Diabetes and Periodontal Diseases

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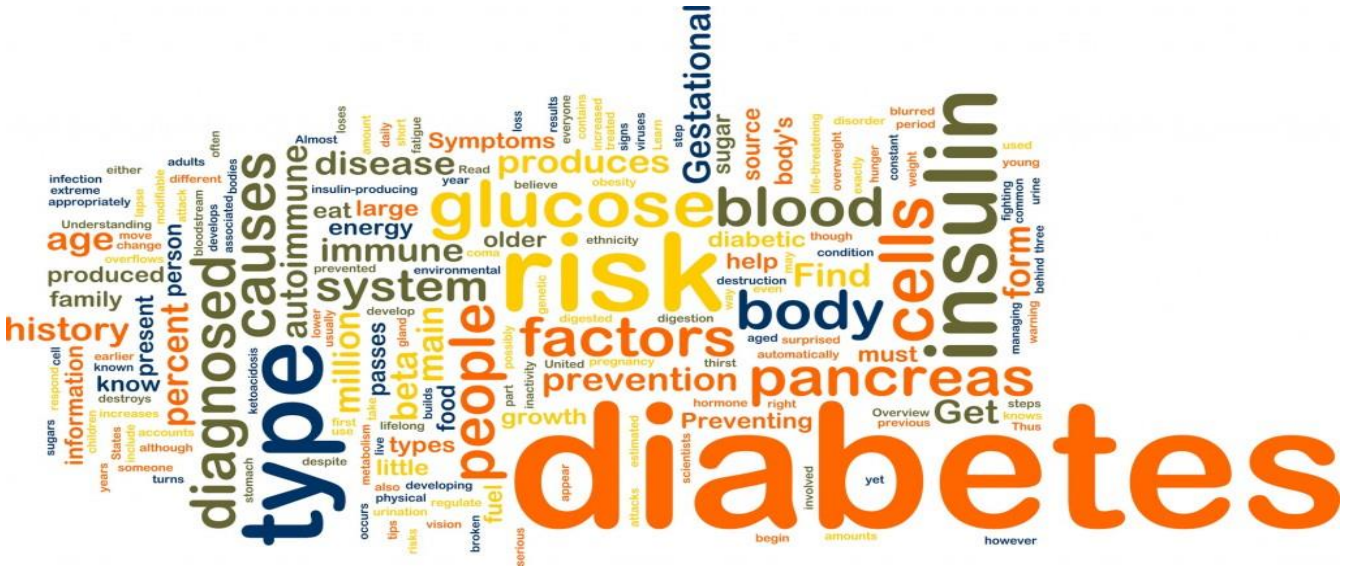
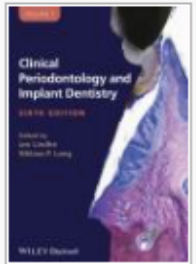


Dr Leticia A Miranda & Dr. Pradeep Koppolu

Reading Resources

Clinical Periodontology and Implant Dentistry, 2 Volume Set



by Niklaus P. Lang, , Jan Lindhe, , and Niklaus P Lang

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SECTION V: CONDITIONS AFFECTING THE PERIODONTAL PATIENT

CHAPTER 25

Influence of Systemic Conditions on the Periodontium

Perry R. Klokkevold | Brian L. Mealey | Yvonne L. Hernandez-Kapila

For expanded discussions on female sex hormones, genetic disorders, and nutritional influences on periodontal disease as well as online-only content on hyperparathyroidism, anemia, thrombocytopenia, antibody deficiency disorders, and other systemic conditions, please visit the companion website at eBooks.Health.Elsevier.com.

