EDITORIAL

Material World

When considering implant dentistry, we live in a world of materials. The materials that we use determine the dimensions of implants, the design of prostheses, and the likelihood that we can make artificial substitutes that truly mimic nature.

Implants come in a variety of sizes, configurations, surfaces, and shapes. These variations are made possible by the physical properties and manipulation methods applied to the implant material. We all know that the material world of implants is centered around titanium, but we also know that this metal, in a commercially pure form, has a variety of different grades. Each grade of commercially pure titanium must meet specific minimum property standards but could dramatically exceed these minimums depending on the methods used to prepare the stock material. Add to this the fact that there are a number of different titanium alloys used in dentistry and we quickly gain an appreciation of how many design/material permutations exist in implant dentistry.

I started thinking of this topic when I recently heard two songs with virtually identical titles. Madonna and George Harrison wrote of "living in the (or a) material world." Madonna seems to have embraced the lifestyle while Harrison identified a darker side associated with materialism. Consider Madonna's comments: "Living in a material world; and I am a material girl" and contrast these with Harrison's: "As I'm faded for the material world; get frustrated in the material world." Indeed, I understand that these performers were addressing materialism, but my mind morphed the topic into a discussion of dental materials.

Like it or not, we constantly face the same contradictions posed by these two artists. Sometimes we embrace new materials, other times we reject them and many times we are simply confused by them. It is clear that our profession is dependent upon an understanding of the materials we use and this situation takes on much more importance when foreign bodies are implanted in patients, as our professional responsibility increases when materials cannot be easily removed from the oral cavity. The complexity of this problem grows when we realize that our knowledge is dependent upon information provided by manufacturers and laboratories, and this information has, from time to time, not been accurate.

A few months ago, there were reports of crowns that included toxic chemicals in their alloy. These crowns were made internationally and the public outcry was quickly diminished with the thought that "this couldn't happen here." Of course it did happen here and it can certainly happen again. Our knowledge of the materials we use is based upon the labeling of the materials and trust in the supplier to adhere to the published proportions shown on such labels. I think that most manufacturers are reasonably consistent but there are a few qualifiers in this sentence. Is contamination possible? It seems naïve to suggest otherwise.

In essence the field of implant dentistry began with the recognition that devices placed within the body must exhibit low electromotive forces, as material corrosion ensures tissue reaction and eventual implant failure. From those early days we learned to manipulate materials to the point where modern implants enhance biologic response. Early discussions of osseointegration correlated implant failure with the presence of foreign bodies near the osteotomy site. We have all seen radiographs showing residual dental amalgam from previous apical surgeries adjacent to dental implants. When an implant fails in this situation, local contamination is often cited as the culprit. Similarly, an implant could be contaminated before being placed into a pristine osteotomy resulting in a failure to achieve integration. If we think of all the steps from manufacture to decontamination to sterilization to shipping to placement in the surgical tray to insertion into the osteotomy, there are many opportunities for minor contamination that could, for some patients, lead to failure. Is it common? The answer is clearly "no"—but is it impossible?

There is no doubt that the material world has been responsible for many of the advances in implant dentistry. Implants made of titanium, placed with a specific technique, and restored using strict protocols brought implant dentistry out of the realm of clinical unpredictability and into the routine practice of dentistry. With scientific investigation we began to understand that the surface chemistry associated with these titanium implants was responsible for the favorable biologic response. Current and future research will undoubtedly lead to a better understanding of material optimization in an effort to reduce variability in clinical outcomes.

Patients, of course, seek care to replace teeth, not to obtain dental implants. The use of the implant to support and retain dental prostheses is another opportunity for material interaction. Inappropriate alloys connected to dental implants could result in corrosion. The procedures involved in the fabrication of a dental prosthesis will alter the mating surfaces and could alter screw seats. This alteration will result in additional friction that could impact the preload of connected components, thereby resulting in increased susceptibility to screw loosening.

Prosthetic materials appear to be selected based upon the personal preference of the clinician rather than the unique demands placed upon the material by the individual patient. In fact, when designing prostheses to meet the physical demands of the patient, the clinician has little definitive information on the forces that the patient will place on the prosthesis. Most clinicians use generalizations and intuition to estimate force. One wonders if future advances will develop materials that could be used provisionally and assessed after use to clearly identify maximum force as well as duration of force. The creation of such a material would provide a clear indication of the most appropriate material for the individual patient. No longer will the clinician look at gender, age, and stature as predictors; instead materials will be chosen to meet specific demands. When this happens, the clinical results will improve and the cost of care may be reduced, as all patients will receive individually optimized treatment. Given these circumstances, it is possible that everyone will embrace the material world.

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