Defeating the scourge of orthodontic therapy – plaque

Dr. Larry W. White discusses a product that can prevent plaque from undermining orthodontic treatment success

Abstract

Dental plaque remains the scourge of orthodontic therapy because it often gains unusual vigor throughout orthodontic treatment and retains the ability to damage the teeth and gingiva irreversibly, which often cancels the esthetics of optimal alignment and occlusion. Despite the efforts of orthodontists to minimize decalcification, caries, and gingivitis with intensive oral hygiene instruction as well as products such as chlorhexidine, fluoride varnish applications and rinses, sealants, and dietary restrictions, the destructive effects of pathological bacteria continue to do harm because the previously prescribed products have limited effects on the pathogenicity of the causative organisms. A new filled sealant and adhesive containing selenium (SeLECT Defense™, Element 34 Technology Inc.), which creates a powerful antioxidant and forms superoxide radicals that provide a toxic environment for bacteria, offers orthodontists and their patients a powerful and durable remedy for the harmful effects of dental plaque.

Introduction

Fixed orthodontic appliances make the removal of dental plaque more difficult[1] (Figure 1). All of the elements of orthodontic therapy apparently gather plaque, e.g., brackets bands, elastics, elastomerics, springs, plastic sleeves, etc.[2] Bloom and Brown[3] discovered in 1964 that oral bacteria increase significantly during orthodontic treatment. Several researchers[4-7] have discovered how the escalation of *Streptococcus mutans* during orthodontic treatment increases patients' risk of experiencing enamel decalcification and/or caries. Grant[8] has documented how benign oral bacteria can mutate into pathogenic types during orthodontic therapy, while Matassa[9] has demonstrated that oral bacteria nourish themselves on the adhesives orthodontists use to attach brackets to enamel.

Professional literature made clinicians aware many years ago about the relationship between the quality of orthodontic treatment and the patient's quality of oral hygiene.[10] Also, much evidence exists regarding the ability of plaque to cause inflammation[11] with a subsequent lowering of patients' pain tolerances,[12] which causes patients to further neglect their oral hygiene. The cycling effect of neglect to plaque accumulation to inflammation to lowered pain tolerances and back again to more neglect contributes greatly to orthodontists' inability to achieve quality therapies.[13] Because ample evidence exists that defines sensitivity as a genetic trait,[14,15] dental clinicians may well decide that interrupting the accumulation and destructive consequences of plaque might offer a more productive strategy than trying to change patients' habitual toothbrushing behaviors.

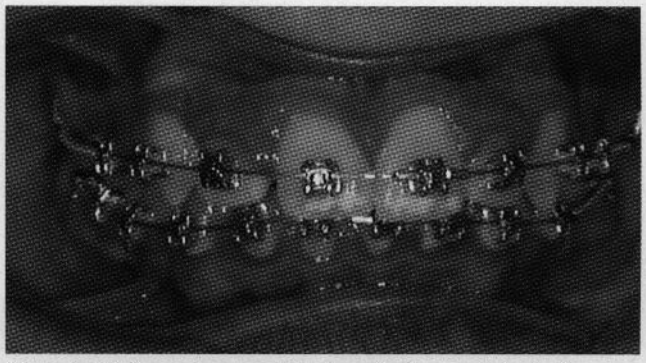

Figure 1: White spot enamel demineralization and gingival inflammation caused by chronic plaque accumulation

Common strategies for dealing with plaque

Today, the most currently used preventive measures against plaque accumulation include: intensive oral hygiene instructions,[16,17] fluoridated rinses,[18-20] and/or fluoridated gels/toothpastes.[16,18,20-23] Some have advocated fluoride varnishes[24-26] or fluoride-containing adhesives/primers[18,20] and fluoride releasing/filled sealants,[27] and/or antimicrobial varnishes (e.g., chlorhexidine or cetylpyridinim chloride).[19,28] Despite the efficacy of these applications, they remain inefficient because they need frequent reapplication by clinicians or recharging of fluoride ions through patient compliance.[16,21,25] These requirements have limited their clinical adoption, use, and effectiveness. Even more distressing, Derks, et al[29] discovered that although orthodontists know about the various demineralization therapies available, outside of oral hygiene instruction, few implement any of the strategies as routine protocol.