JDR Centennial Series

Periodontal Medicine: 100 Years of Progress

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2019, Vol. 98(10) 1053–1062

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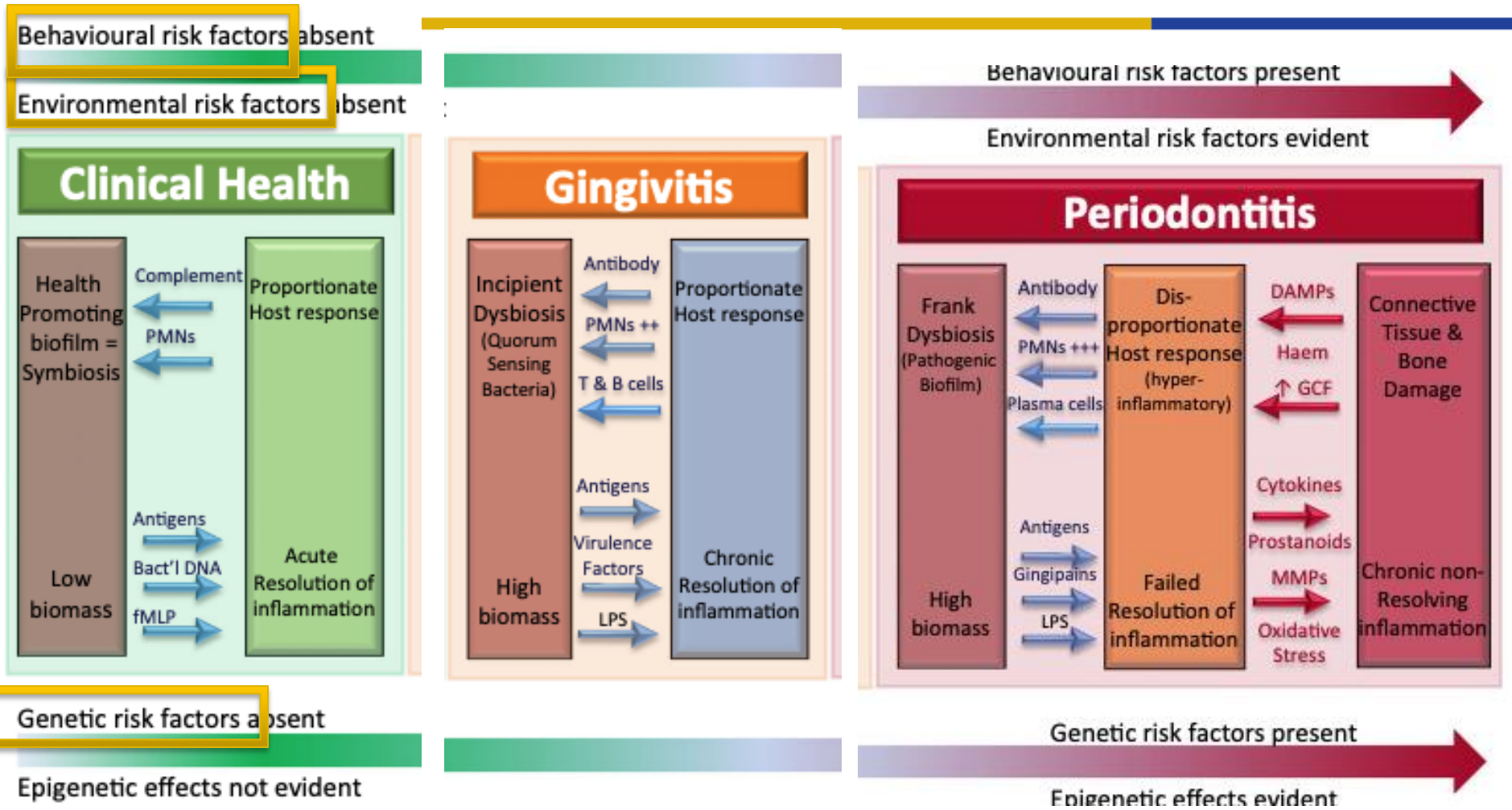
journals.sagepub.com/home/jdr

J.D. Beck[1], P.N. Papapanou[2], K.H. Philips[3], and S. Offenbacher[1]

Current etiopathogenesis model



Chapple 2015

Although dental plaque accumulation is a cause of periodontal disease, it may not be a sufficient cause since some individuals have large accumulations of dental plaque and suffer little periodontal disease, while others have very little plaque accumulation and suffer severe periodontal disease. It appears then that risk factors are important in periodontal disease; determining who develops the disease, the severity of the disease the individual develops, which sites in the dentition are affected, the rate of progression of the disease, the response to therapy, and the recurrence rate. In assessing risk, the probability that a disease outcome will occur following a particular exposure is estimated (Last, 2001).

