Predicting Tooth Loss in Periodontal Patients

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The purpose of Linking Research to Clinical Practice is to present evidence-based information to clinical dental hygienists so that they can make informed decisions regarding patient treatment and recommendations. Each issue will feature a different topic area of importance to clinical dental hygienists with A BOTTOM LINE to translate the research findings into clinical application.

Eickholz Peter, Kaltschmitt J, Berbig J, Reitmeir P, Pretzl B. Tooth loss after active periodontal therapy: patient-related factors for risk, prognosis and quality of outcome. J Clin Periodontol. 2008;35(2):165-174.

Objectives: Assessment of patient-related factors contributing (1) to tooth loss and (2) to the quality of treatment outcome 10 years after initiation of anti-infective therapy.

Material and Methods: All patients who had received active periodontal treatment 10 years ago by the same examiner were recruited consecutively until a total of 100 patients were re-examined. Re-examination was performed by a second examiner and included clinical examination, test for interleukin-1 (IL-1) polymorphism, smoking history, review of patients' files (e.g. regularity of supportive periodontal therapy: SPT). Statistical analysis included Poisson and logistic regressions.

Results: Fifty-three patients attended SPT regularly, 59 were females, 38 were IL-1 positive. Poisson regressions identified mean plaque index during SPT ($p<0.0001$), irregular attendance of SPT ($p<0.0001$), age ($p<0.0001$), initial diagnosis ($p=0.0005$), IL-1 polymorphism ($p=0.0007$), smoking ($p=0.0053$), and sex ($p=0.0487$) as factors significantly contributing to tooth loss. Additionally, mean plaque index during SPT ($p=0.011$) and irregular SPT ($p=0.002$) were associated with a worse periodontal status 10 years after initiation of therapy.

Conclusion: The following risk factors for tooth loss were identified: ineffective oral hygiene, irregular SPT, IL-1 polymorphism, initial diagnosis, smoking, age and sex.

Commentary

The primary aim of surgical and nonsurgical periodontal treatment is to control loss of attachment and retain teeth over the person's lifetime. Over the past three decades, considerable research has explored factors that are associated with an increase risk for tooth loss, and those that predict progressive loss of attachment. Following definitive periodontal treatment, numerous variables have been shown to influence stability of the periodontium. Regular supportive periodontal therapy (SPT) has been shown to be crucial for long-term management of patients. Other variables have been identified as important predictors of advancing disease, as well. While this field of inquiry has identified multiple risk factors, many of the classic studies were retrospective in design or only used clinical characteristics of disease progression as surrogate markers of tooth loss. One premise of the current study is that since the goal of periodontal treatment is to preserve the dentition, evaluating the relationship of predictors of tooth loss is important in understanding the multifactorial nature of periodontal progression. In addition, recent evidence on the importance of genetic predisposition as a predictor of tooth loss has been controversial. This study was uniquely designed, using a prospective approach, to model the periodontal outcomes, tooth loss and disease progression, 10 years following initial therapy. Predictors of these two outcomes included baseline clinical findings and associated prognosis, IL-1 polymorphism testing, smoking history, diabetes status, and reason for previous tooth loss.

Subjects in this study were 100 patients who had received either surgical or nonsurgical (SRP under local anesthesia) treatment at the periodontal clinic at the University of Heidelberg by a single trained periodontist beginning in 1992. Subjects had to have complete radiographs and clinical records obtained prior to treatment in order to be included in the 10-year re-examination.

At the 10-year (±6 months) re-examination period, gingival bleeding, plaque score, pocket depth, clinical attachment levels, suppuration and, where relevant, furcation involvement were assessed at 6 sites per tooth by a single examiner. Complete periapical radiographs were obtained and the amount of bone loss measured at the most severely affected site using a Schei ruler. Based on that measurement, teeth were categorized into 1 of 5 groups based on severity of bone loss. In addition, interproximal sites

with the most severe loss were also characterized as to whether there was an infrabony defect or not. Where present, infrabony pockets were grouped as to shallow, moderate or deep defects. These data were used to assign a prognostic rating to each tooth in the mouth that was categorized as either hopeless (bone loss >75%), questionable (bone loss between 50% and 75% or presence of an angular defect or furcation involvement), or good (bone loss <50% with no angular defect or furcation involvement). Based on these tooth-level ratings, a patient prognosis index was computed by summing the number of questionable teeth and hopeless teeth and subjects subsequently divided into 3 prognostic categories: (A) Prognosis Index <0.27; (B) 0.27 ≤ Prognosis Index <0.5, and (C) Prognosis Index >0.5. All patients were tested for Interleukin – 1 polymorphism using the IAI ParoGen Test. Patients who had lost teeth during the 10-year period were queried as to the reason. Smoking status was also obtained and subjects categorized as to current, former (quit smoking at least 5 years prior) and never.

