A Prognostic Mapping in Periodontics

Review Article

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Abstract

Prognosis is an integral part of the periodontal practice because it directly influences treatment planning. However, there is limited direct evidence in the literature regarding the assignment of periodontal prognosis. There are several important concepts to consider in developing a system of periodontal prognosis. Historically, several authors have formulated and investigated their own prognostication systems. Results were variable, but they generally showed that systems based on tooth loss were unpredictable over the long term. Therefore, the purpose of this review relevant literature and propose a new periodontal prognostication system.

Key words: Prognosis, Periodontal disease, Periodontal prognostication system

Introduction

Development of an accurate prognosis is an integral component of treatment planning in the practice of periodontics. In addition, assignment of good, long term prognosis is critical in reliably determining an appropriate restorative treatment plan following periodontal therapy, particularly if major prosthetic reconstruction or placement of dental implants is under consideration. The etymologic origin of the term "prognosis" derives from Latin and literally means "foreknowledge". Prognosis is the prediction of the probable course, duration, and outcome of a disease based on a general knowledge of the pathogenesis of the disease and the presence of risk factors for the disease[1].

Prognosis is often confused with the term risk. Risk generally deals with the likelihood that an individual will develop a disease in a specified period. Risk factors are those characteristics of an individual that put the person at increased risk for developing a disease. In contrast, prognosis is the prediction of the course or outcome of a disease. Prognostic factors are characteristics that predict the outcome of disease once the disease is present. In some cases, risk factors and prognostic factors are the same.

There are several important concepts in prognosis. Prognostication systems traditionally are based on tooth mortality. Prognosis also can be described in terms of the stability of supporting tissues. Periodontal stability can be evaluated continually by clinical attachment level and radiographic bone measurements. The second essential element of prognosis is the timing of the projection. The third essential element of prognosis is the consideration of individual teeth versus the overall dentition[2].

Michael K. McGuire *et al*. in 1996 have evaluated the validity of use of clinical parameters for correctly assigning prognosis and predicting tooth survival and change in clinical condition overtime and they concluded there was a relationship between many commonly used clinical factors and prediction of change in clinical status over time as well as tooth loss rate, although the ability to predict the future condition of a tooth varied by tooth type (i.e. molars vs. non-molars) [3]. Machtei *et al*. in 1999 evaluated both clinical parameters and certain immunological and microbiological parameters for predicting change in clinical status over time as well as tooth loss[4]. Nieri *et al*. in 2002, examined subject-level (positive IL-1 genotype), tooth-level (mobility) and site-level (periodontal distruction and bone level) variables as predictors of alveolar bone loss over time[5]. Horwitz *et al*.in 2004, three radiographic measures were found to be predictive of the healing of class II furcation involvement following surgical intervention[6].

Factors affecting prognosis

Prognosis can be divided into overall prognosis and individual tooth prognosis. The overall prognosis is concerned with the dentition as a whole. Factors that may influence the overall prognosis and individual prognosis are given in table 1 [1].

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General factors affecting prognosis:

Patient's age: For two patients with comparable levels of remaining connective tissue attachment and alveolar bone, the prognosis is generally better for the older of the two. For the younger patient, the prognosis is not as good because of the shorter time frame in which the periodontal destruction has occurred; the younger patient may have an aggressive type of periodontitis, or disease progression may have increased because of systemic disease or smoking. In addition, although the younger patient would ordinarily be expected to have a greater reparative capacity, the occurrence of so much destruction in a relatively short period would exceed any naturally occurring periodontal repair.

***Disease Severity*:** The severity of the disease might be slight, moderate or severe depending on depends on pockets depth, level of attachment, bone loss and osseous defect.

Individual prognosis	Percentage bone loss
	Probing depth
	Distribution and type of bone loss
	Presence and severity of furcations
	Mobility
	Crown/root ratio
	Root form
	Pulpal involvement
	Caries
	Tooth position and occlusal relationship
	Strategic value
	Therapist knowledge and skill
Overall prognosis	Age
	Medical status
	Individual tooth prognosis
	Rate of progression
	Patient cooperation
	Economic considerations
	Knowledge and ability of dentist
	Etiological factors
	Oral habits and compulsions

Table 1 Prognostic clinical parameters[1]

Pocket depth: Shallower pockets have a better prognosis than do deep pockets. Deep pockets have a favorable prognosis if attachment and bone levels are high.**Level of attachment:** The determination of the level of clinical attachment reveals the approximate extent of root surface that is devoid of periodontal ligament. Pocket depth is less important than level of attachment, because it is not necessarily related to bone loss. Tooth with deep pockets and little attachment and bone loss has a better prognosis than one with shallow pockets and severe attachment and bone loss[7].