Risk factors (behavioural, environmental and genetic), have the potential to **modify** patient's response to the presence of dental biofilm.

This is important because periodontal tissue destruction in periodontitis fundamentally results from the body's response to plaque rather that the plaque itself (Page and Schroeder, 1976).

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What is a risk factor?

A risk factor can be an aspect of personal behaviour or life style, an environmental exposure, or an inborn or inherited characteristic that changes the susceptibility to periodontal disease. It can also be a local factor which increases the infection of a site.

Types of risk factors for periodontal disease

There are two major classes of risk factors for periodontal disease.

1 *Local factors* such as overhanging restorations and root caries that tend to allow for plaque accumulation and hence result in more periodontal disease. Other local risk factors for periodontal disease include pocket depth, intrabony pockets especially involving furcations, and root canal infections.

2 *Systemic factors* that affect the entire body, such as cigarette smoking, diabetes mellitus and genetic factors (Table 10.2).

Other used terms

Predisposing Factors

- Predisposing factors might increase the probability of disease occurrence and usually have localised effects.
- These factors include anything, which retains or **hinders the removal of dental plaque:**
  - dental calculus
  - overhangs restorations,
  - subgingival restorations,
  - subgingival restoration margins,
  - open contact points,
  - partial dentures,
  - tilted/rotated/crowded teeth,
  - bulbous crowns,
  - grooves on teeth and more.

Modifying Factors

- Modifying factors tend to act in a systemic fashion, which will alter the nature of a disease.
- A **modifying factor can alter the nature or course of the inflammatory response to the plaque by modifying:**
  - The susceptibility of disease,
  - Plaque microbiota,
  - Clinical presentation of periodontal disease,
  - Disease progression and
  - Response to treatment

SYSTEMIC MODIFYING FACTORS FOR PERIODONTAL DISEASE

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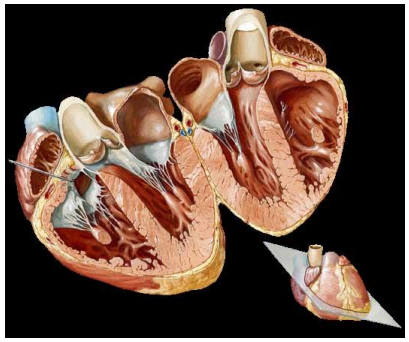
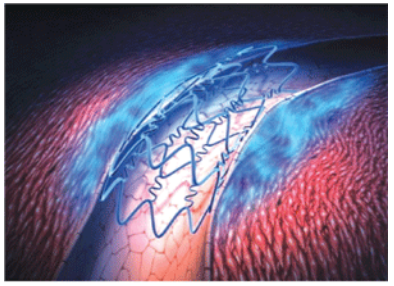
Diabetes **Smoking**
Puberty **Menopause**

Pregnancy

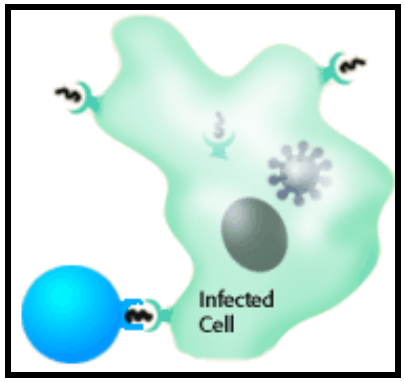
EFFECTS ON

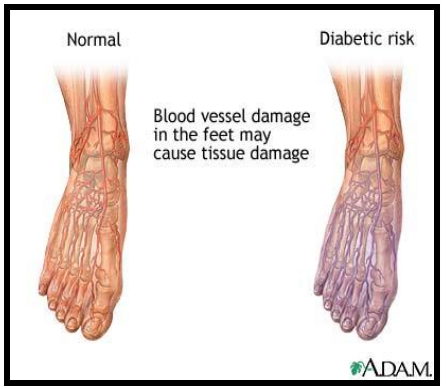
- **Physiological response**
- **Vascular system**
- **Inflammatory response**
- **Immune system**
- **Tissue repair**
- **Microbiota?**



