USERS' GUIDE TO THE DENTAL LITERATURE

How to Use an Article about Prognosis

Patrick M. Lloyd, DDS, MS

Today's prosthodontic treatments are some of the most sophisticated the profession has ever been able to offer. State-of-the-art materials simulate the color, texture, pliability, and wear of human tissues to near perfection. Techniques have been refined, dramatically reducing the time required for sophisticated procedures. With proper planing and sequencing, function and appearance can be restored to such a high level that the artifice is imperceptible even to the most critical patient.

Coincident with the availability of advanced forms of therapy, patients have also become more sophisticated and present with specific requests and desires. Because many patients are financially secure, they are able to support the costs associated with extensive prosthodontic treatments. These are patients who, after reviewing the evidence, are most willing to make the investment of time and resources to achieve a particular outcome. They have high expectations and will not be satisfied by results that fall short of predicted outcomes. The demand for authority to support a particular intervention has become increasingly common among prosthodontic patients whose treatments are either fully or partially the responsibility of third-party providers. Because third-party providers oversee the care of thousands (sometimes hundreds of thousands persons), they are likely to demand an even greater degree of proof before they support a given intervention.

From the Department of Family Dentistry, The University of Iowa College of Dentistry, Iowa City, Iowa

With the growing need for documented efficacy of treatment and efficiency of rendering care, prosthodontists will serve their patients best when they fully understand the intricacies of clinical research and the results reported. This article proposes a structure for evaluating the literature that pertains to prognosis—the prediction of outcomes and the frequency of such occurrences (see box).

Users' Guide for Evaluating an Article About Diagnosis

1. Are the results of the study valid?
   - Primary guides
     - Was there a representative and well-designed sample of patients at a similar point in time?
     - Was follow-up sufficiently long and complete?
   - Secondary guides
     - Were objective and unbiased outcome criteria used?
     - Was there adjustment for important prognostic factors?
2. What are the results?
   - How large is the likelihood of the outcome events in a specified period of time?
   - How precise are the estimates of likelihood?
3. Will the results help a clinician care for patients?
   - Are the study patients similar to those in the clinician's practice?
   - Will the results lead directly to selecting or avoiding therapy?
   - Are the results useful for reassuring or counseling patients?

From Jacob R, Lloyd P: How to evaluate a dental article about harm. J Prosthet Dent 84:8–16, 2000; with permission.

It will help practitioners develop the ability to judge whether the results of an investigation are valid, to interpret the results, and to determine whether the analysis of the results is relevant to their practice. A hypothetical case is given here for discussion.

CLINICAL SITUATION

The first patient of the day is a 52-year-old woman with an unremarkable health history. She has been referred by a general dental practitioner for evaluation and possible treatment of a missing mandibular left first molar. About 15 years earlier, tooth #19 was restored with a multiple-surface, intracoronal silver amalgam restoration. About 3 months ago, the patient bit into a hard piece of bread, separating the lingual surface of the tooth and resulting in an immediate sharp pain that persisted for 2 days. Her general dentist diagnosed it as a vertical

root fracture and recommended extraction. The patient has excellent oral hygiene, a class I Angle's malocclusion bilaterally, no mucogingival defects, and an extensively restored posterior dentition (with silver amalgam as the predominate restorative material). Her third molars are the only other missing teeth.

Her chief concern is whether a dental prosthesis should be fabricated to replace her missing molar tooth. Her general dentist has told her that if the edentulous space is left untreated, it will lead to future problems, the most significant of which would be drifting and shifting of the adjacent and opposing teeth. Such tooth movement, the dentist said, often results in severe occlusal disharmony, limiting a patient's ability to eat comfortably and, because of the concomitant gingival and periodontal complications, ultimately leading to the demise of other teeth. At present, the patient does not find the toothless site to be an esthetic problem. She reports having slightly modified her chewing pattern, eating more on her right side than her left since the trauma to tooth #19.

The prosthodontic specialist informs the patient that before treatment options can be considered it is necessary to make diagnostic casts and to test the vitality and physical condition of the teeth surrounding the edentulous space. A relevant article reporting a study of the consequences of not replacing a missing posterior tooth has been published recently in a national dental journal. The specialist promises to share the results presented in that article with the patient at her next visit so that she can make an informed decision.

After spending almost an hour rummaging through a stack of journals later that day, the practitioner finally locates the article. Its title seems to fit the patient's condition perfectly: "The consequences of not replacing a missing posterior tooth," by Shugars et al.[6] Because the specialist has read it once, a few months ago, he plans to review it again in more detail before the patient's next appointment.

