



The Art and Science of Periodontal Prognosis

STEVEN E. SCHONFELD, DDS, PHD

ABSTRACT In this paper, periodontal literature related to making a periodontal prognosis is reviewed. Factors that can influence both an overall and tooth-specific prognosis are enumerated. Factors influencing the overall periodontal prognosis include age, genetics, oral hygiene, systemic conditions, and tobacco use. Tooth-specific influences include the amount of attachment loss, crown:root ratio, position in the arch, and presence or absence of furcation invasions. These factors are then synthesized into a scheme for determining a periodontal prognosis.

AUTHOR

Steven E. Schonfeld, DDS, PhD, is a periodontist in private practice in Eureka, Calif.

Periodontal prognosis refers to the expected longevity of teeth with or without periodontal therapy. One can consider an overall prognosis for the dentition and also a prognosis for individual teeth. The concept of periodontal prognosis is an expression of the expected longevity of a tooth or an entire dentition and is useful for making decisions on whether to treat, retain, or remove periodontally involved teeth.

In this paper, the author was charged with discussing the “art and science” of periodontal prognosis. This article will discuss the science relating to both overall prognosis and the prognosis for individual teeth. While many considerations from the classical periodontal literature still apply, new information and techniques should be considered when making the decision on whether to retain teeth or not, which is where the “art” of periodontal prognosis comes into play.

The Science

I. OVERALL PROGNOSIS

There are a number of factors which need to be considered when deciding on an overall periodontal prognosis:

Age: Studies consistently show more periodontal disease and generally greater severity of disease in older as opposed to younger people.^{1,2} However, this is primarily a function of the chronicity of the disease process (i.e., older individuals have had the disease for a longer period of time than younger ones). Provided that things are not already too far gone at the initial examination, it is possible to treat older adults successfully. Therefore, age is really not a major factor that needs to be considered in a patient’s prognosis for garden-variety chronic adult periodontitis; if anything, an older patient probably has a better prognosis for a given level of attachment loss than a younger patient does. There are also aggressive forms of periodontitis that are

seen generally in much younger patients.

Oral Hygiene: While periodontal diseases are associated with a number of specific bacterial pathogens, rather than the total microbial plaque burden, the patient's ability to perform adequate plaque control is clearly important in determining whether or not the disease can be arrested.³

Smoking: Dentists have long suspected that tobacco use was a risk factor for periodontal disease. Because it was also noted that smokers generally had a higher level of plaque and calculus than nonsmokers, the role of smoking per se remained unclear. In the past 15 years, there have been a number of studies reporting the role of smoking as a major risk factor for periodontitis, and that there is a linear dose-response relationship between amount of tobacco use (in pack years) and periodontal attachment and bone loss.⁴⁻⁶ Hence, other things being equal, a patient who continues to smoke will have a worse prognosis than one who either does not smoke or quits.

Systemic Diseases or Conditions: A number of systemic diseases and conditions can affect an overall periodontal prognosis. Among the more common ones are:

- **Diabetes:** The vast preponderance of studies find a strong association between both Type 1 and Type 2 diabetes and periodontal disease.⁷ This is not surprising, as diabetes is known to reduce resistance to infection and to compromise healing. Thus, patients with diabetes, especially poorly controlled diabetics, will generally have a worse overall prognosis than patients who are not diabetic or who are well controlled.

- **Genetics:** There are reports suggesting that genetic polymorphisms in certain genes involved in the immune response (e.g., interleukins IL-1 and IL-10 as well as Fc gamma receptors) may be associated with susceptibility to severe periodontitis

in some populations. While it is easy to imagine how these genes could affect the host response to infectious disease, a recent review suggests that more research needs to be done in this area before definitive statements can be made.⁸

- **Immunodeficiency states:** The human immunodeficiency virus is well known for increasing susceptibility to infections. Periodontal infections are included in the spectrum of oral manifestations of HIV infection.⁹ Because of their severely compromised immune system, AIDS patients generally have a

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poor periodontal prognosis, although HIV+ patients who are being successfully managed with anti-retroviral drugs and proteinase inhibitors can have a good long-term prognosis.

