



What parents should know about estrogen-like compounds in dental materials

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Abstract

The use of pit and fissure sealants has been reported to increase exposure to xenoestrogens. Because these estrogen-mimics are suspected of having many deleterious effects in animals, and perhaps humans, several types of studies were undertaken by our Biocompatibility Group. We confirmed that bisphenol A (BPA) and bisphenol A dimethacrylate (BPA-DM) have proliferative effects in cells with high levels of estrogen receptors. However, BPA was not detected by our group in American-made sealants, and BPA-DM was detectable in only a few. In addition, the surface layer of the sealant can be treated to reduce the possibility of unpolymerized BPA-DM being left on the tooth. We believe it is important to reassure parents that their children are less likely to be exposed to BPA from sealants than from the ingestion of soft drinks or canned food. (Pediatr Dent 22:75-76, 2000)

Recent reports have suggested that estrogenic compounds such as bisphenol A leach into the human body from dental materials, including pit and fissure sealants and composite resins (Olea et al., 1996). Summaries of these findings have appeared in print journals available to the general public, thus raising concerns among the parents of our patients. At the 1998 AAPD meeting, many clinicians expressed interest in this area of research. In this article, we summarize the findings of our Biomaterials Research Group in an attempt to give practitioners the information needed to allay the concerns of parents regarding the safety of these commonly used dental materials.

Natural estrogens and xenoestrogens

The major estrogen, 17 β -estradiol, is a hormone produced by a variety of tissues, including the ovaries and the testes. The principal actions of estrogens are seen in the female reproductive tract, where they regulate the tissues involved in reproduction. Although estrogens are produced in much smaller amounts in males, this hormone is essential for stimulation of sperm production. Other "natural" estrogens to which humans are exposed include phytoestrogens, which are manufactured by various plants and fungi. Xenoestrogens, although structurally unrelated to estrogen, have the potential to mimic estrogen's effects, and have been mentioned as suspects in the apparently increased incidence of breast cancer and a decrease

in sperm counts, as well as other disturbing findings.^{2,3} The controversy surrounding bisphenol A and other possible contaminants of dental resins stems from the fact that bisphenol A is classified as a xenoestrogen. Major sources of xenoestrogens include the linings of food and drink cans, as well as pesticides and preservatives.⁴ In addition, polycarbonate baby bottles were recently reported to leach bisphenol A when the formula they contained was heated.⁵

Dental materials and xenoestrogens

Since Olea et al.¹ reported that both BPA and BPA-DM leach from pit and fissure sealants, we felt it was important to support or refute such potentially serious findings. Our group investigated their claims with a variety of methods. We used the cell culture methods reported by Olea's group, and here we compare their findings to those we obtained with the same as well as with other methods and materials, including flow cytometry, different cell culture conditions, and a variety of estrogen-sensitive cell lines.

We confirmed that both BPA and BPA-DM (also found in some resins) have the potential to mimic the proliferative effects of estrogen on certain estrogen-responsive cells.⁶ However, and importantly, BPA was not identified in any of the sealant brands we tested in our system, which has a level of detection of less than 1 $\mu\text{g}/\text{mL}$ (1 ppm).^{7,8} These findings are supported by those of Hamid and Hume⁹ and Nathanson et al.¹⁰ Similarly, in another study, blood samples were obtained from two groups of dentists: those who had pit and fissure sealants on their teeth, and those who did not. Subsequent testing of the blood samples indicated that none contained detectable levels of BPA, independent of the presence or absence of sealants on the subjects' teeth.¹¹

BPA-DM, which is added as a copolymerizer to some brands of sealants and resins, also has the potential to mimic the proliferative effects of estrogen when tested in the E-screen assay,¹² which is used to screen for estrogenic action. Not only is the dimethacrylate itself estrogenic, but as reported by Schmalz et al.,¹³ salivary esterases can convert the dimethacrylate to BPA in vitro. The presence of BPA-DM in several brands of sealant has been confirmed by our group as well as others.⁷⁻¹⁰ However, it is important to note that the quantity of detectable BPA-DM is small even when the uncured

materials are tested. When cured, the amount of available BPA-DM in sealants is reduced even further, as curing incorporates the BPA-DM into a polymer. The source of any BPA-DM detected in cured resins appears to be from unpolymerized chemicals in the air-inhibited layer. This layer of resin can be removed, and our group has experimented with various methods to determine the most efficient and effective means of removal of this residual chemical.¹⁴ Although rinsing with an air-water spray reduced the amount of detectable monomer in this surface layer, use of a pumice slurry applied with either a rubber cup or a cotton pellet provided a significantly greater reduction in monomer content.