Patients' charts were also examined to extract information that reflected home and professional care during the 10-year period. Mean scores were computed for gingival and plaque indices that had been documented at SPT visits, and irregularity of SPT determined by whether the patient had extended the SPT recall interval by more than twice at any point over 10 years. Lastly, each individual was assigned to 1 of 4 levels of periodontal treatment outcome using a composite of clinical findings proposed by the Swiss Dental Society.

The primary outcome variable used for statistical analyses was tooth loss after Active Periodontal Treatment (APT). One hundred forty-five patients who had been treated 10 years before were invited to participate; however, 42 were unwilling to be re-examined and 3 did not have sufficient data for inclusion. Patients, who ranged in age from 15 to 67 at initial therapy, were reexamined at the 10-year period. Fifty-nine were female, and 53 participants received regular SPT. Overall, 89 were classified as well maintained, with the remainder categorized as downhill or extremely downhill.

Data were analyzed using Poisson regression analysis to predict tooth loss as a function of multiple variables, including irregular SPT, Interleukin – 1 polymorphism, severity of initial diagnosis, smoking, plaque control over 10 years, age, gender and presence of diabetes. This analytical technique allows for the assessment of each variable's contribution to predicting tooth loss while controlling for other variables. Results showed that regular SPT had a protective effect against tooth loss, whereas IL-1 polymorphism, age, female gender, smoking and diagnosis of aggressive or severe disease increased the risk of tooth loss. Of particular interest was the protective effect of SPT. Fifty-three individuals who received regular SPT lost on average 0.55 (±0.99) teeth compared to 2.68 (±4.44) for those not receiving regular SPT. Also, 38 patients were determined to be IL-1 positive and they lost on average 2.24 (±4.82) teeth compared to 1.13 (±1.74) for the IL-1 negative patients. The Prognosis Index did not have a significant association with tooth loss; however, a high level of risk at the start of SPT was associated with increased tooth loss during the 10-year period. Lastly, logistic regression was used to predict periodontal treatment outcome classification as a function of multiple variables. Only regular SPT and average plaque control over time were statistically significant predictors of better periodontal outcomes.

These results have important implications for the dental hygienist. Results from the Poisson regression showed that several nonmodifiable risk factors are associated with tooth loss, including age, gender and IL-1 polymorphism. Knowledge of this information can assist the clinician in selecting appropriate SPT intervals and encouraging adherence on the part of patient. Moreover, for each 10% increase in average plaque score over the 10-year period, there was a 58% increased risk for tooth loss.

Improving plaque control over time is an important modifiable risk factor that is well within the dental hygienist's scope of influence. Recent findings in health psychology suggest that changing patients' behavior rather than providing authoritative information should be the goal of clinician-patient communication.[1-6] When patients are ready for change, providing information can be beneficial in supporting improved health behavior. However, many periodontal patients are not ready for change and can become resistant when clinicians use overt persuasion. Strategies such as motivational interviewing may have utility for changing patient behavior and reducing risk of tooth loss associated with poor plaque control.

Matuliene G, Pjetursson BE, Salvi GE, Schmidlin K, Bragger U, Zwahlen M, Lang NP. Influence of residual pockets on progression of periodontitis and tooth loss: results after 11 years of maintenance. J Clin Periodontol. 2008;35(8):685-695.

Background: Limited evidence exists on the significance of residual probing pocket depth (PPD) as a predictive parameter for periodontal disease progression and tooth loss.

Objective: The aim of this study was to investigate the influence of residual PPD ≥5 mm and bleeding on probing (BOP) after active periodontal therapy (APT) on the progression of periodontitis and tooth loss.

Material and Methods: In this retrospective cohort, 172 patients were examined after APT and supportive periodontal therapy (SPT)

for 3–27 years (mean 11.3 years). Analyses were conducted using information at site, tooth and patient levels. The association of risk factors with tooth loss and progression of periodontitis was investigated using multilevel logistic regression analysis.

Results: The number of residual PPD increased during SPT. Compared with PPD≤3 mm, PPD=5 mm represented a risk factor for tooth loss with odds ratios of 5.8 and 7.7, respectively, at site and tooth levels. The corresponding odds ratios for PPD=6 mm were 9.3 and 11.0 and for PPD≥7 mm 37.9 and 64.2, respectively. At patient level, heavy smoking, initial diagnosis, duration of SPT and PPD≥6 mm were risk factors for disease progression, while PPD≥6 mm and BOP≥30% represented a risk for tooth loss.