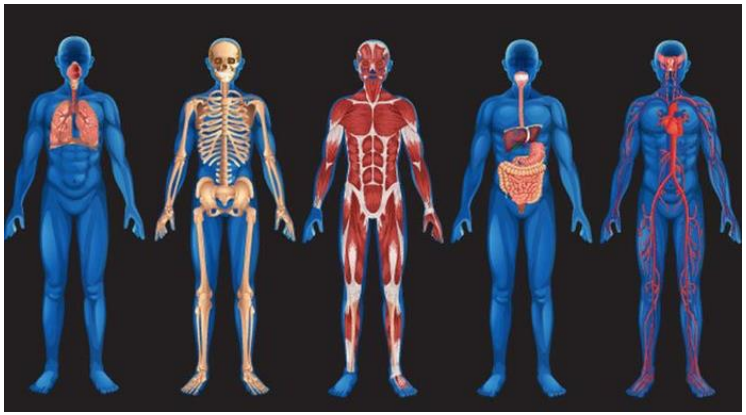


The CYPHER™ stent emits the drug Sirolimus inside an artery. This prevents reblockage of the artery.





Periodontal Medicine



Definition of periodontal medicine

We view the term periodontal medicine, as first suggested by Offenbacher (7), to be a broad term that defines a rapidly emerging branch of periodontology focusing on the wealth of new data establishing a strong relationship between periodontal health or disease and systemic health or disease. This means a two-way relationship in which periodontal disease in an individual may be a powerful influence on an individual's systemic health or disease as well as the more customarily understood role that systemic disease may have in influencing an individual's periodontal health or disease. Logically included in this definition would be new diagnostic and treatment strategies that recognize the relationship between periodontal disease and systemic disease.

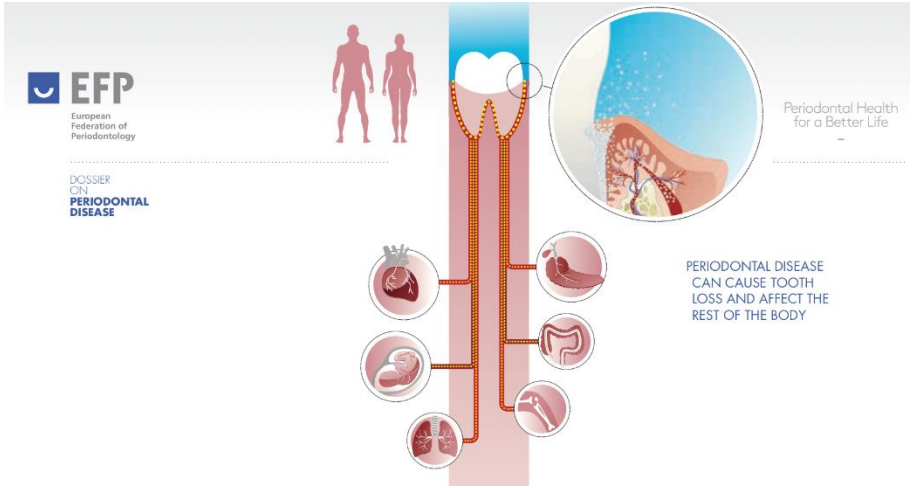
Willians & Offenbacher 2000

Periodontal Medicine

SYSTEMIC DISEASES → PERIODONTITIS

More than a 100 systemic diseases/conditions and 500 medications have oral manifestations. Kane, 2017

SYSTEMIC DISEASES ← PERIODONTITIS



DIABETES

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High level of blood glucose due to absolute or relative lack of hormone insulin

TYPE 1 DM:

- Autoimmune destruction of pancreatic β-cells
- Leads to total loss of insulin production
- Usually diagnosed in children and adolescents

