

## Effect of a training program on periodontal health status in diabetic patients

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### Summary

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#### Purpose

Since systemic inflammation appears to be a major factor of diabetes, periodontitis may be considered a representative site of this general immunological disorder. Diabetes is associated with increased prevalence, severity, and progression of periodontal diseases. The prevalence of diabetes is more than twice as high in patients with periodontitis compared to healthy subjects. Periodontal disease may contribute to systemic inflammation and worsening insulin resistance and glycemic control due to the generation of inflammatory cytokines. Physical exercise may be helpful to increase insulin sensitivity and to improve glucose metabolism. Further moderate endurance exercise may improve resistance against infectious diseases. The aim of this study was to determine the effects of physical exercise on periodontal inflammation in diabetics with periodontal diseases.

#### Methods:

14 good controlled type 2 diabetics were examined before and after 6 months of moderate recreational training 2 times a week. A self-reported oral hygiene and health questionnaire was completed. All subjects had a clinical dental examination, including plaque index and gingivitis index, probing depth, clinical attachment loss and Periodontal Screening Index.

#### Results:

There were no significant changes in weight and HbA1c. Overall dental hygiene was not changed. Insignificantly improved values were found for clinical attachment loss and loss of insertion. The periodontal screening index (PSI) was significantly decreased by 8%. The periodontal bleeding index 3 (PBI) was significantly reduced to 39% of pre-training score values. The number of probing pocket depth sites >5 mm or >6mm was highly significantly reduced to 61% or 23%, respectively. The gingival index (GI) was highly significantly reduced to 61%.

#### Conclusions:

A six months rehabilitative exercise training had only minor effects on body weight and HbA1c values. Unexpectedly the major effects were related to a relevant improvement of indices of periodontal inflammation. The results may indicate that a consequent training regimen in diabetics may improve the systemic inflammatory status of the patients. It is known that physical training improves the immune status including cellular defense of the gingival tissues. Diabetes reduces the local gingival defense and enhances the severity of periodontal disease. It appears that chronic physical exercise may act as an antagonist against these undesirable effects.

**Key words:** diabetes, periodontal disease, inflammation, rehabilitative training, physical exercise, sports

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### Introduction

Periodontal disease is considered a chronic complication of diabetes mellitus. Since systemic inflammation appears to be a major factor of diabetes, periodontitis may be considered a representative site of this general immunological disorder. The prevalence of diabetes mellitus is more than twice as high in patients with periodontitis compared to healthy subjects. Diabetes is a disease that frequently causes multiple comorbidities. Periodontal disease and other oral pathologies (gingivitis, candidiasis, oral malignancies etc.) are frequent

complications of diabetes. The diagnosis and control of periodontal disease with its adverse effects on insulin resistance through the generation of inflammatory cytokines can have a major impact on diabetes control. A large body of information exists, showing that prevention, early diagnosis and consequent treatment of periodontal disease may have a major impact on the control of diabetes. Severe periodontal disease causes attachment loss, alveolar bone loss and tooth loss, extending beyond the local level to produce systemic effects. It exacerbates

the inflammatory milieu, increases insulin resistance, and potentially worsens cardiovascular disease. Severe periodontitis is a risk factor for early death due to ischemic heart disease or renal dysfunction independent of diabetes, increasing the risk 3.2 fold as compared with those with none, mild, or moderate periodontitis (10). There is a direct causal or modifying relationship in which poor glycemic control results in more severe periodontitis (3). The worsening effects of diabetes on periodontal inflammation are well known. Studies also indicate a correlation between periodontal inflammation on diabetic balance and insulin resistance syndrome (1,5,6). This

evidence points to a vicious cycle in which diabetes and periodontitis exacerbate one another. Periodontal treatment may improve diabetes control measured as a reduction in glycated hemoglobin (2,9). Physical exercise has been shown to be an important adjunct in diabetes therapy because its beneficial effect on insulin resistance and glucose metabolism. Further moderate endurance exercise may improve resistance against infectious diseases. However, we are not aware of any studies which have looked for effects of physical exercise training on periodontal inflammation in diabetic patients.

## Methods

14 good controlled type2 diabetic subjects ( $58 \pm 5.9$  years, weight  $101 \pm 19$  kg, height  $173 \pm 9.7$ cm, BMI  $33.8 \pm 5.9$ , HbA1c  $6.9 \pm 0.8\%$ ) with periodontitis (2 or more teeth with pockets  $\geq 5$  mm, mean  $18.5 \pm 13.4$  teeth) participated in this study. 7 of these patients had an oral medication and 7 an insulin therapy.