Bone loss and osseous defect: Greater the bone loss, poorer is the prognosis. Three - walled osseous defect provides a scaffold for repair and

good regenerative potential. Two - walled osseous lesion has poorer and one - walled the poorest, prognosis for bone regeneration. Thus, prognosis is related to theheight of remaining bone.

Plaque control: Patient cooperation is essential for satisfactory plaque control, but is also necessary for the control of predisposing and aggravating etiological factors.

Patient compliance: The prognosis for patients with gingival and periodontal disease is dependent on the patient's attitude, motivation and dexterity to keep good oral hygiene. Patient cooperation is more likely to be forthcoming after the patient has been given information about the nature of the problem. Time spent in providing such information and in explaining the rationale behind the treatment plan will improve the chances of achieving a good prognosis**.**

Smoking: Smoking affects the severity of periodontal destruction as well as the healing potential of the periodontal tissues. The prognosis in patients who smoke and have slight to moderate periodontitis is generally fair to poor. In patients with severe periodontitis, the prognosis may be poor to hopeless.

Systemic disease: Patient's health and associated capacity for repair are important factors to consider in developing the treatment plan and prognosis.

Genetic factors: Genetic factors play an important role in determining the nature of the the host response.

Stress: Any emotional condition will interfere with the patient's oral hygiene regime.

Local Factors Affecting the Prognosis

Plaque/calculus: The patient who shows a severe response to minimal amounts of plaque has poorer prognosis than does the patient who exhibits a resistant response in the presence of a considerable amount of plaque. The microbial challenge presented by plaque and calculus is the most important local factor in periodontal disease. Thus, good prognosis is dependent on the ability of the patient and clinician to remove plaque. But when the teeth are drifted or rotated, oral hygiene may be more difficult; in such case the prognosis is poorer.

Subgingival restorations: Tooth with overhangs or a subgingival margin discrepancy has a poorer prognosis than a tooth with well-contoured, supragingival margins.

Anatomic factors:

Short, tapered roots: Teeth with short, tapering roots have a poorer prognosis than do those with long and broad roots. The more favorable the crown-root ratio, the better the prognosis. An upper molar with widespread roots and therefore a large root base has a much better prognosis than a conical - rooted premolar or incisor with the same amount of bone loss.

Cervical enamel projections and enamel pearls: These enamel projections on the root surface have a negative effect on the prognosis.

Root concavities: Prominent root proximal concavities are present on maxillary first premolars, mesiobuccal root of maxillary first molar, both roots of mandibular first molars and mandibular incisors. These are the areas that can be difficult for the therapist and patient to clean and thus, these worsen the prognosis.

Developmental grooves: Grooves on the root are an invagination resulting from incorrect formation of the root. The grooves often begin at the cingulum and extend a variable distance apically on the root - surface between the midpalatal line and the line angle that is why called as cinguloradicular groove. These grooves are found on maxillary lateral incisors (5.6%) and maxillary central incisors (3.4%) which act as plaque - retentive area that are difficult to instrument.

Proposed Classification System

Because tooth loss is influenced by natural and iatrogenic reasons, a periodontal prognostication system based on the probability of disease progression is hereby proposed. Individual tooth prognosis is based on the prediction of future stability of the periodontal supporting tissues. For the sake of simplicity, three primary classifications are proposed table 2

Study	Classification				
	Good	Fair	poor	Questionable	Hopeless
Hirschfeld and Wasserman, 1978[8]				1. Furcation involvement. 2. A deep, noneradicable pocket. 3. Extensive alveolar bone loss. 4. Marked mobility in Conjunction with probing depth (2 or 2.5 degrees on a scale of three).	
Becker et al., 1984[9]				Teeth with more than one of the following problems: 1. Bone loss close to 50% of the root length. 2. Probing depths of 6 to 8 mm. 3. Class II furcation involvement with minimal interadicular space. 4. Presence of deep vertical groove on palatal aspect of maxillary incisors. 5. Mesial furcation involvement of maxillary first bicuspids.>50% attachment loss resulting in a poor crown/root ratio. Poor root form. Class II furcations not easily accessible to maintenance care, or Class III furcations. ‡2+ mobility. Significant root proximity.	Teeth with more than one of the following problems: 1. Loss >75% of the supporting bone 2. Probing depths >8 mm. 3. Class III furcation involvement. 4. Class III mobility with tooth movement in mesial-distal and vertical directions. 5. Poor crown/root ratios. 6. Root proximity with minimal interproximal bone and evidence of horizontal bone loss. History of repeated periodontal abscess formation.

