.** *Arch Oral Biol.* 2008 Dec;53(12):1179-85.

Strep mutans levels in saliva (measured with monoclonal antibodies) are significantly associated with carious lesions, especially root surface lesions. This study justifies the use of the "Saliva Check Mutans" rapid test now available in the US. **Association of salivary streptococcus mutans levels determined by rapid detection system using monoclonal antibodies with prevalence of root surface caries.** *Am J Dent.* 2008 Oct;21(5):283-7.

MSB culture of strep mutans is similar in sensitivity/specificity to PCR. Although our tendency is to believe the best tests require expensive technology, simple cultures apparently yield similar results. **Distribution of Streptococcus mutans and Streptococcus sobrinus in saliva of Mexican preschool caries-free and caries-active children by microbiological and molecular (PCR) assays.** *J Clin Pediatr Dent.* 2008 Winter;32(2):121-6.

Support for the "arginolytic bacteria hypothesis" and provides more evidence for the delicate acid-alkaline balance of microbial dynamics within the human mouth. **Correlations of oral bacterial arginine and urea catabolism with caries experience.** *Oral Microbiol Immunol.* 2009 Apr;24(2):89-95.

An excellent review of biofilm dynamics and biofilm diseases. Unfortunately the role of biofilm in dental caries is not addressed, but periodontal disease is. **Biofilms: Survival Mechanisms of the Clinically Relevant Microorganisms.** *Clin Microbiol Rev.* 2002 Apr 2002 167-193.

A three-part series of papers describing the complex nature of dental caries. This paper is an excellent place to start understanding the caries process. More evidence supporting measurement of bacteria levels in patients to better understand their future risk of dental caries. **Biological factors in dental caries: role of saliva and dental plaque in the dynamic process of demineralization and remineralization (part 1, 2,&3).** *J Clin Pediatr Dent* 28(1):47-52, 2003. *J Clin Pediatr Dent* 28(2):119-124, 2004. *J Clin Pediatr Dent* 28(3):203-214, 2004.

The caries process cannot be prevented, but it can be controlled. The specific plaque that forms is responsible for dental caries...it is not a haphazard array of bacteria but rather a highly specialized growth of certain bacterial species. **What constitutes dental caries? Histopathology of carious enamel and dentin related to the action of cariogenic biofilms.** *J Dent Res* 83(Spec Iss C.):C35-38, 2004.

Assessing plaque pH and acidogenic potential is a good indicator of future caries risk. This article (without overtly saying so) appears to support the use of biofilm ATP measurement and/or the commercial Saliva/Plaque-Check product, both available for use in the US. **Clinical, salivary, and bacterial markers for caries risk assessment in schoolchildren: a 4-year follow up.** *Intl J Paed Dent* 2009; 19:186-192.

Mothers with high levels of MS have children who have more carious lesions. **Relationship of quantitative salivary levels of Streptococcus mutans and S. sobrinus in mothers to caries status and colonization of mutans streptococci in plaque in their 2.5-year-old children.** *Community Dent Oral Epidemiol* 2009; 37:241-249.

Dental caries cannot be controlled unless the clinician accurately assesses and understands the microbiological ecology in individual patient mouths. This paper seems to say a “one size fits all” mentality cannot be used when treating patients for dental caries. Every patient needs to have a tailored treatment plan. **Bacterial biofilm formation, pathogenicity, diagnostics and control: an overview. Indian J Med Sci. 2009 Jul;63(7):313-21.**

Fluoride Research

Even monthly topical fluoride applications cannot prevent early childhood caries. When I read this article I was blown away. Children had high levels of MS at ~13 months of age and were given either daily high concentration fluoride toothpaste “prophies” or monthly NaF varnish treatment and they still developed Early Childhood Caries. Whatever happened to water fluoridation? It blew up on us! **Failure of intense preventive efforts to arrest early childhood and rampant caries: three case reports. Pediatr Dent. 1999 May-Jun;21(3):160-3.**

If you are a believer in fluoride varnish and quick to dismiss the benefit of chlorhexidine varnish, you should read this study. A well constructed study indicating topical sodium fluoride is not effective at lowering Strep mutans levels in children, but chlorhexidine varnish is. However, in our student research at LLU, I found both were effective for at least one month. **Sodium fluoride and chlorhexidine effect in the inhibition of mutans streptococci in children with dental caries: a randomized, double-blind clinical trial. Oral Microbiology Immunology 2008 23:486-491.**

A meta-analysis of the correlation between fluoride concentration and dental caries. 2800 ppm fluoride toothpaste is significantly better than 1100 ppm (OTC strength). The analysis also revealed unexpected sensitivities to research methods with respect to the broad sweeping statements that more fluoride is always better. **Reduction in dental caries with four concentrations of sodium fluoride in a dentifrice: a meta-analysis evaluation. J Clin Dent. 2001;12(3):57-62.**

Hidden caries was one of the original terms given to undetectable carious lesions that form on the occlusal surface of apparently sound teeth (now described as “Occult Caries”). This article is a concise review of the early literature. **Hidden caries: What is it? Does it exist? Does it matter? Intl J Dent 1997 47(5) 259-265.**

Fluoride alone is not enough to have an anti-caries effect. However, when calcium is present in specific concentrations, fluoride can have a beneficial effect on the chemical process of caries. Note: this is an in vitro study using agar plates, not patient mouths. **Effect of calcium in model plaque on the anticaries activity of fluoride in vitro. J Dent Res 1992 Aug;71(8):1482-6.**