Conclusion

Since BPA has not been detected as a contaminant of any brand of US-manufactured sealant tested in a variety of studies, the main dental source of xenoestrogenic compounds appears to be BPA-DM. This is an avoidable source, as it was detected in only a few brands of sealants or resins. Even if a dimethacrylate-based material is chosen for use, removing the air-inhibited layer can reduce exposure to leachable dimethacrylate. Parents are undoubtedly confused and perhaps even alarmed by the reports that very commonly used dental materials may be harmful to their children. These reports have appeared on the Internet, as well as in magazines and newspapers. We feel it is important to acknowledge some dental materials as one possible source of estrogenic compounds, but to downplay their importance in the overall lifetime exposure to these chemicals. We believe that most American-made sealants lack detectable xenoestrogens, and that other sources, such as food and drink can linings, are much more pervasive, and thus much more likely to contribute to the body's burden of these estrogen mimics.

References

1. Olea N, Pulgar R, Perez P, Olea-Serrano F, Rivas A, Novillo-Fertrell A, Pedraza V, Soto AM, Sonnenschein C: Estrogenicity of resin-based composites and sealants used in dentistry. *Environ Health Perspect* 104:298-305, 1996.
2. Safe S: Is there an association between exposure to environmental estrogens and breast cancer? *Environ Health Perspect* 105(3): 675-78, 1997.
3. Raloff J: That feminine touch: Are men suffering from prenatal or childhood exposures to "hormonal" toxicants? *Science News*, 1994.
4. Zava DT, Blen M, Duwe G: Estrogenic activity of natural and synthetic estrogens in human breast cancer cells in culture. *Environ Health Perspect* 105(3): 637-44, 1997.
5. Baby alert: New findings about plastics. *Consumer Reports* pp 28-9, May 1999.
6. Schafer TE, Lapp CA, Hanes CM, Lewis JB, Wataha JC, Schuster GS. Estrogenicity of Bisphenol A and Bisphenol A Dimethacrylate *in vitro*. *J Biomed Mat Res* 45:192-197, 1999.
7. Wataha JC, Rueggeberg FR, Lapp CA, Lewis JB, Lockwood PE, Ergle JW: In vitro cytotoxicity of resin-containing restorative materials after aging in artificial saliva. Submitted to *Clinical Oral Investigations*.
8. Lewis JB, Rueggeberg FA, Lapp CA, Ergle J, Schuster, GS: Identification and characterization of estrogen-like components in commercial resin-based dental restorative materials. *Clinical Oral Investigations*, in press.
9. Hamid A, Hume WR: A study of component release from resin pit and fissure sealants *in vitro*. *Dent Mater* 13:98-102, March 1997.
10. Nathanson D, Lertpitayakun P, Lamkin MS, Edalatpour M, Chou LL: In vitro elution of leachable components from dental sealants. *JADA* 128:1517-23, 1997.
11. Siew C, Miaw, L, Chou HN, Gruninger SE, Geary R, Fan PL, Meyer DM: Determination of Bisphenol A in dentist serum samples. Abstract #1070, IADR Annual Meeting, January 1998.
12. Villalobos M, Olea N, Brotons JA, Olea-Serrano MG, de Almodovar JMR, Pedraza V: The E-screen assay: a comparison of different MCF-7 cell stocks. *J Environ Health Perspect* 103:844-50, 1995.
13. Schmalz G, Priess A, Arenholt-Bindslev D: Bisphenol A content of resin monomers and degradation products. Abstract # 1134, IADR Annual Meeting, January 1998.
14. Dlugokinski MD, Rueggeberg FA, Ergle JW: Minimizing Patient Exposure to Uncured Components in a Dental Sealant. 1999 Hinman Dental Meeting.

ABSTRACT OF THE SCIENTIFIC LITERATURE



A DESCRIPTIVE STUDY OF MISSED APPOINTMENTS

Two hundred participants with a history of missed appointments to the Children's Hospital Medical Center in Akron, Ohio were randomly selected to participate in a telephone survey. Ninety-five of the families selected did not have telephones. The majority of the families were headed by young single mothers. The families identified transportation problems, wait times, and not knowing the reason for the appointment as barriers to keeping appointments.

Comments: Clearly these issues affect us at pediatric dental clinics and in urban private practices. Intervention for transportation may be beyond our control if their social workers cannot give them vouchers for travel. Decreasing waiting times and making sure that there is knowledge, and as importantly, understanding of the intended appointment are interventions that we as providers can provide. LPN

A descriptive study of missed appointments: families perceptions of barriers to care. Pesata V, Pallija G, Webb A. J. *Pediatr Health Care* 13:178-182, 1999.

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