McGuire and Nunn, 1996[3]	Control of the etiologic factors and adequate periodontal support as measured clinically and radiographically to ensure the tooth would be relatively easy to maintain by the patient and clinician assuming proper maintenance.v	Approximately 25% attachment loss as measured clinically and radiographically and/or Class I furcation involvement. The location and depth of the furcation would allow proper maintenance with good patient compliance	50% attachment loss and Class II furcations. The location and depth of the furcations would allow proper maintenance, but with difficulty.	>50% attachment loss resulting in a poor crown/root ratio. Poor root form. Class II furcations not easily accessible to maintenance care, or Class III furcations. ‡2+ mobility. Significant root proximity.	Inadequate attachment to maintain the tooth in health, comfort, and function. Extraction was performed or suggested.

Table 2 classification for determination of prognosis[2]

Classification And Regression Trees (CART)

The traditional method for assignment of prognosis involves a subjective process based on commonly taught clinical parameters and the therapists experience and training. There is no established universal set of criteria for assignment of periodontal prognosis, and thus different practitioners may assign varying prognoses for the same tooth, which may be problematic for referring dentists, third-party payment plans (e.g. dental insurance companies) and the patients themselves, as, rather than providing guidance for treatment planning, it creates further uncertainty. In order to remedy this situation Martha E. Nunn *et al*. in 2012 embarked on a long-term project to establish objective criteria for assignment of prognosis based on actual outcome and that was Classification And Regression Trees (CART). They extended the method of CART for survival to accommodate multivariate failure time data such as tooth loss and restoration failure observed in dental research, by applying techniques used for multivariate survival analysis to CART for survival in which they used two approaches[1]:

1) The marginal goodness-of-split approach

2) The multivariate exponential model with gamma frailty

They collected data of 100 well maintained periodontal patients who were diagnosed with moderate to severe periodontal disease, in order to determine evidence-based criteria for assignment of prognosis based on commonly taught clinical parameters.

Based on the first split on furcation involvement in the marginal goodness-of-split approach, further survival tree modeling was performed using stratification by molars and non-molars figure 1.

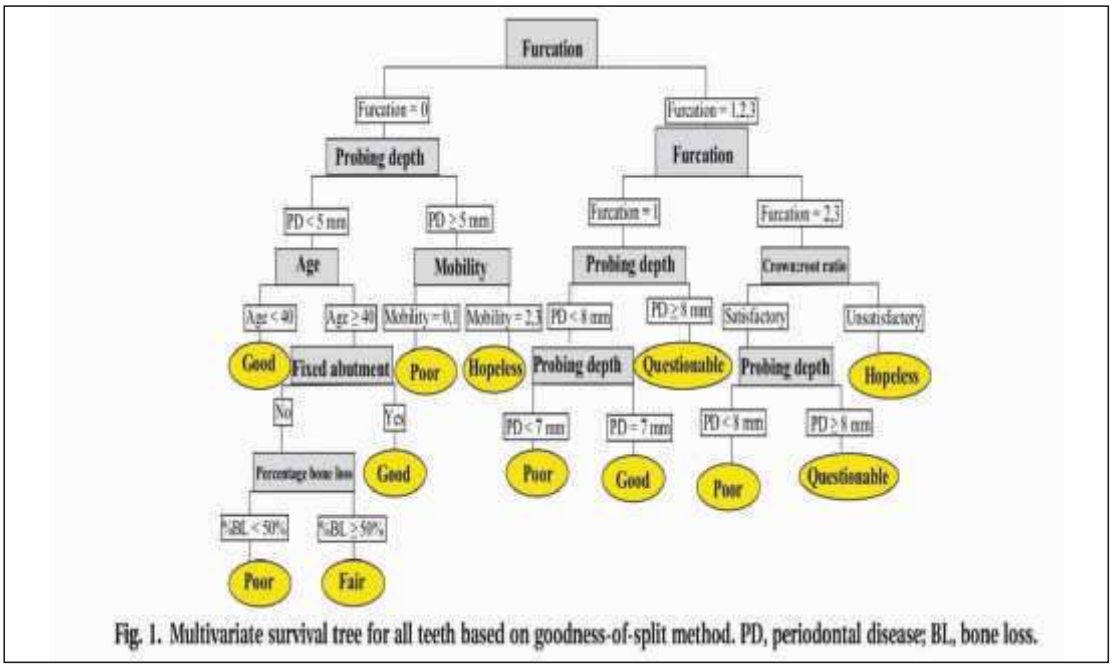

Fig. 1. Multivariate survival tree for all teeth based on goodness-of-split method. PD, periodontal disease; BL, bone loss

