The value of information and the cost of uncertainty: Who pays the bill?

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Orthodontics is the successful, respected product of more than a century of evolution. Over these years, the specialty has embraced a bewildering succession of appliances and "philosophies." Although some of these treatments now seem patently bizarre, generation after generation of orthodontists have enjoyed great professional success (by whatever criterion you may favor) earnestly regulating malocclusions with the device *du jour*—twin wire, segmented arch, labio-lingual, pin-and-tube, open tube, edgewise, Begg, Herbst, Oliver guide plane, bioprogressive, etc. Indeed, there have always been so many different appliances that the first step in setting up a practice is to choose a single "system" (an appliance and its various treatment options) for more or less exclusive day-to-day use.

Today, orthodontists commonly enter the fray armed with some sort of preadjusted edgewise appliance, a few treatment protocols, and a "functional" or two. In recent years, however, many orthodontists have carried the winnowing process to its extreme by opting, not just for a single appliance, but instead for a single protocol, usually some sort of two-phase, nonextraction protocol. Given the disparate nature of contemporary treatment strategies, it would be remarkable if all were equally effective. It would be even more remarkable if any single treatment variation could achieve optimal results on application to all patients, independent of chief complaint and present "illness."

If, as must surely be the case, some appliances and strategies work better in specific circumstances than others, then it is clear that the makeup of each orthodontist's clinical armamentarium—both physical and philosophical—must have a major impact on the outcome of a given patient's treatment. Given the significance of the basic decision to be, say, a "Begg" orthodontist or a "Tweed" orthodontist or a "nonextraction" orthodontist, there is surprisingly little in the way of serious demand for data upon which to base these important choices. How can this be?

Bias-free clinical studies are not only notoriously difficult to conduct, but also so time-consuming that they easily can be rendered obsolete by events. In the end, however, nobody dies from malocclusion; treatments evolve and researchers are left behind. Indeed, the actual effectiveness of an appliance system is not now, and probably never has been, crucial to the success of an individual practice. Orthodontists were probably as professionally and financially successful jumping the bite 100 years ago as they were extracting premolars 50 years ago or as they are using functional appliances (jumping the bite revisited?) and straight wire today.

Perhaps because there is no obvious penalty for being wrong (or for not being as right as one might like), decision-making in the face of uncertainty (i.e., in the absence of data) is a time-honored orthodontic tradition. Because clinical data are not seen to be a practical necessity, the researcher is forced, sooner or later, to consider

The Angle Orthodontist

Volume 68 Number 2 1998

the possibility that even perfect data might not have much of an impact on the nature of clinical practice. This independence, however, does not extend to the results of clinical practice.

In the long run, a willingness to treat without reference to evidence has a price that can be measured. Stated simply, it is the difference between what the patient actually gets and what he or she could have gotten from the best available treatment. The cost of this difference (the "regret") always comes due and is borne in full by the patient. In the end, it is exactly the same as the value of information—data that would identify the best available treatment to the orthodontist. Both parties should be equally concerned and of a single mind; I would argue that often they are not. Instead, there can be a conflict of interest that is of great potential significance, both to the specialty and to the public it serves.

Consider the various combinations of appliances and strategies ("treatments") available to the contemporary clinician. On what basis are therapeutic decisions commonly made? In most instances, the orthodontist has a menu of options, each of which can be evaluated in light of "expected" gain. Greatly oversimplified, every treatment option features a number of possible outcomes, each of which has a value—either positive or negative—to the patient. This personal value (which can be estimated by the use of reference lotteries[1]) is the utility of the event. Utility multiplied by probability is the outcome's *expected* utility. The algebraic sum of the given treatment's expected utilities (one for each possible outcome) is the expected (i.e., probable) gain or "payoff" of the treatment. To a first approximation, one might expect the orthodontist to be guided by outcome data in an effort to choose for the patient (or at least to recommend) the treatment option with the highest expected gain. There are, however, situations in which the clinician might deviate from this decision rule.

For example, an orthodontist might choose a treatment with a lower expected gain if the statistically superior alternative occasionally produces a truly disastrous outcome (e.g., death from a surgical treatment). The orthodontist thus would be like a tightrope-walker deciding whether or not to use an inventive, crowd-pleasing routine that works well most of the time. Given a risk-averse patient, some sort of "minimax" or "maximin" strategy makes sense. I would argue, however, that a treatment with an inferior expected return also may be chosen because of its perceived benefits to the orthodontist: speed, simplicity, safety (i.e., freedom from lawsuits), popularity with referring dentists, etc.