Discrepancies exist concerning the effectiveness of fluoride at various concentrations. This paper describes clinical data which does not necessarily indicate a linear correlation to increased anti-caries effects, and in vivo research does not always agree with in vitro research findings. It is important to note this research came from Colgate Palmolive **Evaluation of topical fluoride preparations. J Dent Res 1990 Feb;69 Spec No:771-9 & 820-3.**

Root caries requires significant levels of fluoride in order to be treated successfully. This article states there is no universally accepted way to treat root caries, but high content fluoride may be very helpful. **Reversal of Primary Root Caries Using a Dentifrice with a High Fluoride Content. Caries Res 2001;35(suppl 1):60-64.**

One of the first articles proclaiming the virtues of fluoride varnish. Interestingly, this paper only describes 2% NaF varnish (the varnish currently available in the US is 5% NaF). This begs the question: Is 5% better than 2% NaF? **Fluoride – Is It Capable of Fighting Old and New Dental Diseases? Caries Res 2001;35(suppl 1):6-9.**

Among populations with high caries incidence and prevalence, water fluoridation does not seem to work. The abstract states, “There was no linear correlation between water fluoride level and caries experience.” This research comes from a country where you can still experiment on the public without their knowledge. Published in a respected journal such as the International Journal of Dentistry (not Dentistry Today) the arguments and assertions should be strongly considered. **Caries prevalence and its relation to water fluoride levels among schoolchildren in Central Province of Saudi Arabia. Int Dent J. 2004 Dec;54(6):424-8.**

Baking Soda

This article is a good review of baking soda use in oral hygiene. It describes the low abrasivity and effectiveness against periodontal pathogens. Unfortunately it also states baking soda is not effective in the fight against dental caries. It is my opinion (in light of other papers stating the opposite), that while baking soda may not have intrinsic antibacterial properties, it’s mechanism of action isn’t via killing bacteria but rather disrupts the physiology of strep mutans. **The use of sodium bicarbonate in oral hygiene products and practice. Compend Contin Educ Dent Suppl. 1997;18(21):s2-7.**

I’m still trying to wrap my mind around how opening a bag of chips with your teeth can make you break a tooth (that was the one day of dental school I missed). I guess some dentists have it all figured out, but most still proclaim how bad baking soda is on the teeth. This article answers a whole host of *your* questions about baking soda and tooth decay. **Effects of sodium bicarbonate dentifrices on the levels of cariogenic bacteria in human saliva. Caries Res. 1995; 29:143-147.**

Many dental professionals shudder at the thought of recommending baking soda to patients because it's soooooo abrasive. However the research DOES NOT support this theory. The research DOES indicate *spraying* dry sodium bicarbonate on teeth as a "polish" can damage enamel. But I've never told patients to spray it on their teeth with compressed air. **Abrasivity of sodium bicarbonate. Clin Prev Dent. 1983. 5(1):17-18**

Public Health and Dental Caries

Caries incidence among children is increasing in Norway, despite more widespread use of fluoride. **Evidence for the reversal of the caries decline among Norwegian children. Intl J Paed Dent 2002; 12:306-315.**

The incidence of caries showed a steep decline in the beginning of widespread fluoride use, but the beneficial effect appears to be waning. Recently caries rates are unchanged. **Dentition and lesion history. Monogr Oral Sci. 2009;21:102-12.**

At the age of 13.5 years, clinicians are poised to best predict the caries rates of patients as they transition to adulthood. This paper implies that pediatric (and general dentists) should pay particular attention to patients in this age group because it may be a pivotal point in preventing tooth decay. **Relationship between caries prevalence and incidence among adolescents. Community Dent Oral Epidemiol. 1982 Dec;10(6):340-4.**

Caries rates are increasing in Australia. While the oral health of Australians improved up until the early 1990's, caries rates are now increasing again. **Quarter of a century of change: caries experience in Australian children, 1977-2002. Australian Dental Journal 2008; 53:151-159.**

Caries and Nutrition

A ground-breaking paper providing evidence in support of the theory that diets deficient in protein and high in carbohydrates (especially corn) increase the levels of dental caries in population groups. **Dietary Carbohydrates and Dental-Systemic Disease. J Dent Res. 2009; 88(6):490-502.**

Ancient populations DID have tooth decay and it was related to plant-based diets. Describes a positive correlation between the rates of dental caries and the adoption of agriculture rather than hunting by indigenous peoples. **Prevalence of oral pathologic findings in an ancient pre-Columbian archeologic site in the Atacama Desert. Oral Diseases 2009; 15 287-294.**

Everyone wants to believe there is a magic cure for tooth decay. What it boils down to is caries is the result of a very long chain of events that starts with diet. Applications of medications (e.g. topical fluoride toothpaste) is not the end all solution to this disease. **Efficacy of chlorhexidine varnish applications in the prevention of early childhood caries. Eur J Paediatr Dent. 2005 Sep;6(3):149-54.**

Notes or silly doodle area...

If you're reading this it probably means you are really bored, so amuse yourself by drawing something in this space. Better yet, write down everything you like about the speaker, then turn this in for your course evaluation. If you're still bored, pretend to take a call from your office and go buy a cup of coffee, take a walk, or just sit and doodle.