STUDY DESIGNS THAT YIELD INSIGHT AND IDENTIFY PROGNOSIS FACTORS

To advise the patient with the greatest degree of confidence, it is desirable to have the results of a clinical study that follows over time a large population of patients who are in every way similar to this patient. The subjects of the study would have the same condition (missing a mandibular first molar) and would be comparable in all other domains (e.g., age, gender, oral hygiene, periodontal support, classification of malocclusion). Such a study design would allow observation of the natural history or clinical course of the condition. It would be possible to monitor the status of anatomic, physiologic, and psychologic conditions that have been reported to occur as a consequence of no treatment.

Ultimately, the clinician would have definitive insight to share with the patient and could feel secure in advising her.

This type of study would provide the information the reader desired, but it is unlikely to be undertaken for many reasons. First are considerations of cost and time. To assemble such a pool of patients would require innumerable resources: hundreds of calibrated examiners and clinical facilities that could accommodate tens of thousands of subjects. Identical follow-up treatment would have to be provided to each subject (e.g., the same period for prophylaxis, operative treatments, and other, more complicated procedures). To assure that there were no influences from other health conditions, it would be necessary to remove patients from the study who developed illnesses or were prescribed medications. Ultimately, the initial population might be reduced to too small a group to make a conclusive assessment. Many years would be required collect the data necessary to allow advice to be given with confidence.

A cohort study design offers a more realistic approach for exposing the risks associated with certain conditions. Patients in a cohort study would have the same condition (missing a mandibular first molar) but would be different in ways previously reported to influence the outcome (e.g., type of malocclusion, periodontal status, other tooth loss). Subjects would be grouped according to these prognostic factors and followed over time. Data collected on other conditions that arise during the course of the study would allow additional analysis to expose other factors that contribute to the negative outcomes. Absolute risk ratios could be calculated so that the patient could be offered probabilities on the outcomes associated with not treating her condition.

The case-control study design is even more practical from both a resource and a time perspective but is extremely prone to bias. In a case-control study, subjects with the condition who have experienced the negative outcome (periodontal destruction, additional tooth loss) are compared with subjects who have not. Because subjects, cases, and controls are selected after the event has or should have occurred, there is tremendous potential bias. Investigators, because they must examine subjects to determine their appropriateness for the study, cannot be blinded during the selection process. The population from which subjects are drawn (e.g., a convenience sample from a dental college) further contributes to bias. Bias is compounded by the inherent shortcomings of a retrospective study design, substantially reducing the confidence that clinicians can realistically derive from such a study. Also, because case-control studies do not follow subjects over time, only relative risks can be calculated. In spite of these deficiencies, skillfully planned and tightly monitored case-control studies can play a significant role in patient care, especially when the outcome under consideration is infrequently detected or the time needed to observe the outcome is excessively long. (For example, mesial drifting of teeth posterior to the edentulous space has been reported to take several years.)

ARE THE RESULTS OF THE STUDY VALID?

Primary Guides

Was There a Representative and Well-defined Sample of Patients at a Similar Point in the Course of the Disease?

The validity of the conclusions drawn by investigators from their work should be judged on how well the population is defined. Are the criteria for patient selection well defined and appropriate? Is the database adequate to determine whether the study group represents the total population of patients at risk for the negative outcome? Shugars et al studied patients from a large group-model health maintenance organisation who had a first molar or second premolar extracted, were 18 years of age or older, and were enrolled in the program for at least 8 years.[7]

The potential for introducing bias into an investigation during the selection of subjects is quite strong. Questions that should be asked include:

Did all types of patients have an equal probability of being selected?
Were some patients filtered out because of coexisting conditions?
What measures were taken to ensure that patients represented a broad cross-section of the population (e.g., age, sex, geographic origin, socioeconomic status)?

In judging whether a study on prognosis is valid, it is also important to make sure that all patients entering the investigation are at a similar, well-defined point in the course of their condition. The investigators should describe, as specifically as possible and using discipline terminology, the stage patients must be in to be included in the study. Shugars et al decided to enroll patients if there was a radiograph of the adjacent and opposing teeth within 6 months before or after the extraction.[7]

Was Follow-up Sufficiently Long and Complete?