Conclusion: Residual PPD≥6 mm represents an incomplete periodontal treatment outcome and requires further therapy.

Commentary

Preventing tooth loss in periodontal patients continues to be the goal of periodontal therapy. While many researchers have attempted to identify risk factors that influence that natural history of progressive periodontal attachment loss and tooth loss, few studies have examined the impact of residual pockets following active treatment on meaningful outcomes. Researchers at the University of Bern in Switzerland recently explored the influence of residual periodontal pockets and bleeding on probing on progression of periodontitis and tooth loss. The study team used a retrospective approach to identify patients who had been treated by periodontal residents at that institution between the years 1978 and 2002. A total of 392 patients were identified, and of those, 199 agreed to participate and be re-examined. Inclusion criteria for participation stipulated that subjects must have two complete sets of periodontal and radiographic records; one obtained prior to active periodontal therapy and one from the end of active treatment. Of the original 199 patients, 122 met these criteria. The sample consisted of 55.2% women, and subjects' mean age was 45 (±11) years.

Data on prevalence of residual pockets of varying depths and bleeding on probing was obtained from the post-APT records. These data were also used to retrospectively classify patients as having Level 1 or Level 2 periodontitis. Level 1 was defined as presence of proximal attachment loss of ≥3 mm in two or more teeth. Patients were classified as Level 2 if they had proximal attachment loss of ≥5 mm in at least 30% of teeth. Active treatment delivered by the residents consisted of scaling and root planing (SRP) under anesthesia, if needed. Periodontal surgery was performed following re-evaluation if indicated by response to SRP. Subjects requiring prosthetic therapy received treatment by either implants or fixed prostheses. All subjects, including those who had received or who had refused surgery, received SPT following APT by their private dentist or at the University of Bern.

At the re-examination appointment, patients were asked about their smoking habits and frequency of SPT over the post-APT period and then reclassified as being progressive or not. The criterion for determining "progressive" was having at least 2 teeth with additional attachment loss of ≥3 mm. The average time period between APT and re-examination ranged from 3 to 27 years, with an average of 11.3 (±4.9) years. Patients' average age at re-evaluation was 56.6 (±11 years).

An advanced statistical analysis (multilevel logistic regression) was used to account for periodontal sites, clustered within teeth, which were clustered within patient in assessing tooth loss. This strategy accounts for the fact that sites and teeth are not independent of the patient, thus improving the validity of statistical decisions made about relationships of risk factors to periodontal outcomes. Because progression of periodontitis is a patient-level outcome, a more straightforward analytical approach (logistic regression) was used in this analysis.

After APT, 98 patients received their SPT at the university, whereas 73 returned to their private dentist. Patients' self-report of SPT visits showed that the SPT intervals were significantly ($p < .0001$) shorter for subjects attending the university clinic, with 95% receiving SPT at least twice or more times per year compared to 68% in the private sector.

At the end of active treatment (APT), approximately 29% of patients had no residual pockets ≥5 mm, 40% had 1 to 4, 16 % had 5 to 8 and 15% with ≥9 sites. At the reexamination period (again, on average 11 years later) these values had shifted to 19% with no sites ≥5mm, 41% with 1 to 4 sites, 18% with 5 to 8 sites and 23% with 9 or more sites. Of particular note, the percent of patients with >9 sites in smokers increased from 31% to 52% between active treatment and re-examination. In nonsmokers, the increase was considerably smaller, from 7% to 15%. The trend for full-mouth bleeding scores was similar, with more bleeding on probing on average noted at re-examination.

At the tooth level, results showed that the odds of tooth loss at re-examination increased dramatically as a function of increasing residual pocket depth present at end of treatment, and that this effect was dramatically influenced by presence of bleeding at that site. When the analysis was conducted at the patient level, the picture of risk for tooth loss became clearer. Patient-level factors that were significantly predictive of tooth loss included full-mouth bleeding scores >30%, a diagnosis of Level 2 disease, the years of SPT over 10 years and presence of residual pockets >6 mm after APT.

Smoking habits, health status, gender and age were not significant predictors of tooth loss. However, when periodontal progression was modeled as the outcome, heavy smoking was a predictor of progression along with SPT exceeding 10 years, Level 2 diagnosis, presence of at least 1 site >6 mm, or >9 sites with pocket depths of ≥5 mm at the end of APT.