Larry W. White, DDS, MSD, FACD, graduated from Baylor Dental College and then served in the US Air Force from 1959 to 1961. He practiced general dentistry in Hobbs, New Mexico, from 1961 to 1966 and returned to Baylor to receive an MSD degree in orthodontics in 1968. He is a diplomate of the American Board of Orthodontists, a fellow in the American College of Dentists, past director/president of the Rocky Mountain Society of Orthodontists, and past president of the New Mexico Orthodontic Society and the Texas Orthodontic Study Club. He reviews for *American Journal of Orthodontics* and *Orthodontic Practice US*, was editor of the *Journal of Clinical Orthodontics* for 17 years, and has contributed more than 100 original articles to the dental literature, and lectured in over 35 countries. Dr. White was the first director of the University of Texas Health Science Center in San Antonio Orthodontic Residency Program. He is also a contributing editor for the *Orthodontic CyberJournal*. He practices in Dallas, Texas, and serves as an adjunct professor at Baylor Dental College in Dallas. He can be reached at larrywwhite@hotmail.com.

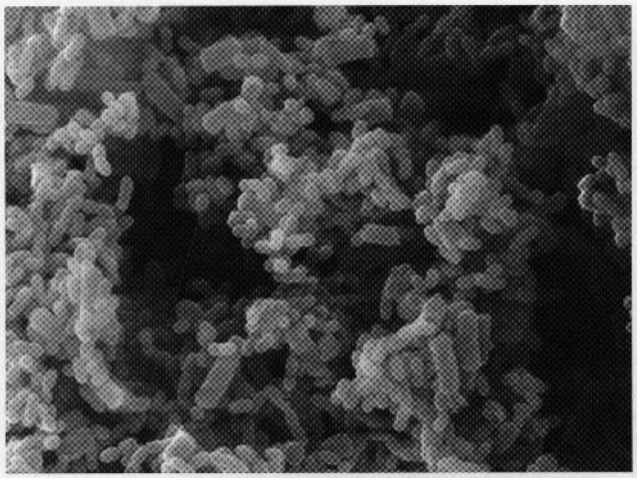

Figure 2: Photomicrograph of untreated enamel with plaque accumulation

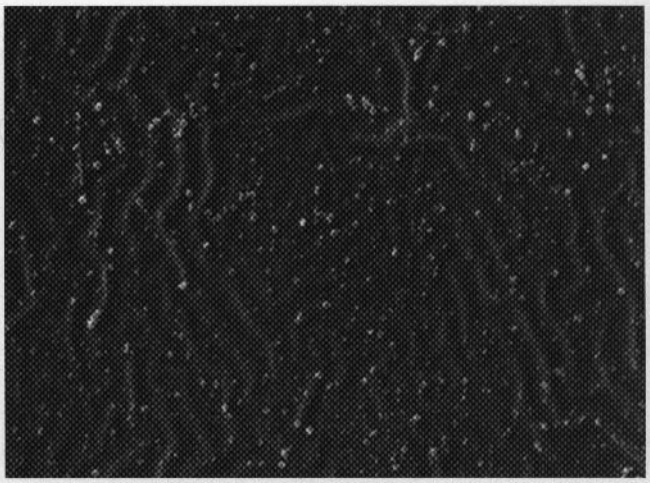

Figure 3: Photomicrograph of enamel treated with selenium-based SeLECT Defense™. Note the absence of plaque

Figure 4: Photomicrograph of untreated polyurethane O-ring. Note the abundance of plaque

