# Linking Research to Clinical Practice

## Periodontal Disease and Type 2 Diabetes

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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.

**Periodontal disease and incident type 2 diabetes: results from the First National Health and Nutrition Examination Survey and its epidemiologic follow-up study. Diabetes Care. 31(7):1373-9, 2008 Jul.**

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**Objective:** Type 2 diabetes and periodontal disease are known to be associated, but the temporality of this relationship has not been firmly established. We investigated whether baseline periodontal disease independently predicts incident diabetes over 2 decades of follow-up.

**Research Design and Methods:** A total of 9,296 nondiabetic male and female National Health and Nutrition Examination Survey (NHANES I) participants aged 25-74 years who completed a baseline dental examination (1971-1976) and had at least one follow-up evaluation (1982-1992) were studied. We defined 6 categories of baseline periodontal disease using the periodontal index. Of 7,168 dentate participants, 47% had periodontal index = 0 (periodontally healthy); the remaining were classified into periodontal index quintiles. Incident diabetes was defined by 1) death certificate (ICD-9 code 250), 2) self-report of diabetes requiring pharmacological treatment, or 3) health care facility stay with diabetes discharge code. Multivariable logistic regression models assessed incident diabetes odd s across increasing levels of periodontal index in comparison with periodontally healthy participants.

**Results:** The adjusted odds ratios (ORs) for incident diabetes in periodontal index categories 1 and 2 were not elevated, whereas the ORs in periodontal index categories 3 through 5 were 2.26 (95% CI 1.56-3.27), 1.71 (1.0-2.69), and 1.50 (0.99-2.27), respectively. The OR in edentulous participants was 1.30 (1.00-1.70). Dentate participants with advanced tooth loss had an OR of 1.70 ($P < 0.05$) relative to those with minimal tooth loss.

**Conclusions:** Baseline periodontal disease is an independent predictor of incident diabetes in the nationally representative sample of NHANES I.

### Commentary

There continues to be considerable attention to the link between periodontal infections and systemic diseases, such as cardiovascular disease, adverse pregnancy outcomes, and diabetes. The odds of developing type 2 diabetes doubled between the 1970s and 1990s and current estimates shows that approximately 8% of children and adults in the U.S. have diabetes. Additionally, recent research suggests that there is a bi-directional relationship between periodontal infections and diabetes such that either condition has the potential to exacerbate the other. Much of the current knowledge regarding the association between periodontitis and diabetes has been derived from cross-sectional and case-control designs. The current study is a large follow-up epidemiological study that followed a national sample of individuals who completed the medical examination in the National Health and Nutrition Examination Study I (conducted in 1971-74) for 18 years. Of the original 11,375 participants 9,296 were available for evaluation at the 1982-84, 1987, and 1992 follow-up cycles.

Dental examiners evaluated the periodontal condition of subjects

using an 8-point periodontal index. This index was used to obtain a score on each tooth in the mouth, and then an average score was computed for each individual. In addition, each tooth was scored as decayed, missing, or filled to yield a DMFT score. For statistical analysis purposes, periodontal disease was categorized in 3 ways. First, individuals were grouped with those having a periodontal index score of 0 categorized as healthy and all others grouped based on their percentile periodontal index score or edentate. A second method categorized individuals into one of 3 groups - healthy, gingivitis, or periodontitis. The last method categorized individuals according to the number of remaining based on the assumption that missing teeth is a surrogate marker for periodontal disease in adults. Characterizing periodontal disease in various ways allows the researchers to determine if findings are consistent across the different definitions of periodontal disease. If so, this would give additional credence to the results.

Incident diabetes was determined either by self-report, discharge diagnosis from a health care facility or death certificate with information indicating a history of diabetes. Several other factors were considered in the data collection to account for other possible risk factors for diabetes, and included: demographics such as age, gender, and education; poverty level; body-mass index; skin-fold test; cholesterol level; blood pressure; and cigarette smoking. Logistic regression modeling was used to determine the relationship of periodontal disease to incident diabetes (all new diagnosis over the evaluation period) and for incident cases restricted to > 10 years after baseline to minimize any potential for bias in undiagnosed diabetes at baseline.