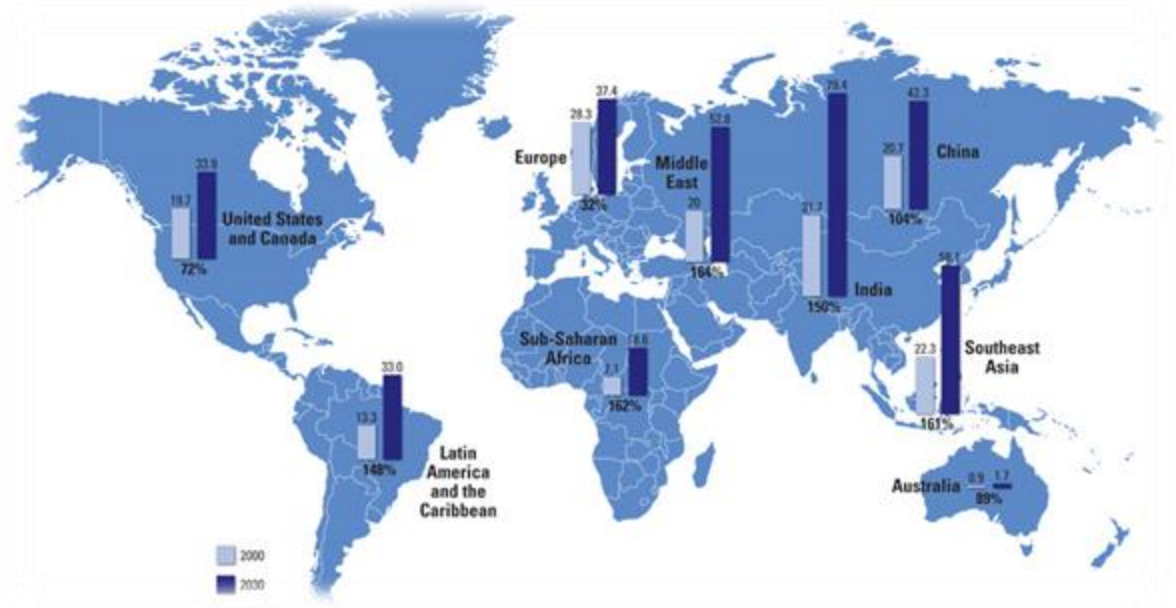
TYPE 2 DM

- Develop resistance to insulin with reduced β-cell function
- Reduced insulin production, but retains ability for some insulin production
- After 40 years old & associated with obesity