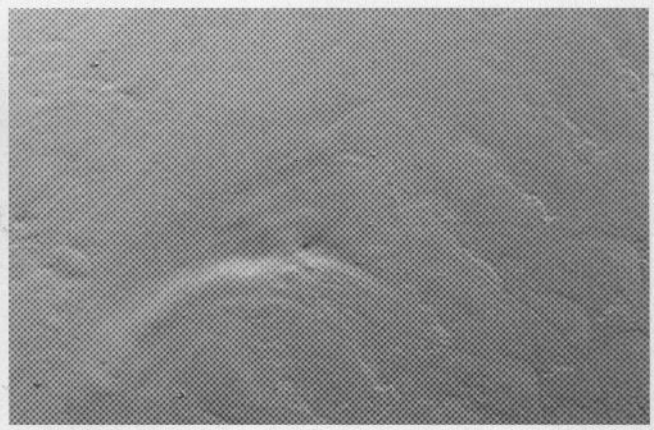

Figure 5: Photomicrograph of treated polyurethane O-ring. Note the absence of plaque

A promising new antimicrobial sealant and adhesive

A new company, Element 34 Technology Inc., or E34™, has introduced a selenium-based product called SeLECT Defense™, which combines selenium with a filled enamel surface sealant and adhesive. Researchers have found that selenium has antioxidant properties and assists enzymes in the formation of superoxide radicals.[30-32] Superoxide radicals have a toxicity for microorganisms[33] but not for humans, even in elevated amounts.[34]

In vivo and in vitro university studies[35-37] have proven SeLECT Defense™ effective as an antimicrobial agent and as a prophylactic against demineralization, while simultaneously displaying adequate shear bond strength and durability when used with Transcend™ adhesive (3M Unitek) or with SeLECT Defense™ adhesive.

Other sealants and protective coatings have displayed demineralization and cavity prevention properties,[38-41] but neither their endurance nor long-term effectiveness has been well documented. Some researchers[16] have even questioned their overall effectiveness and disputed if they make a statistical difference.

Other than chlorhexidine varnishes, which the US Food & Drug Administration (FDA) has not yet approved, none of the studied prophylactic remedies have any specific antimicrobial action, and the leaching of fluoride ions from sealants and adhesives, which limits their usefulness, is well documented.[42-44]

Orthodontic clinicians have need for an antimicrobial sealant and adhesive whose active ingredient will not leach out or wear off during an extended orthodontic treatment. From the in vivo and in vitro tests so far, SeLECT Defense™ gives every indication of filling this therapeutic requirement (Figures 2 and 3). Any nourishment oral pathogens attempt to extract from a selenium-laced adhesive will prove toxic, and the selenium will not diminish throughout orthodontic therapy. The filled enamel sealant will provide not only an antimicrobial agent but also a durable physical barrier to the harmful effects of oral pathogens.

SeLECT Defense™ has gained FDA approval and offers clinicians the appealing feature of not requiring them to change their routine bonding protocol. Instead of using unfilled sealants or those without antimicrobial effects, they can simply incorporate this new sealant with their usual bonding techniques and have confidence that it will minimize the demineralization and gingival inflammation caused by plaque. SeLECT Defense™ has also effectively reduced surface accumulation of plaque when coated on polyurethane O-rings (Figures 4 and 5) and metal brackets.

Summary

Orthodontists have long needed a product for their patients

that can negate the harmful effects of dental plaque. Since repeated lessons of oral hygiene instruction have borne such little fruit for many patients with low sensitivities to discomfort, any strategy that can limit the destructiveness of plaque would offer orthodontic clinicians an appreciated and useful addition to their routine armamentarium. A selenium-laced bonding composite and sealant has shown evidence of that ability and should prove an excellent alternative to previously available products, and one that can protect not only the teeth and gingiva, but can limit the accumulation of plaque on ligatures and metal brackets as well.

