EDITORIAL

The significance of in vitro studies

Data obtained from research is justifiably sorted by a hierarchy of significance. It is obvious that data obtained from properly designed in vivo studies have the highest value to our profession. However, humans should not be the first line for testing new materials. Many properties of biomaterials can be thoroughly studied in vitro prior to being considered for any sort of clinical trial. The biggest advantage, and sometimes the disadvantage, of in vitro studies is their ability to isolate certain parameters and specifically examine them. Unfortunately, the tunnel vision created by isolating certain parameters may be far from the clinical reality if all parameters were included.

Many scholars have identified the fact that, just like in vivo studies, not all in vitro studies are alike. Some provide data that may have viable clinical relevance, while others are, at best, meaningless. One of the biggest challenges is to design an in vitro study that will mimic the parameters existing in the oral environment. Factors such as constant moisture, temperature changes, pH changes, and the constant fatigue of dental restorations have to be considered, and, whenever possible, simulated.

An example would be immediate bond strength studies, a huge number of which are readily available. They basically consist of bonding the tested material to a substrate (ie, extracted tooth), and shortly thereafter testing the strength of the bond. Some data obtained from such studies can be of value; for example, materials that fail this test by demonstrating low bond strength values should be approached with extra caution. However, the reality is that the results of such studies often are used for a completely different purpose; for example, materials that pass those immediate tests with no form of simulated aging are marketed as materials proven to work, when actually their performance in the clinical situation may be extremely poor.

Another good example is strength tests of indirect restorations. The restorations are cemented to extracted teeth and loaded to failure. In many instances, the outcome is fracture of the teeth, not the restorations. This meaningless outcome immediately allows manufacturers to market those restorations as safe for use in any clinical situation; after all, the crown-tooth complex is stronger than the tooth itself. Ask yourself, what usually happens to a ceramic restoration, for example, that is in service for a few years and fatigued by repeated loading? It may break or chip; rarely is it the tooth that breaks.

While such studies demonstrate the possible shortcomings of in vitro studies, properly done laboratory studies can provide invaluable information and serve as a reasonable predictor of clinical performance. Keep in mind that the potential for producing poorly done clinical studies, which later may be quoted and used for establishing guidelines for patient care, is not too small either.

This should serve as an appetizer. I promise to revisit this topic and elaborate more on it in upcoming editorials.

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