- **Neutrophil disorders:** Severe periodontitis can be associated with rare systemic conditions such as Chediak-Higashi or Papillon-Lefevre syndromes; leukocyte adhesion deficiency and others, including acquired neutrophil defects. Any systemic disease that lowers neutrophil count or impairs neutrophil function can be associated with an increased risk of periodontal destruction.⁷

- **Osteoporosis:** There is increasing evidence of the association between osteoporosis and periodontitis, particularly in women.¹⁰

- **Stress:** Many periodontists are of the opinion that stress adversely affects periodontal prognosis. A recent meta-analysis of the literature suggests that psychological stress can lead to increased periodontal disease and, hence, a worse overall prognosis.¹¹

II. PROGNOSIS FOR INDIVIDUAL TEETH

There have been some interesting studies concerning which periodontal diagnostic criteria were the most important in determining tooth loss and periodontal prognosis.^{12,13} They found that probing depth, furcation involvement, crown-to-root ratio, fixed abutment status, and percent bone loss were the most important factors in determining tooth loss.

Probing depth, crown:root ratio and percent bone loss are all measures of periodontal attachment loss. Clearly, the greater the attachment loss tooth has, the worse the prognosis for that tooth. Remember that attachment loss can be caused by root resorption in addition to periodontal pocketing.

Fixed abutment status is a measure of occlusal load and also of the patient's ability to perform plaque control (floss needs to be threaded under soldered contacts).

The classic literature can still tell us a lot about the prognosis for individual teeth. Hirschfeld and Wasserman did an extensive analysis of tooth loss in their patients.¹⁴ They divided their patients into three groups: well-maintained, downhill, and extreme downhill. It is likely that some of the factors discussed previously in the section on overall prognosis influenced which patients fell into each group.

A key finding was that "there is a predictable order of likelihood of tooth loss according to position in the arch" with posterior teeth being more likely to be lost earlier than anterior teeth.

For example, when all three groups of patients were considered, tooth loss over 22 years for incisors ranged from 3.4 percent (mandibular laterals) to 6.3 percent (mandibular centrals); 0.8 percent of mandibular and 3.6 percent of maxillary cuspids were lost. Mandibular premolars experienced about a 3 percent loss, while maxillary premolars experienced about a 6 percent loss. Mandibular first and second molars averaged about a 10.5 percent loss; while about 17.5 percent of maxillary first and second molars were lost.

The principal reason for the increased tooth loss in posterior teeth is the greater complexity of root morphology (convexities, furcations) found in these teeth.¹⁵ When furcations are invaded, the prognosis for the teeth becomes worse. This is probably due to the difficulty of adequately debriding and maintaining the root surfaces within the furcation (both by the hygienist during supportive periodontal therapy and by the patient attempting to control plaque).

Interestingly, Hirschfeld and Wasserman found that the overall prognosis for a given patient had a great deal of influence on posterior tooth loss. Less than 20 percent of furcation-involved teeth were lost over 22 years in the well-maintained group, as contrasted to almost 70 percent in the downhill group, and more than 84 percent in the extreme downhill group.

The Art

I. OVERALL PROGNOSIS

Given the above information, how does a dentist go about systematically assessing the periodontal prognosis for a particular patient and for particular teeth in that patient's dentition?

The first step is to evaluate the patient's social and medical history. Does the patient have any of the known

risk factors (e.g., diabetes, tobacco use, stress, immunodeficiency diseases)? If the patient does have risk factors, what is the potential for mitigating them (e.g., tightly controlling their diabetes, reducing or eliminating tobacco use or behavior modification for stress control)? This should give the dentist a feeling as to their overall health and for their potential to control their periodontitis.

The second step is to perform a complete periodontal examination with radiographs. This should consist of six-point probings for each tooth as well as mea-

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surement of gingival recession, mobility, furcation invasions and recording bleeding on probing or the presence of exudate.

The third step is to form an opinion of the overall periodontal health of the patient based on the results of the examination. Is the disease localized or generalized? If the disease is localized, are there obvious local factors (such as a palatal groove or trauma) which could account for the involvement of those particular teeth? Is the overall case type one of gingival health, gingivitis only (inflammation of the gingiva without attachment loss), or is there attachment loss?

If there is attachment loss; is the disease early, moderate, or advanced? Reasonable rules of thumb for determining case type are:

- Early disease: Attachment loss of 3 mm or less (generally corresponds to probing depths of 3-6 mm with normal gingival margins).

- Moderate disease: Attachment loss of 3-6 mm (generally corresponds to probing depths of 6-9 mm with normal gingival margins).