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The best performance in terms of prediction was obtained from the multivariate exponential survival trees shown in Figs 2 and 3. Figure 2 shows the final multivariate exponential survival tree for non-molars. Probing depth, untreated bruxism (i.e. parafunctional habit without a bite guard), oral hygiene, mobility, removable abutments and mean percentage bone loss were all significant factors in the multivariate exponential survival tree for predicting tooth loss over time in non-molars.

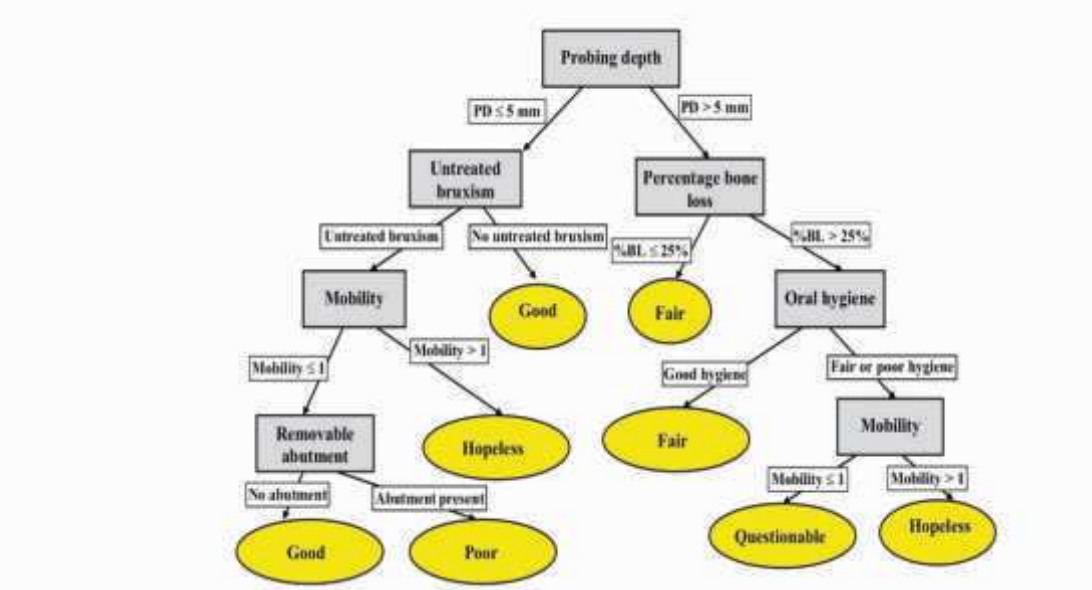

Fig. 2 Multivariate exponential survival tree for non-molars. PD, periodontal disease; BL, bone loss[1]

Figure 5 shows the final multivariate exponential survival tree for molars. Based on Fig. 5, crown/root ratio, probing depth, furcation involvement, root form, untreated bruxism, oral hygiene, mobility, bite guard, mean percentage bone loss and family history of periodontal disease were all significant factors in the multivariate exponential survival tree:

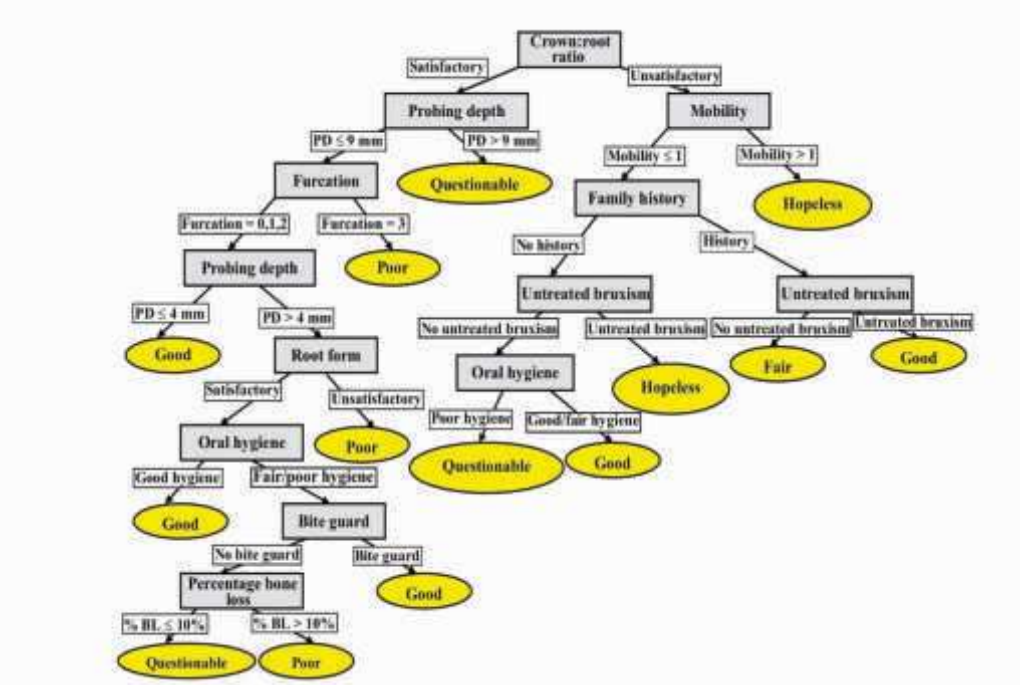

Fig. 3 Multivariate exponential survival tree for molars[1]

PROGNOSIS OF PATIENTS WITH GINGIVAL AND PERIODONTAL DISEASES

Prognosis of Patients with Gingival Diseases

Gingivitis associated with dental plaque only: Prognosis for patients with gingivitis associated with dental plaque only is good, provided all local irritants and other local factors contributing to plaque retention are also eliminated. Plaque-induced gingival diseases modified by systemic factors: Long-term prognosis for these patients depends not only on control of bacterial plaque, but also on control or correction of systemic factors. Plaque-induced gingival diseases modified by medications: The severity of drug induced gingival enlargement can be limited by controlling the plaque.

Surgical intervention is usually necessary to correct the alterations in gingival contour. Continued use of the drug results in recurrence of the enlargement, even following surgical intervention. Long term prognosis is dependent on whether the patient's systemic problem can be treated with an alternative medication that does not have gingival enlargement as a side effect. Gingival diseases modified by malnutrition: The prognosis in these patients may depend on the severity and duration of the deficiency and on the likelihood of reversing the deficiency through dietary supplementation.

Non-Plaque-induced gingival lesions: Prognosis depends on elimination of the source of the infectious agent. In patients with atypical gingivitis seen in dermatologic disorders, prognosis is linked to management of the associated dermatologic disorder. Prognosis of patients with allergic, toxic, and foreign body reactions, as well as mechanical and thermal trauma, depends on elimination of the causative agent.

Prognosis of Patients with Periodontitis

Chronic Periodontitis: In cases where the clinical attachment loss and bone loss are not very advanced (slight to moderate periodontitis), the prognosis is generally good, provided the inflammation can be controlled through good oral hygiene and the removal of local plaque-retentive factors. In patients with more severe disease, as evidenced by furcation involvement and increasing tooth mobility, or noncompliant patients prognosis may be downgraded from fair to poor.

Aggressive Periodontitis: The clinical, microbiologic, and immunologic features

suggest that patients with aggressive periodontitis would have a poor prognosis. However, in cases of localized aggressive periodontitis, the patients often exhibits a strong serum antibody response to the infecting agents, which may contribute to localization of the lesions. When diagnosed early, conservative therapy with oral hygiene instruction and systemic antibiotic therapy, can result in an excellent prognosis.

Periodontitis as a Manifestation of Systemic Diseases: Systemic diseases alter the ability of the host to respond to the microbial challenge presented and this may affect the progression of disease and therefore the prognosis. Unless the systemic disease can be corrected, these patients present with a fair to poor prognosis. In case of genetic disorders that alter the host response, prognosis is generally fair to poor.

Necrotizing Periodontal Diseases: With control of both the bacterial plaque and the secondary factors, such as acute psychologic stress, tobacco smoking, and poor nutrition, the prognosis for a patient with NUG is good. With repeated episodes of NUG, the prognosis may be downgraded to fair. In patients with NUP the prognosis depends on not only reducing the local and secondary factors, but also on dealing with the systemic problem.

Conclusion

The determination of periodontal prognosis has been arbitrary. The proposed prognostication system, based on stability and evidence-based modification factors, may be more predictable. Eventually, with accumulation of longitudinal data from many practices, we should be able to develop evidence-based prognostic indicators that can be utilized by periodontists, dentists, third-part payment plans and patients to determine the optimum treatment plan in each case, based on evidence-based prognosis**.**

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