These results contribute new information to our understanding of periodontal progression and tooth loss over time. The authors argue effectively that the true measure of periodontal therapy success should be preventing loss of teeth. While measuring periodontal pocket depth and attachment loss over time (e.g., periodontal progression) is the focus of periodontal supportive therapy and maintenance, the importance of these data lies in their predictive value rather than in the data themselves. One shortcoming of the current study is that reason for tooth loss was not explicitly tied to progression of periodontal disease. It is likely that some teeth may have been extracted during the study period as a result of caries, fracture or endodontic problems. The impact of this source of error on results is not known; however, it could attenuate the predictive strength of the patient-level and site-level factors on tooth loss. Additionally, patients in this study were treated by a number of dentists during the study period. As philosophies and subsequent treatments may have differed, it is possible that clinician decisions to maintain versus extract teeth may have varied as well. Despite this, the concordance of these findings to those reported by other authors gives additional support to concern regarding the potential negative consequences of not retreating bleeding residual pockets following active therapy.

The Bottom Line

Periodontal disease continues to be the number one reason for tooth loss in the U.S. *Oral Health in America: A Report of the Surgeon General* (Department of Health and Human Services, 2000) reports that approximately 22% of individuals have destructive periodontal disease.[7] Beyond the financial and quality of life impact periodontal disease has on individuals, there is also a concomitant economic impact on society in terms of lost productivity and revenue. Dental hygienists commonly spend a great amount of time attending to the needs of individuals and communities with gingival and periodontal diseases with the intent of reducing the burden of disease. However, it is not uncommon in private practice for dental hygienists to attend to the direct patient care issues (SRP) and lose sight of how residual disease might affect tooth retention. In many dental offices, the amount of time allotted for dental hygiene treatment, along with third-party reimbursement limitations, can force the clinician to make compromises in the extent and frequency of dental hygiene care. Dental hygienists are fortunate if they have 60-minute appointments in which to provide care. This timeframe has become a standard appointment interval, and was originally supported by the findings of Schallhorn and Snider.[8] In 1981, Schallhorn and Snider determined that routine dental hygiene care consisted of the following: patient greeting, health history update, dental screening, periodontal assessment and recording, plaque index, oral hygiene review, polishing and flossing, scaling and root planing, assessment of caries and defective restorations, chemical therapy (if needed), fluoride rinse, dismissal and reappointment of the patient.[8] In their assessment, no consideration was given to degree of residual disease present, and this study was conducted prior to the development of universal precautions for infection control as well as before adjunctive treatments such as local drug delivery. This begs the question of whether adequate and appropriate periodontal supportive care can be provided within a 60-minute dental hygiene appointment. While these studies do not directly address this dilemma nor suggest what treatment should be rendered, they do provide good longitudinal evidence supporting the need to more aggressively treat residual bleeding pockets. More importantly, they suggest that "watching" a tooth with residual bleeding pockets is not a valid strategy when the goal of therapy is to retain teeth. The results of these two studies do, however, provide evidence to support the following conclusions:

- The primary goal of periodontal treatment is maintenance of a functional dentition and prevention of tooth loss.
- Over time, factors including regular SPT and good plaque control can reduce the odds of periodontal disease progression and tooth loss.
- Following active periodontal treatment, the presence of residual periodontal pockets (both bleeding and non-bleeding) significantly increases the odds for future periodontal attachment loss and tooth loss.
- Interleukin – 1 (IL-1) polymorphism increases the odds of disease progression and tooth loss.

Summary

The practice of dental hygiene is frequently constrained by expectations of the supervising employer and third-party coverage related to procedures and recall intervals. This can put the clinician in a compromising situation where short-term, procedure-based goals outweigh the long-term goal of preserving the dentition. Examining the long-term consequences of residual dis-

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ease (following active treatment) and irregular SPT provides a strong rationale for re-evaluating our current standards of practice. Ultimately, the dental hygienist must advocate on behalf of the patient for effective and appropriate care. This may involve having critical discussions with other members of the dental team about modifying office standards and policy to ensure that new evidence is considered in the provision of treatment and long-term management of patients. As I have stated in previous columns, it is often the dental hygienist who is charged with providing nonsurgical periodontal care and evaluating the results of such care. This puts the dental hygienist in the important role of influencing best practice standards in the dental office. This is most effectively achieved by being knowledgeable of current and developing evidence, focusing on desired outcomes, and being an active advocate for patients in the dental practice.

Keeping an eye on the evolution of scientific evidence is critical if our primary goal is to improve the health status of individuals and communities. Remaining current is no longer an option for clinicians. Engaging in outdated practice standards and relying on knowledge acquired years ago to guide clinical decisions not only threatens oral health of individuals, but threatens the viability of the profession of dental hygiene.

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