- Advanced disease: Attachment loss of greater than 6 mm (generally corresponds to probing depths greater than 9 mm with normal gingival margins).

Of course it is possible to have generalized early or moderate disease with areas of advanced disease. Again, one should look for localized factors that might be responsible for the advanced disease on certain teeth.

One also should consider the amount of attachment loss in relation to the patient's age. Advanced loss of attachment in younger patients (under age 30-35) is suggestive of aggressive disease with a correspondingly worse prognosis than similar levels of attachment loss in older patients and, the younger the patient, the worse the overall periodontal prognosis.

In the middle-aged patient without systemic risk factors, the overall prognosis for early-moderate periodontal disease case types is generally good. The overall prognosis for patients with generalized advanced disease is generally bleak although it is sometimes possible to maintain teeth in these patients for many years.

Finally, one should consider the patient's ability and consistency in performing plaque control when determining the overall prognosis. Clearly, the better his or her plaque control, the better the long-term prognosis. This determination is an important part of the re-evaluation examination following initial root planing and oral hygiene instructions.

II. PROGNOSIS FOR INDIVIDUAL TEETH

One should evaluate the prognosis for individual teeth. The most important consideration is the amount of attachment loss. Teeth with less than 4 mm of attachment loss (probing depths of 7 mm or less with normal gingival margins) generally have a good prognosis if they are not going to be used as abutments. Teeth with more than 7 mm of attachment loss (probing depths of 10 mm or more with normal gingival margins) generally have a poor prognosis.

Remember the crown-root ratio is also a measure of attachment loss, especially when dealing with root resorption (where attachment loss occurs from the apical end).

As seen from the work of Hirschfeld and Wasserman, the next most important consideration is the presence of furcation invasions. Teeth with minimal (Class I) or no furcation invasions generally have a good prognosis (other things being equal). The greater the amount of attachment loss in the furcation, the worse the long-term prognosis for that tooth. Teeth with complete loss of bone in the coronal aspect of the furcation (Class III) generally have a poor prognosis.

Teeth such as the maxillary premolars, which have pronounced root concavities, are also more difficult to instrument and maintain, and likewise have a worse prognosis than teeth with relatively straight roots.¹⁴

Severe mobility of a tooth is also generally an indicator of a poor long-term prognosis.

Know When to Hold 'Em and When to Fold 'Em:

Clearly, teeth with a good periodontal prognosis should be maintained, provided the patient is capable of doing their part (adequate oral hygiene and

keeping to a schedule of appointments for supportive periodontal therapy).

In most cases, one should consider removing a tooth with a poor prognosis, especially in patients with systemic conditions that compromise the overall prognosis. On the other hand, if maintaining a marginal tooth could compromise the patient's overall health (for example, a patient who is about to undergo organ transplantation, chemotherapy, or radiation treatment to tooth-bearing bone), it should similarly be removed.

However, the overall and tooth-

ADVANCES IN TECHNOLOGY

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specific periodontal prognoses are not the only elements that go into the decision of whether to treat or to remove a given tooth or teeth. Equally important is the overall treatment plan.

Is there arch integrity? If the patient has intact arches and no teeth will need to be replaced, a tooth with a relatively weaker prognosis can be maintained for longer than if there are many missing teeth (with correspondingly increased occlusal loads on the remaining teeth). If teeth are going to be replaced, is the tooth in question going to be a prosthetic abutment? If so, the prognosis needs to be better than for a tooth in an intact arch.

Does the tooth require endodontic treatment and/or extensive restorations? One must balance the costs of such treatment with the projected longevity

of the tooth. Does it make sense to put thousands of dollars of endodontic and restorative treatment into a tooth with a guarded-poor prognosis (i.e., a tooth that is expected to be lost in only a few years, even with treatment)? Of course patient wishes and expectations play a role in the decision-making process here as well.

Advances in technology may make it possible to have a more positive outlook on the prognosis for teeth with severe periodontal involvement. In the past 20 years, techniques such as guided-tissue regeneration and the use of biological modifiers such as enamel matrix proteins and tissue growth factors have given dentists the ability to regenerate periodontal tissues to a greater extent than ever before. For example, when the author was a dental student in 1972, a lower second molar with a deep distal intra-bony lesion might have been given a poor prognosis. Today, skilled clinicians utilizing regenerative techniques can restore such a tooth to a state of periodontal health with a fairly high degree of predictability.

