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Toxicity Studies of Cured Epoxy Resins

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Tissue-culture techniques have been used in almost every field of medicine and biology. It has been possible, for example, to study the chemical and physical effects on living cells and the specific action of drugs on the cells, along with the effects that antibiotics and antiseptics have on them. The tissue-culture technique is a sensitive, definitive, and quantitative technique that eliminates some of the shortcomings of animal testing, such as (1) differences between animals of the same species; (2) species differences, making accurate comparisons difficult; (3) quantity of animals required for adequate data; (4) partial masking of toxicity results by foreign-body reactions; and (5) inaccuracies of quantitative studies. In adapting the tissue-culture technique to dental materials, epithelial cells, which are the cells mainly encountered in the oral cavity, can be used.

A reasonable application of this technique was used in testing the toxicity of some of the newer epoxy resin formulations. Preliminary tissue-culture tests were conducted at the Wistar Institute, Philadelphia, Pennsylvania. Samples of cured epoxy resins from major resin producers were evaluated for toxicity along with samples of a commercial dental epoxy resin,* alumina-filled epoxy resins, and polymethyl methacrylate.

The epoxy resin samples were cured in teflon molds, ejected, and autoclaved for sterility. Triplicate samples were made for each manufacturer's resin. The resin strips were introduced into large tissue-culture flasks. The tissue-culture preparations were of two types. In the first type the tissue-culture medium was seeded with HeLa cells, and then the resin strips were introduced into the flask. In the second, the strips were introduced into a tissue-culture medium which had not been seeded with HeLa cells until after the strips were introduced. Controls identical with the experimental cultures were maintained for both types.

The culture medium was Eagle's (a buffered saline solution containing the essential ions in proper proportions) fortified with 10 per cent human serum. All cultures, both experimental and control, were sterile.

Those cultures exposed to the unfilled resin strips, the commercial epoxy resin, and polymethyl methacrylate showed no divergence from the controls within experimental error in seeding or cell count. It is apparent from these preliminary results that the resin strips tested were innocuous.

The alumina-filled epoxy resin strips inhibited the growth of cells and degenerated those cells used to seed the cultures. When this type of strip was introduced into established, healthy cultures, the sheeted cells and free cells degenerated within 48 hours. Furthermore, those cultures into which alumina-containing strips were introduced showed a progressive increase in pH from 7.0 to 11 during the period of 4 days, even though the culture medium was well buffered. The toxic effect of alumina occurred before the onset of any marked increase in pH, indicating that the pH was merely contributory to the toxicity.

Patch tests conducted on the flexor surface of the forearm of twenty dental students, using powdered, cured, unfilled resins and alumina-filled resins, showed neither signs of sensitization nor evidence of possible primary irritation.

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* Epoxylon, Surgident Ltd., Los Angeles, Calif.