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THE EDITOR'S CORNER

The Problems with Bonding Studies

Bonding has been one of the most closely examined subjects in orthodontics since its introduction in the mid-'60s. A quick search of the JCO Online Archive turns up no fewer than 239 articles in this journal alone with the word "bond" in the title. Of course, bonding is of vital, real-world interest to practicing orthodontists. Few procedures have a greater impact on practice efficiency. Clinicians are always trying to find faster ways of getting the brackets on the teeth, searching for techniques that reduce doctor time while increasing the comfort and convenience of the patient. I learned early on in my career that, from a patient's perspective, time is trauma. Anything we can do to decrease the amount of time the patient has to stay in the chair—assuming, of course, that quality of care is not diminished—increases patient comfort. Efforts in this direction include the many different procedures we have seen developed for indirect bonding. In addition, advances in resin chemistry have produced more rapid reactions in chemically cured adhesives, and research into the use of lasers, halogen lights, and other light sources has increased the speed of photopolymerization.

One of the most annoying sounds to a busy orthodontist is that *click* you often hear when tying in an archwire after the initial application of bonded brackets. That one little *click* indicates a primary bond failure. At that point, you have no other option than to stop, remove the archwire you just placed, re-prep the tooth, and bond it again—a waste of at least 15 minutes. Similarly, the child who comes in on a monthly basis with two or three brackets broken off because he won't follow simple orthodontic dietary guidelines is another source of immense frustration. Every practicing orthodontist has learned to include some unscheduled time in each day for such occurrences, but that time could be allocated to much more productive or enjoyable endeavors were it not for bond failures.

Why does bonding continue to vex the practitioner, despite the plethora of studies that have already been published? While bracket placement appears to be a relatively

simple procedure, it is, in fact, extraordinarily complex. Definitive research that we can use to our practical, clinical benefit is almost impossible to conduct in the laboratory, even under rigorous scientific conditions. In the laboratory, engineers and technicians can carefully control all variables, screening out those extraneous factors that they don't want to study in a particular experiment, but in a real-world clinical practice, the orthodontist can't even identify all the extraneous variables, let alone control for them.

In this issue of JCO, Contributing Editor Michael Swartz elaborates in much greater detail on the many pitfalls of in vitro studies. As he concludes in his article, laboratory research may be valuable to the practitioner as a starting point in analyzing the available data on orthodontic bonding, but it is certainly not appropriate as the only evidence to be used in making clinical decisions.

Last month in JCO, Dr. Jose C. de Castro identified several areas of research that are still worthy of research activity. These include bonding systems and materials, especially polycarbonate bases, with higher bond strengths at the bracket-resin interface, as well as adhesives with lower bond strengths at the resin-enamel interface. Such characteristics may seem contradictory at first glance, but the combination actually makes it easier to remove a bracket at the end of treatment without damaging the tooth. Although enamel damage is rare using current materials, it still occurs often enough to warrant further improvement. Like Dr. Swartz, Dr. Castro also called for the standardization of in vitro testing methods, so that test brackets can be debonded with load forces and head speeds more similar to those found in actual mastication, using effective synthetic substrates resembling human enamel in adhesive strength.

As Dr. Swartz maintains, what practicing orthodontists need most are well-controlled, large-scale, multi-site clinical trials. In contrast to the validity problems he points out with laboratory studies, however, the biggest concern with in vivo studies is their reliability. We periodically receive manuscripts describing individual doctors' experiences with particular bonding systems over particular periods of time. While many of these papers are interesting, there is no way of knowing whether the data gathered in one individual practice can be applied to thousands of others. Many of the extraneous variables associated with the process under study *may* be consistent with those of other practices, but they are impossible to isolate and quantify.

Manufacturers are probably doing as much as we could reasonably expect. Most of them have beta-testing practices that evaluate their products under conditions that can indeed be considered "real-world". For obvious economic reasons, however, they cannot achieve the enormous, broad-based sample sizes that would be required to provide definitive clinical answers. What they get is, at best, a pretty good educated guess as to what will happen once a product is brought to market. Not only that, but the pressures of competition may tend to bias their results and lead us to question their reported outcomes.

At this point, open communication among private practitioners regarding their experiences with direct bonding may be as close as we can come to well-controlled, large-scale, multi-site clinical trials. In the future, it may be possible for us to standardize at least some of the bonding parameters across a broad consortium of private practices, thus creating a sizable clinical research base. JCO's readers—and writers—could make significant contributions to this endeavor.

RGK