On the other hand, advances in technology may also make it less desirable to retain teeth with severe periodontal involvement. Particularly in the past 25 years, with the advent of highly predictable dental implants, it is no longer necessary or even desirable to try to maintain a tooth with extensive periodontal destruction and a correspondingly poor prognosis. Although the author does not think we should be too quick to "pull the trigger" on a periodontally involved tooth, removal of a tooth and replacement with an implant is probably preferable to heroic treatment such as root amputation with corresponding endodontic and restorative costs.

Another important consideration in deciding when to remove a tooth is that, in general, the longer a tooth

with a poor periodontal prognosis is retained, the greater the amount of bone loss that can be expected. This may make eventual replacement with an implant more difficult or impossible.

Putting It All Together

From this review, it is clear there are some objective criteria that go into deciding on a periodontal prognosis. However, there are also many judgments that need to be made regarding the prosthetic treatment needed, patient desires and expectations, and the patient's willingness and ability to follow through with treatment recommendations. A clinician's knowledge of, and experience with, various treatment modalities also enters into what he or she thinks is realistically possible in terms of treatment, which clearly influences that individual's idea of the prognosis. Finally, and perhaps most importantly, a judgment needs to be made about the patient's willingness and ability to maintain themselves following the active treatment phase.

An experienced clinician will integrate all of the previously mentioned factors into a prognosis for the case and for individual teeth. While it has often been said there can only be one correct diagnosis, different dentists and periodontists may well give a single case a different prognosis and consequently different treatment plans based on their perceptions and judgments regarding all of the factors mentioned. ■■■■■

REFERENCES

1. Miller AJ, et al, Oral Health of United States Adults: National Findings. NIDR, Bethesda Md., 1987.
2. Schei O, Waerhaug J, et al, Alveolar bone loss as related to oral hygiene and age. *J Periodontol* 30:7-16, 1959.
3. Dzink JL, Tanner AC, et al, Gram negative species associated with active destructive periodontal lesions. *J Clin Periodontol* 12:648-59, 1985.
4. Ismael A, Burt B, Eklund S, Epidemiologic patterns of smoking and periodontal disease in the United States. *J Am Dent Assoc* 106:617-23, 1983.

5. Grossi S, Sambon JJ, et al, Assessment of risk for periodontal disease. I. Risk indicators for attachment loss. *J Periodontol* 65:260-7, 1994.
6. Grossi S, Genco RJ, et al, Assessment of risk for periodontal disease. II. Risk indicators for bone loss. *J Periodontol* 66:23-9, 1995.
7. Genco R, Risk factors for periodontal disease. In: *Periodontal Medicine* by Rose, Genco, Mealey and Cohen, BC Decker, 2000.
8. Loos BG, John RP, Laine ML, Identification of genetic risk factors for periodontitis and possible mechanisms of action. *J Clin Periodontol* 32(suppl(6)):210-3, 2005.
9. Greenspan D, Silverman S, Oral lesions of HIV infection. *J Calif Dent Assoc* 15(1):28-31, 1987.
10. Gomes-Filho IS, Passos Jde S, et al, The association between postmenopausal osteoporosis and periodontal disease. *J Periodontol* 78:1731-40, 2007.
11. Peruzzo DC, Benatti BB, et al, A systematic review of stress and psychological factors as possible risk factors for periodontal disease *J Periodontol* 78:1491-1504, 2007.
12. Nunn ME, Fan J, McGuire MB, Determination of periodontal prognostic indicators based on multivariate survival trees.

IADR Abstract No. 756, 2002.

13. McGuire, MK and Nunn, ME. Prognosis versus actual outcome. II. The effectiveness of clinical parameters in developing an accurate prognosis. *J Periodontol* 67:685-65, 1996.
14. Hirschfeld I, Wasserman B, A long-term survey of tooth loss in 600 treated periodontal patients. *J Periodontol* 49:225-37, 1978.
15. Gher ME, Vernino AR, Root morphology—clinical significance in pathogenesis and treatment of periodontal disease. *J Am Dent Assoc* 101:627-33, 1980.

TO REQUEST A PRINTED COPY OF THIS ARTICLE, PLEASE CONTACT Steven E. Schonfeld, DDS, PhD, 2773 Harris St., Suite B, Eureka, Calif., 95503.