All subjects had a clinical oral examination for gingival index (GI), papillary bleeding index (PBI), periodontal screening index (PSI), probing pocket depth (PPD), which was measured by probing around each tooth with a ball-point probe. For the analyses, the values of the worst 6 sites of the tooth were taken. Two training sessions weekly were performed, one with 45 min of endurance training (cycle-ergometer, tread mill, rowing)

and 15 min of pulley exercises, the 2<sup>nd</sup> with 45 min of moderate swimming. Before, after each training and also after special training units heart rate, blood pressure, blood glucose, and load in watt were measured. Data baseline and after  $6.2 \pm 2.4$  months of training were analysed. A self-reported oral hygiene questionnaire was completed before clinical examination at baseline and follow. Levels of self-care were estimated using oral health behaviour items included frequencies and time amount of tooth brushing, approximal cleaning, use of mouth rinses and dental visiting. The dental self-efficacy scale was designed by Syrjälä (12), who modified items of the self-efficacy scale developed by Lawrence (4).

## Results

### Body composition and metabolic parameters

Weight, body mass index: Weight before and after the training period was  $101 \pm 19$ kg vs.  $100 \pm 19$ kg ( $p < 0.075$ ). The respective BMI values were  $33.8 \pm 5.9$  and  $33.4 \pm 5.9$  respectively.

HbA1c: A small but significant decrease in HbA1c values occurred ( $6.8 \pm 0.8\%$  vs.  $6.6 \pm 0.77\%$  ( $p < 0.02$ ))

Number of teeth:  $18.5 \pm 13.4$

### Oral hygiene parameters (baseline vs. training period)

Frequency of tooth brushing per day:  $1.9 \pm 0.36$ , no change after 6 months

Time amount for tooth-brushing per day:  $5.7 \pm 2.1$  min vs.  $5.6 \pm 2.2$  (n.s.)

Daily use of interdental cleaning devices:  $0.5 \pm 0.9$  vs.  $0.4 \pm 0.9$  times per day

Daily use of mouth rinses:  $1.1 \pm 0.7$  vs.  $1.1 \pm 0.8$  (n.s.)

### Training parameters (baseline vs. training period)

Endurance capacity increased from  $40 \pm 15.7$  W to  $79 \pm 17.1$  W ( $p < 0.0002$ ).

### Periodontal parameters (baseline vs. training period)

Periodontal screening and recording (PSR) score: The means of PSR scores decreased significantly from  $3.3 \pm 0.8$  bzw.  $3.0 \pm 0.7$  ( $p < 0.05$ )

### Papillary bleeding index (PBI) (Saxer & Mühlemann 1975):

- Number of teeth with profuse bleeding into the approximal area (code 3): Significant decrease from  $4.4 \pm 4.5$  to  $1.7 \pm 2$  ( $p < 0.016$ ).

### Probing pocket depth (PPD):

- PPD 5mm: The reduction from  $17.4 \pm 13.5$  to  $10.6 \pm 10.3$  ( $p < 0.005$ ).
- PPD 6mm: The number of 6mm pockets decreased from  $4.6 \pm 5.0$  to  $1.1 \pm 1.2$  ( $p < 0.005$ ).

Gingival index (GI): This score decreased extremely significant from  $2.6 \pm 0.5$  to  $1.6 \pm 0.9$  ( $p < 0.0005$ ) (highest score is 3).

## Discussion

A six months rehabilitative exercise training two times a week had only minor effects on body weight and HbA1c values. Unexpectedly the major effects were related to a significant improvement of periodontal inflammation and endurance capacity. The improvement of the periodontal indices cannot be referred to a change in oral hygiene practices. Thus the major reason for the gingival improvement must be the higher physical activity level. It is known that physical training improves the immune status including cellular defense of the gingival tissues. The association of diabetes and periodontal disease may be due to numerous physiological phenomena found in diabetes (impaired resistance, vascular changes, abnormal collagen metabolism). The periodontal pathogen bacteria cause a chronic local low-grade

inflammation and contribute to systemic inflammation. This is reflected by higher circulating levels of inflammatory markers such as C-reactive protein, IL-6 and TNF- $\alpha$ , the latter being responsible for worsening insulin resistance and diabetes (6). IL-6 which often has been seen as cause of chronic inflammation may rather be seen as a marker or even an anti-inflammatory agent (7,8). Exercise may induce increased levels of anti-inflammatory cytokines (IL-10, IL-6), and cytokine inhibitors (IL-1 and TNF- $\alpha$  receptor antagonist). Acute exercise causes an increase of IL-6 depending on exercise intensity and duration (7,11). It is suggested that an increase of IL-6 two times a week due to the training may improve the overall immune status.

## Conclusions

A six months rehabilitative exercise training in type 2 diabetic patients had only minor effects on weight and HbA1c and induced a significant improvement of endurance capacity and periodontal inflammation indices.

The results may indicate that a consequent exercise training regimen in diabetics may improve the systemic inflammatory status of the diabetic patients assessed by periodontal inflammation markers.

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