Even if there is a true association between a prognostic factor and an outcome of interest, it may take an extended period of time before the connection becomes evident. The chronic nature of most dental diseases and their delayed sequelae call for a rather long and protracted observation phase to confirm or deny a relationship. For instance, the loss of additional teeth as a consequence of not replacing a missing posterior tooth may take several years to occur. Patients should be examined at regular intervals over a sufficiently long period to judge whether such an outcome is related to a particular prognostic factor.

Investigators studying the natural history or clinical course of a disease process or clinical condition are compelled to maintain contact with individual patients in their study populations. Because of myriad circumstances, most of which might have little effect on the results of the study, many patients may be unavailable for follow-up. They may

fail to return for a recall examination because of a family relocation, a loss of interest in the study, an unrelated debilitating illness, or because the condition under scrutiny has bothered them enough that they elect to seek treatment (e.g., placement of a fixed partial denture). The greater the number of patients lost to follow-up, for whatever reason, the less confidence can be placed in estimates of true risk for a given adverse outcome.

The effect of patients who are lost to follow-up depends on the size of the population being studied and the rate of risk for the outcome event. For example, if 50 patients in a study population of 1000 were not available for recall, and the calculated risk of the outcome event for those patients examined was 25%, the worst-case scenario (i.e., all 50 experienced the event) would be a rate of 30%. Although this effect may be of statistical importance, it would be unlikely to be of clinical import. If, however, the calculated risk were only 1%, the worst-case scenario would be 6%, an outcome with substantially different clinical implications.

To lessen the impact of patients lost to follow-up on a study's ralidity, investigators need to report the reasons for unavailability. Each unamilable patient should be individually counted and identified. In addition, a comparison should be made, using a multitude of demographic parameters and clinical conditions, between those for whom a complete set of follow-up data was collected and those with partial data on follow-up. Such reporting and analysis increase the confidence that can be placed on the conclusions made.

This type of analysis, comparing the demographics of respondents and nonrespondents, was done by Haselton et al[1] in a retrospective study of the clinical performance of high-strength all-ceramic crowns over a 3-year period. They showed that the age range, gender distribution, number of ceramic crowns received, and the type of ceramic restoration were comparable between the two groups, allowing readers to place more confidence in conclusions they drew from the patient base available for examination.

WHAT ARE THE RESULTS?

How Large is the Likelihood of the Outcome Event Over a Specified Period of Time?

Of all the questions patients pose, none is more frequent than "How long will it last?" or, in the case of predicting risk, "What are the odds that it will happen to me?" To satisfy the sophisticated patient whose decision whether to be treated may depend on the response to this question, the practitioner should consider crafting an answer that will address the issue even more completely than the patient expects.

One could first offer a predication based on absolute prevalence rates—the percent of likelihood that a particular event will occur at

some time in the future. In the article by Shugars et al[6], 12% of the patients who did not receive treatment for a missing posterior tooth lost an additional adjacent tooth. The median time was 2.5 years, with a range of 0.9 to 6.7 years. An additional 13% experienced a tilting of the teeth adjacent to the edentulous space by a distance greater than 2.0 mm, with a median time of 6.9 years and a range of 1.1 to 9.6 years.

A second-level response would be to advise the patient of the relative likelihood that she will experience the outcome. This response would involve calculating the relative risk that the event (additional tooth loss) would occur during a specified period of time if no treatment were rendered. In a related article on the same cohort of patients, Shugars et al[7] reported the status of teeth adjacent to a bound edentulous space for patients who received no treatment and for patients for whom a fixed partial denture was fabricated. There was a 13% failure rate (e.g., an additional tooth was lost adjacent to the edentulous space) for the untreated group of patients and a 7% failure rate for those who received a fixed partial denture. These rates demonstrate a relative risk of 1.86. In other words, patients in this study were 1.86 times as likely to lose a tooth adjacent to an edentulous space if they received no treatment than if a fixed partial denture were constructed.

Finally, to provide the patient with a perspective on the rate at which the event is likely to occur over time (more often than not, there is significant variation), one could provide information gleaned from a survival curve. These graphic representations depict what occurs over the course of time and yield information of potentially great value to the patient. McLaren and White, in a report on the survival rates of In-Ceram (In-Ceram, Vident, Brea, California) crowns, used multiple survival graphs to show the rate of failure in each successive month (Fig 1).[3a]