An "iatrocentric" approach in which gain is assessed from the perspective of the orthodontist is facilitated by consensual uncertainty: given a real or claimed absence of data ("We just don't know...."), it is possible to camouflage practice management decisions as biological imperatives. The intrusion of data, therefore, constitutes for many a threat to the quiet enjoyment of a successful practice. Nonextraction straightwire, for example, is popular with referring dentists and surely is easier than, say, extraction "Tweed." Accordingly, if one pays lip-service to mischievous claims concerning the long-term effects of premolar extraction ("dished in" profiles, temporomandibular dysfunction, etc.), the path of least resistance becomes instead an enlightened public service.

Unfortunately, the various St. Louis University/University of Michigan extraction/nonextraction comparisons[2-9] argue that these considerations are largely irrelevant. The crowded, protrusive patient thus would pay a big price in terms of regret for an orthodontist's decision to treat "nonextraction" for reasons that are for the most part a contrived fiction.

What about African American patients? If extraction and "backward-pushing mechanics" really are bad, what does orthodontic treatment have to offer? As it turns out, less than one might hope: nonextraction treatment has little impact, either on the profile or on crowding and spacing.[7,9] On average, both whites and blacks prefer the esthetic impact of extraction treatment, although whites tend to like flatter faces than do blacks.[9] Attention to the myths of the marketplace, therefore, would constitute a disproportionate tax on the orthodontist's uncertainty, payable in full by the patient. One more example of the origin and cost of unnecessary uncertainty should suffice.

In a recent letter to the editor of the *American Journal of Orthodontics and Dentofacial Orthopedics,* Stack[10] put into words what is held as an article of faith among the so-called "functional orthodontists": "For the past 30 years, I have never been able to understand why orthodontic treatment of Class II, Division 1 malocclusions has been directed at making the maxilla—in the overwhelming majority of cases normal in position and size—deficient with headgear therapy to match a preexisting deficient mandible...." To the supposed normality of the midface and deficiency of the mandible was added the assertion that "Most Class II, Division 1 malocclusions are...pre-existing unrecognized TMJ problems."

Given these assumptions, the appropriate treatment is clear, at least to the functional orthodontists: "maxillary expansion, mandibular advancement, and left and right buccal quadrant dentoalveolar extrusion." What luck! Treatments that are clinically expedient just happen to be biologically superior. Is this a great country or what?

But what if Class II patients are not universally in need of longer mandibles? What if "functional" appliances have no long-term impact on the size of the mandible? What if, instead, both functional appliances and extraoral traction demonstrate a lasting effect only in the midface? What if expansion and extrusion are unstable? Like it or not, there may be a good bit of truth in each of these subversive reservations.[11-13] If, however, evidence pertinent to these sorts of questions is not factored into the treatment decisions, the cost in terms of outcomes that fall short is passed through to the patient.

Freud argued that biology is destiny; I would argue that the clinician's choice of treatments, both in general and in particular, is the patient's destiny. One cannot, for example, decide to be a "nonextraction" orthodontist or to abandon extraoral traction and expect these global decisions not to have a long-term impact on the outcome of specific treatments. The purpose of this short communication, therefore, is to argue that the specialty has a fiduciary responsibility to be appropriately concerned with the significance of its treatment choices. Concerned enough to demand proof. Concerned enough to be able to distinguish between good data and bad. Concerned enough to apply these good data (and a bit of critical thought) to the various therapeutic decisions that affect the patient. What basic appliances should I use? When should I extract? When should I use functional-appliances? When should I resort to surgery? These decisions make a big difference to the patient. For this reason alone, the necessary data should be equally valuable to the orthodontist. Somebody has to foot the bill. I would argue that it should be paid for by the orthodontist's knowledge at the start of treatment, rather than by the patient's regret at the end.

Acknowledgments

Supported by N.I.D.R. grant DE08716. The author wishes to thank Dr. Carroll-Ann Trotman for her comments during the preparation of this paper.

Based on a paper presented to the Orthodontic Education and Research Foundation and abstracted in the 1998 OERF Newsletter.

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