The average age of participants was 50 years (S.D. 19) with approximately 84% white and 60% female. During the period between 1971-74 and 1992, 817 new cases of diabetes were reported in this population. Even with other risk factors in the logistic model, there was a consistent relationship between moderate periodontal index scores (> 1.6) on incident diabetes and this effect was similar for models in which incident diabetes was determined across the entire 17–year-period, or whether the incident diabetes was determine > 10 years after baseline. This gives additional support that the relationship is valid for both "operational definitions" of incident diabetes. A similar effect was seen when modeling periodontal disease as healthy, gingivitis, or periodontitis. These results showed statistically significant increased odds of incident diabetes of 40% and 50% for gingivitis and periodontics, respectively. Likewise, participants with 25-32 teeth missing at baseline had a statistically significant increase in incident diabetes (70% greater odds) compared to those with 0-8 missing teeth.

It is important to note that the relationship between periodontal disease and incident diabetes does not suggest that periodontal disease will cause an individual to develop diabetes. However, the longitudinal nature of this study and analytical strategies used to ensure that participants periodontal disease occurred before development of type 2 diabetes give increased weight to the evidence of a relationship. This design along with the large sample is relatively unique in the area of linking systemic health with periodontal disease. However, the authors are clear to caution that it is possible that these results might be explained by a common genetic factor that is jointly related to diabetes and periodontal disease. One factor to also consider is that only nine percent of the 9,296 subjects developed diabetes during the 17-year-period. The results for this study were focused solely on the unique role of periodontal disease and type 2 diabetes. This approach allows the reader to see the consistent pattern of association despite how periodontal disease was measured and when controlling for various combinations of other risk factors. This approach, however, does not allow the reader to determine the relative contribution of periodontal disease compared to other known risk factors. Additionally, the very large sample makes it probable that even a small relationship between periodontal disease and type 2 diabetes will be statistically significant. It is far more important to view the odds ratios presented within the framework of the 95% confidence intervals. For instance, the results found an OR of 2.26 (95% CI 1.56-3.27) for moderate periodontal disease. This suggests that the best estimate of increased odds for having type 2 diabetes is 2.26 times greater compared to no periodontal disease. However, the true value of the OR is likely between 1.56 and 3.27. As evidence continues to be published, it is anticipated that the exact mechanism of this relationship will become increasingly clear. Until that time, it is safe to say that studies examining the relationship between periodontal disease and other systemic health issues are producing fairly consistent findings. The interpretation of the exact nature of the relationship remains to be determined.

**Clinical and laboratory evaluations of non-surgical periodontal treatment in subjects with diabetes mellitus. Journal of Periodontology. 79(7):1150-7, 2008 Jul.**

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**Background:** The aim of this study was to evaluate the clinical

and laboratory changes 3 months after full-mouth scaling and root planing in subjects with and without diabetes mellitus.

**Methods:** This study was performed using 10 subjects with type 2 diabetes mellitus who required insulin therapy (DM) and 10 healthy adult control subjects (NDM) with generalized chronic periodontal disease. Both groups were treated with full-mouth scaling and root planing and given oral hygiene instructions. Clinical parameters, including plaque index (PI), gingival index (GI), probing depth (PD), gingival recession (GR), and clinical attachment level (CAL), were measured at four sites per tooth. Subgingival plaque samples were obtained from sites with the deepest PD (> or =5 mm) and with furcations in each subject. Samples were also tested for the presence of Aggregatibacter actinomycetemcomitans (previously Actinobacillus actinomycetemcomitans), Porphyromonas gingivalis, and Tannerella forsythia (previously T. forsythensis) by polymerase chain reaction. Glycemic control (glycosylated hemoglobin [HbA1c] and fasting glucose levels) and clinical and microbiologic assessments were recorded at baseline and 3 months after periodontal treatment.

**Results:** Data revealed statistical changes (P < or =0.05; analysis of variance [ANOVA]) in clinical variables (PI, GI, PD, GR, and CAL) between baseline and 3 months in both groups. Conversely, no improvement in the fasting glucose level or glycosylated hemoglobin (P < or =0.05; ANOVA) was found after treatment. Besides some reduction in the bacterial frequency 3 months after treatment, no statistically significant difference was found between the groups.

**Conclusion:** Clinical and laboratory responses were similar in DM and NDM groups 3 months after full-mouth scaling and root planing.