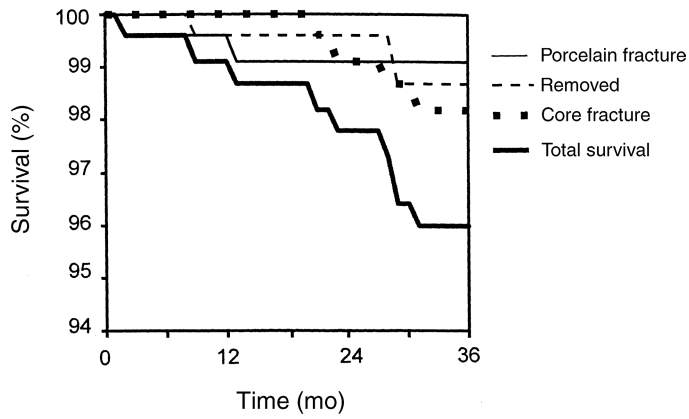

Figure 1. Reasons for loss of service of In-Ceram crowns followed for 36 months. (*From* McLaren E, White S: Survival of In-Ceram crowns in a private practice: A prospective clinical trial. J Prosthet Dent 83:216–222, 2000; with permission.)

In addition, to help practitioners and patients further, they categorised their data to identify specific reasons for failure.

How Precise are the Estimates of Likelihood?

Even with the best of intentions and systematic planning, the population selected for study will always be a sampling of the population as a whole. From the data collected, the relative risk for a particular event can be calculated, but the value will be only an estimate. To show the precision of this estimate, confidence intervals (CIs) are used. Confidence intervals help clinicians decide the range within which they can be confident of the relative risk estimate.[2] Norderyd et al, reporting on the risk of periodontal disease in a Swedish adult population, found that age is correlated with severe periodontal disease progression.[4] Because this was a case-control study, their calculated risks were expressed as odds ratios, with a value of 1.05 for the age correlation. The CI was 1.02 to 1.07, a rather tight range and one indicating that the calculated risk is quite precise.

WILL THE RESULTS HELP THE PRACTITIONERS IN CARING FOR PATIENTS?

Are the Study Patients Similar to Those in the Practitioner's Practice?

Regardless of the steps taken to minimize bias, to standardize measurement, and to adjust for differences, a study on prognosis has limited application to one's practice if the patients under consideration are unlike those one treats from day to day. An adequate base of information on the demographics and clinical conditions for patients used in the study should be reported so that one can judge the level of comparability. Characteristics to consider include age, socioeconomic status, patterns of tooth loss, and medication profile—virtually any characteristic that distinguishes the patient population in a particular practice.

The description of the patients involved in the article by Shugars et al[6], albeit brief, might be adequate to judge their similarity to the patients a practitioner treat. The article reports the gender distribution (51% female) and the mean age and range of the population (45.5 years, with a range of 24 to 90 years). All subjects were also enrolled in a large group-model health maintenance organization in Portland, Oregon. These data, although limited, do offer some insight into the comparability between patients in this study and in one's practice.

Will the Results Lead Directly to Selecting or Avoiding Therapy?

It is highly unlikely that the results of any clinical investigation, whether it deals with prognosis or therapy, will be directly applicable to one's practice. The myriad factors that influence subject selection, measuring, and follow-up protocol should be critically examined to determine what insight, if any, can be applied to a particular clinical situation. Relevance is not and should not be considered an all-or-none situation. Nearly every article contains some evidence that, when used properly, can help support or refute a decision whether to intervene.

The article reviewed here[6] reported a 13% rate of clinically significant tilting (>2.0 mm) of the teeth adjacent to the edentulous space and some loss of alveolar bone around the involved teeth; 12% of the patients who did not receive treatment for a missing posterior tooth lost an additional adjacent tooth. In sharing this information with a patient, a practitioner would be obligated to inform the patient how the subjects were selected and what characteristics could potentially raise or lower that rate, given the patient's unique set of conditions.

Are the Results Useful for Reassuring or Counseling Patients?

For the hypothetical patient discussed in this article, there is evidence that she may not suffer significantly if her condition is not treated immediately. Although there is a risk that not replacing her missing posterior tooth will cause her harm, the risk is apparently less than reported by other investigators and clinicians. To help the practitioner be more confident about the counsel he or she provides, the practitioner may want to reread sections of occlusion, fixed prosthodontic, and orthodontic texts. These texts may offer additional theory on how to manage the condition and what other factors should be monitored to ensure that an intervention is both appropriate and timely.

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Address reprint requests to

Patrick M. Lloyd, DDS, MS
Department of Family Dentistry,
The University of Iowa College of Dentistry
S313 DSB
Iowa City, 1A 52242

e-mail: patrick-lloyd@viowa.edu