Disclosure

Dr. White has no financial interest in Element 34 Technology Inc.

References

1. Zabokova-Bibilova E ST, Sotirovska-Ivkovska A, Sokolovska F (2008) Prevention of enamel demineralization during orthodontic treatment as in vitro study using GC tooth mousse. *Balk J Stomatology* 12:133-137.

2. Basdra E, Huber H, Komposch G (1996) Fluoride released from orthodontic bonding agents alters the enamel surface and inhibits enamel demineralization in vitro. *Am J Orthod Dentofacial Orthop* 109:466-472.

3. Bloom RH BL (1964) A study of the effects of orthodontic appliances on the oral microbial flora. *Oral Surg* 17:658-670.

4. Gorelick L GA, Gwinett AJ (1982) Incidence of white spot formation after bonding and banding. *Am J Orthod* 81:93-98.

5. Artun J BB (1986) Prevalence of caries and white spots after orthodontic treatment with multi bonded appliances. *Eur J Orthod* 8:229-234.

6. Ahn SJ LB, Yang HC, Chang Yi (2005) Quantitative analysis of the adhesion of cariogenic streptococci to orthodontic metal brackets. *Angle Orthod* 75:666-671.

7. Ahn SJ KH, Ki KK, Hahm DS (2003) Adhesion of oral streptococci to experimental bracket pellicles from glandular saliva. *Am J Orthod* 124:198-205.

8. Grant DA, Grant DA, Flynn JM, et al (1995) Periodontal microbiota of mobile and non-mobile teeth. *J Periodontol* 66:386-390.

9. Matassa C (1995) Microbial attack on adhesives. *Am J Orthod Dentofacial Orthop* 108:132-141.

10. Dummett CO (1951) Orthodontics and periodontal disease. *J Periodontol* 22:33-41.

11. Arnim S (1963) The use of disclosing agents for measuring tooth cleanliness. *J Periodontol* 35:227-245.

12. Dubner R, Sessle BJ, Storey AT (1978) *The Neural Basis of Oral and Facial Function*. Plenum Press, New York, New York:49.

13. White L (1984) A new oral hygiene strategy. *Am J Orthod* 86:507-514.

14. Chess S, Thomas A (1987) *Know Your Child*. Basic Books, Inc., New York.

15. Aron EN (1996) *The Highly Sensitive Person*. Carol Publishing Group, New York City.

16. Derks A KC, Frencken JE, van't Hof (2004) Caries-inhibiting effect of preventive measures during orthodontic treatment with fixed appliances. A systematic review. *Caries Research* 38:413-420.

17. White LW (1996) Efficacy of a sonic toothbrush in reducing plaque and gingivitis in adolescent patients. *J Clin Orthod* 30:85-90.

18. Ogaard BL (2008) White spot lesions during orthodontic treatment: mechanisms and fluoride preventive aspects. *Seminars in Orthod* 14:183-193.

19. Ogaard BL, Larsson E, Henriksson T (2001) Effects of combined application of antimicrobial and fluoride varnished in orthodontic patients. *Am J Orthod* 120:28-35.

20. Bishara SE, Ostby AW (2008) White spot lesions: formation, prevention and treatment. *Seminars in Orthod* 14:174-182.

21. Benson PE, Shah AA, Millett DT, et al (2005) Fluorides, orthodontics and demineralization: a systematic review. *J Orthod* 32:102-114.

22. Benson PE, Parkin N, Millett DT, et al (2004) Fluorides for the prevention of white spots on teeth during fixed bract treatment. *Cochrane Database of Syst Rev* 3:DC003809.

23. Erickson RL, Glasspoole EA (1995) Model investigations of caries inhibition by fluoride-releasing dental materials. *Adv Dent Res* 9:315-323.

24. Vivald-Rodrigues G, Demito CF, Bowman SJ, et al (2006) The effectiveness of a fluoride varnish in preventing the development of white spot lesions. World J Orthod 7:138-144.