## Commentary

As the evidence continues to support the link between periodontal disease and diabetes, clinicians are increasingly interested in whether traditional dental hygiene interventions produce differential results in diabetic patients. In this study, a team of Brazilian researchers investigated whether the clinical effect of conservative non-surgical therapy was different for patients with diabetes compared to non-diabetic patients. These authors propose that the relationship between diabetes and periodontal disease might be related to local factors, systemic factors, or a combination between the two. Local factors such as vascular changes in the periodontal tissues and changes in oral organisms may predispose diabetics to more severe periodontal disease. Research is still equivocal as to whether the periodontal microbiota of diabetics is similar or different in non-diabetics and whether SRP can positively influence blood glucose control. Therefore, this study assessed the impact of SRP on three primary outcomes: clinical response; shift in periodontal pathogens; and blood glucose. A total of 20 subjects (10 individuals diagnosed with Type 2 diabetes and 10 non-diabetics) received full mouth scaling and root planing under local anesthesia in a single, 2 hour session. The article did not state who performed the treatment nor whether there was more than one clinician providing therapy. Subjects also received home care instruction that included toothbrushing, interdental cleaning and use of a tongue scraper. At 2 week intervals, subjects also received professional plaque control throughout the 3 month study.

Data were collected at baseline and 3 months following scaling and root planing. Three subgingival periodontal pathogens were assessed by polymerized chain reaction (PCR) and included Porphyromonas gingivalis (PG), Tannerella forsythensis (Tf), and Aggregatibacter (formerly Actinobacillus) actinomycetemcomitans(AA). Clinical response was measured using pocket depth, gingival recession, clinical attachment level, plaque index, and gingival index. Blood glucose was determined on blood samples by glycosylated hemoglobin (HbA1C) and fasting glucose levels.

Twenty healthy subjects who had at least 20 teeth and a diagnosis of generalized periodontitis (defined as having pocket probing depths > 5mm in > 10 teeth along with radiographic bone loss ranging from 30-50%) participated in this trial. Additionally, they could not have used antibiotics in the past 6 months, had to be non-smokers and generally healthy with respect to other systemic conditions. Subjects in the 2 groups were of similar age (47.1 versus 45.6) for diabetics and non-diabetics, respectively. At baseline, the diabetics periodontal severity was slightly greater than non-diabetics with respect to number of sites with >5 mms (33.6 vs. 20.1), average pocket depth (5.72 vs. 4.79), and average clinical attachment loss (4.49 vs. 4.03). Microbiologically, the diabetic group had similar values for AA and PG, but higher values for TF at baseline. HbA1c concentrations at baseline were significantly different at 9.23 + 2.60 vs. 5.88 + 0.16 for diabetics and non-diabetics, respectively.

At the 3 month observation period, all subject regardless of group showed improvements in plaque scores, gingival index scores, pocket depth, and clinical attachment. The authors reported that there was not a statistically significant difference between the clinical response to treatment over time for the 2 groups; however, the relative magnitude of effect was clearly greater for the non-diabetic group. Results were reported for each of the groups as change from baseline to 3 month for the clinical parameters, but this presentation did not take into ac-

count that the groups were different at baseline. For instance, the results for the average change in clinical attachment for diabetics was from 5.72 to 5.00, and for non-diabetics 4.79 to 3.97. The absolute differences were 0.71 vs. 0.82 for the groups – seemingly no difference. However, if one computes a relative proportion of change, the proportional reduction in probing depth is 12.4 vs. 17.1. – a small but non-significant, differential response. At 3 months, there were no differences between the 2 groups with respect to any of the periodontal pathogens; however, scaling and root planing did result in a significant decrease in TF at sites >5 mms in the diabetic group. Similarly, bi differences were observed between baseline and 3 month values in blood glucose for either diabetics or non-diabetics. This suggests that scaling and root planing in the diabetic group did not have an effect on blood glucose measures 3 months following treatment.

This study failed to show a significant differential effect of scaling and root planing on clinical parameters between individuals with and without type 2 diabetes. Both groups showed clinical decreases in plaque scores, gingival index scores, pocket depths, gingival recession and clinical attachment, which would be expected given the treatment of scaling and root planing coupled with the twice monthly professional plaque control. Only TF was reduced over the study period in individuals with type 2 diabetes, whereas PG and AA levels remained fairly constant. The lack of change in the metabolic parameters on blood glucose (both fasting and HbA1C) from baseline to 3 months may be explained by the sample characteristics. HbA1C is a measure of stable glucose /hemoglobin binding over a 90 day period, with normal reference range values for HbA1C in healthy individuals from 4%-5.9%. The 10 individuals with type 2 diabetes had elevated HbA1C values at the start of the study (9.23 + 2.60) suggesting that their metabolic control was poor at the beginning of the study and remained so throughout the 3 month period. Clearly the possible effect of periodontal intervention on blood glucose management is not sufficient to offset other factors that influence metabolic control. Previous research does suggests that elevated HbA1C values (>10%) over time can have an adverse effect on the periodontal tissues; however, results from this study suggest that controlling periodontal inflammation over time does not influence blood glucose in individuals with poor metabolic control. The authors caution that these results should be viewed within the context of the design and relatively small sample size. As an additional piece to the puzzle of understanding diabetes/periodontal disease link, they nonethe-less provide fodder for thought.

## The Bottom Line

The growing body of evidence investigating the relationship between periodontal disease, type 2 diabetes and metabolic control. Previous studies have demonstrated that diabetes is a risk factor for periodontal disease and that patients with diabetes can influence host response, healing and resistance to periodontal infections. These 2 studies add additional evidence. The first study gives solid support for periodontal disease as a precedent factor using a longitudinal observational study on a representative population using data from the National Health and Nutrition Examination Study (NHANES). NHANES is one of the longest epidemiological studies of American's health. Data are collected using interview, direct medical and dental examinations, specimen collection, and medical record review. Study subjects are selected in such a manner as to ensure that the sample is truly representing the U.S. population based on geography and demographics. Theoretically, each subject in the NHANES study represents approximately 50,000 other Americans. The representative nature of the sample, coupled with the longitudinal manner in which the researchers evaluated subjects over time makes the findings obtained in this study valuable estimates of the relationship between moderate periodontal disease and incident type 2 diabetes. Additionally, the data derived from the second study, while admittedly quasi-experimental and based on a small sample size, is informative about the microbiological effects and clinical effects of an intensive approach to disease management in individuals with poor metabolic control. In both studies, the focus is on individuals with moderate to severe chronic periodontal disease. The clinical implications of both studies for dental hygiene practice may be less directive for treatment planning but more informative for long term patient management. Since periodontal disease appears to be a precedent risk factor in the development of type 2 diabetes, more aggressive management of periodontal disease in patients who possess other risk factors for developing diabetes is likely warranted. Similarly, for patients with type 2 diabetes, integrating information on metabolic control with clinical response to dental hygiene interventions can guide the dental hygienist in setting optimal supportive care intervals over time. Additionally, this knowledge allows the hygienist to play an integral role in educating and motivating patients.

Therefore the following recommendations can be made based on the findings in these 2 studies:

Presence of moderate periodontal disease is an independent risk factor for development of type 2 diabetes over a 17 year span. The odds of incident type 2 diabetes is approximately 2.2 times greater for

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individuals with moderate periodontal disease.

Scaling and root planing, coupled with professional plaque removal every two weeks results in similar improvement of periodontal disease in both healthy and diabetic patients and reduced levels of TF in diabetics.

Professionally delivered periodontal care did not impact blood glucose measures in the sample diabetics with poor metabolic control.

## Summary

Dental hygiene clinicians are in a unique role to assist patients in managing the chronic diseases of periodontitis and type 2 diabetes. In doing so, it is important that the clinician have realistic expectations for the role periodontitis has in type 2 diabetes, as well as the expected outcomes to dental hygiene care in this group of patients. Results from the NHANES study suggests that moderate periodontal disease may predispose individuals to increased risk of type 2 diabetes, but not in isolation of other risk factors. Therefore, comprehensive patient evaluation that includes consideration of risk factors such as age, socioeconomic level, body-mass index, blood pressure and tobacco use, along with periodontal status can provide guidance in establishing appropriate periodontal maintenance intervals. Additionally, although it is critical for individuals with type 2 diabetes to have regular and thorough periodontal maintenance, expecting maintenance alone to achieve metabolic control is unrealistic. The dental hygienist is the primary professional in general and periodontal practice charged with providing non-surgical periodontal care and evaluating the results of such care. In order to provide optimal care and assist patients in achieving best outcomes requires an understanding of current and developing evidence. Evidence on the systemic / periodontal link continues to provide clinicians with excellent information that can guide practice, but it is only when clinician appropriately apply that evidence that patient care is optimized.

*Dr. Williams has been active in clinical dental hygiene for over 35 years and in clinical research for 23 years. Her areas of specialization include research design and statistics, educational methods, dental product efficacy, health outcomes research, and clinical dental hygiene. She is a research consultant for numerous dental manufacturers. Dr. Williams has presented papers and continuing education programs throughout the United States and internationally.*