25. Staley RN (2008) Effect of fluoride varnish on demineralization around orthodontic brackets. *Seminars in Orthod* 14:194-199.

26. Schmit JL, Staley RN, Wefel JS, et al (2002) Effect of fluoride varnish on demineralization adjacent to brackets bonded with RMGI Cement. *Am J Orthod Dentofacial Orthop* 122:125-134.

27. Soliman MM, Bishara SE, Wefel J, et al (2006) Fluoride release from an orthodontic sealant and its clinical implications. *Angle Orthod* 76:282-288.

28. Al-Musallam TA Evans CA, Drummond JL, et al (2006) Antimicrobial properties of an orthodontic adhesive combined with cetylpyridinium chloride. *Am J Orthod* 129:245-251.

29. Derks A, Kuijpers-Jagtman AM, Frencken J, et al (2007) Caries preventive measures used in orthodontic practices: an evidence-based decision? *Am J Orthod* 132:165-170.

30. Tran PL, Hammond AA, Mosley T, et al (2009) Organoselenium coating on cellulose inhibits the formation of biofilms by pseudomonas aeruginosa and Staphylococcus aureus. *Appl Environ Microbiol* 75:3586-3592.

31. Kryukov GV, Castellano S, Novoselov SV, et al (2003) Characterization of mammalian selenoproteomes. *Science* 300:1439-1443.

32. Matthews SM, Spallholz JE, Grimson MJ, et al (2006) Prevention of bacterial colonization of contact lenses with covalently attached selenium and effects on the rabbit cornea. *Cornea* 25:806-814.

33. Spallholz JE, Mea B. Selenium free radical chemistry: applications for pharmaceuticals, proceedings of the 6th International Symposium on selenium and tellurium. Selenium Tellurium Development Association 1998.

34. Reid ME, Stratton MS, Lillico AJ, et al (2004) A report of high-dose selenium supplementation: response to toxicities. *J Trace Elem Med Biol* 18:69-74.

35. Amaechi B. Comparative study of product for prevention of demineralization around orthodontic brackets. Accepted for publication in *Am J Orthod Dentofacial Orthop*. In press.

36. Amaechi B. Comparative study of products for prevention of demineralization around orthodontic brackets: Part III - Influence on adhesive bond strength. Accepted for publication in *Angle Orthod*. In press.

37. Amaechi B. Investigation of the antimicrobial effect of SeLECT Defense Primer and Sealant: in vitro study. Accepted for publication in *J Am Dent Assoc*. In press.

38. Todd MA, Staley RN, Kanellis MJ, et al (1999) Effect of fluoride varnish on demineralization adjacent to orthodontic brackets. *Am J Orthod* 116:159-167.

39. Paschos E, Kleinschrodt T, Clementino-Luedemann T, et al (2009) Effect of different bonding agents on prevention of enamel demineralization around orthodontic brackets. *Am J Orthod* 135:603-612.

40. Hu W, Featherstone JD (2005) Prevention of enamel demineralization: an in vitro study using light-cured filled sealant. *Am J Orthod* 128:592-600.

41. Buren JL, Staley RN, Wefel J, et al (2008) Inhibition of enamel demineralization by enamel sealant, Pro Seal: an in vitro study. *Am J Orthod* 133:s88-94.

42. Cohen WJ, Wiltshire WA, Dawes C, et al (2003) Long-term vitro fluoride release and rerelease from orthodontic bonding materials containing fluoride. *Am J Orthod* 124:571-576.

43. Trimpaneers LM, Verbeeck RM, Dermaut LR (1998) Long-term fluoride release of some orthodontic bonding resins: a laboratory study. *Dental Mater* 14:142-149.

44. Banks P, Burn A, O'Brien K (1997) A clinical evaluation of the effectiveness of including fluoride in an orthodontic bonding adhesive. *Eur J Orthod* 19(4):391-395.