GESTATIONAL

PREVALENCE OF DIABETES

- **Over 250 million worldwide** (2007)
- Rates have doubled over past 20 years

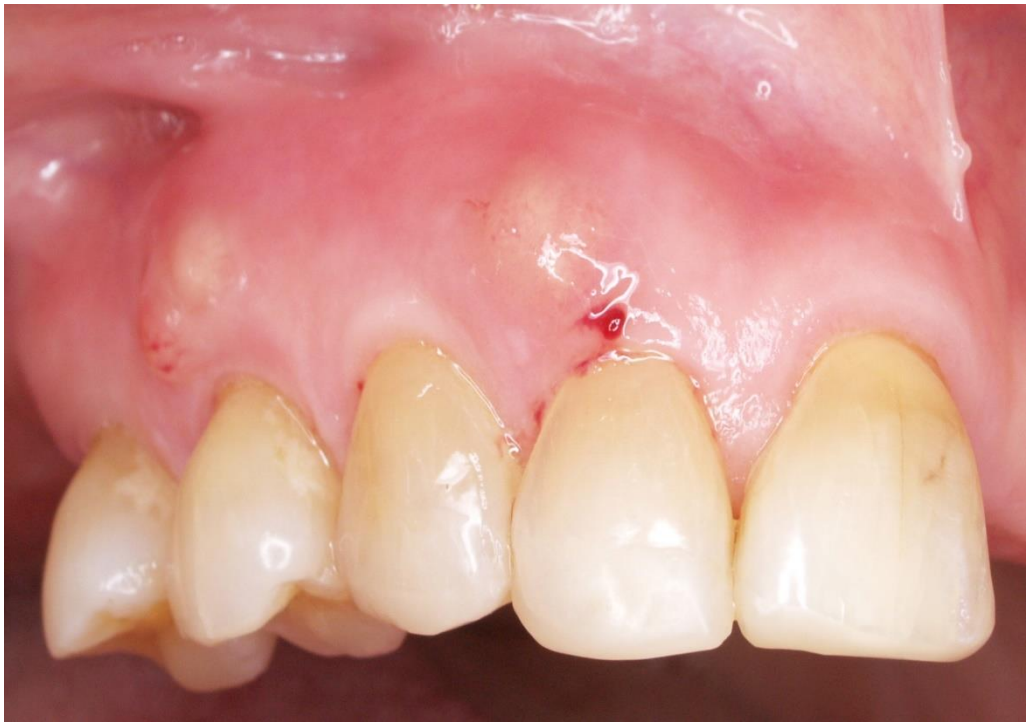


www.worlddiabetesday.org

CLINICAL SYMPTOMS

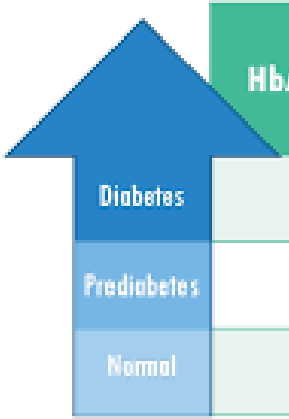
- FATIGUE
- INFECTIONS
- VISION ALTERATION
- WEAKNESS
- HYPERGLYCEMIA
- PRURITUS (Itchy)
- POLYPHAGIA (xs eating)
- POLYURIA

PERIODONTAL ABSCESS



Diabetics are more susceptible to periodontal abcesses (Ueta et al 1993)

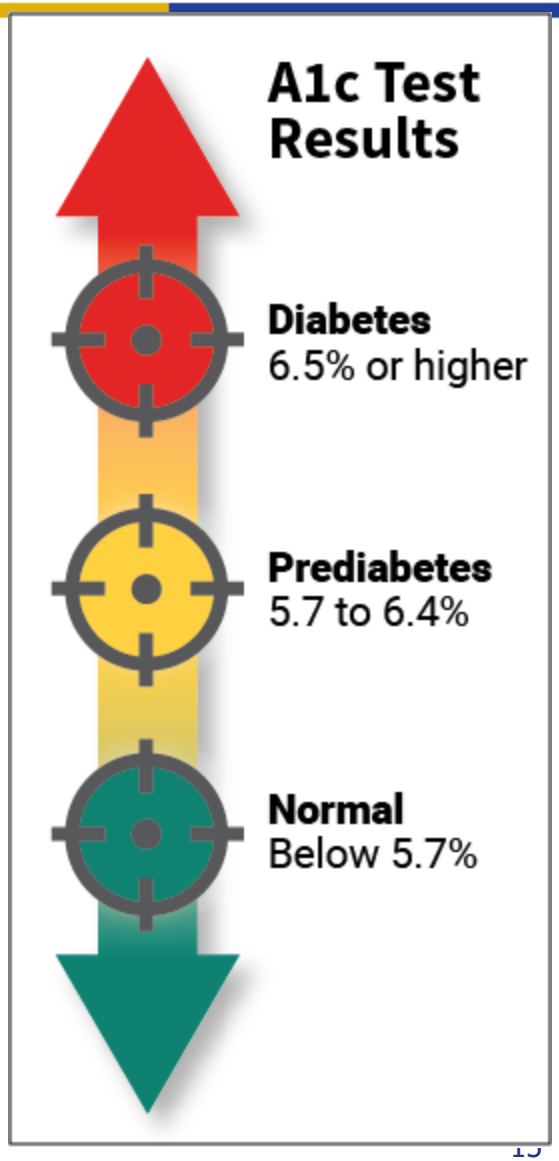
DIAGNOSIS & SCREENING



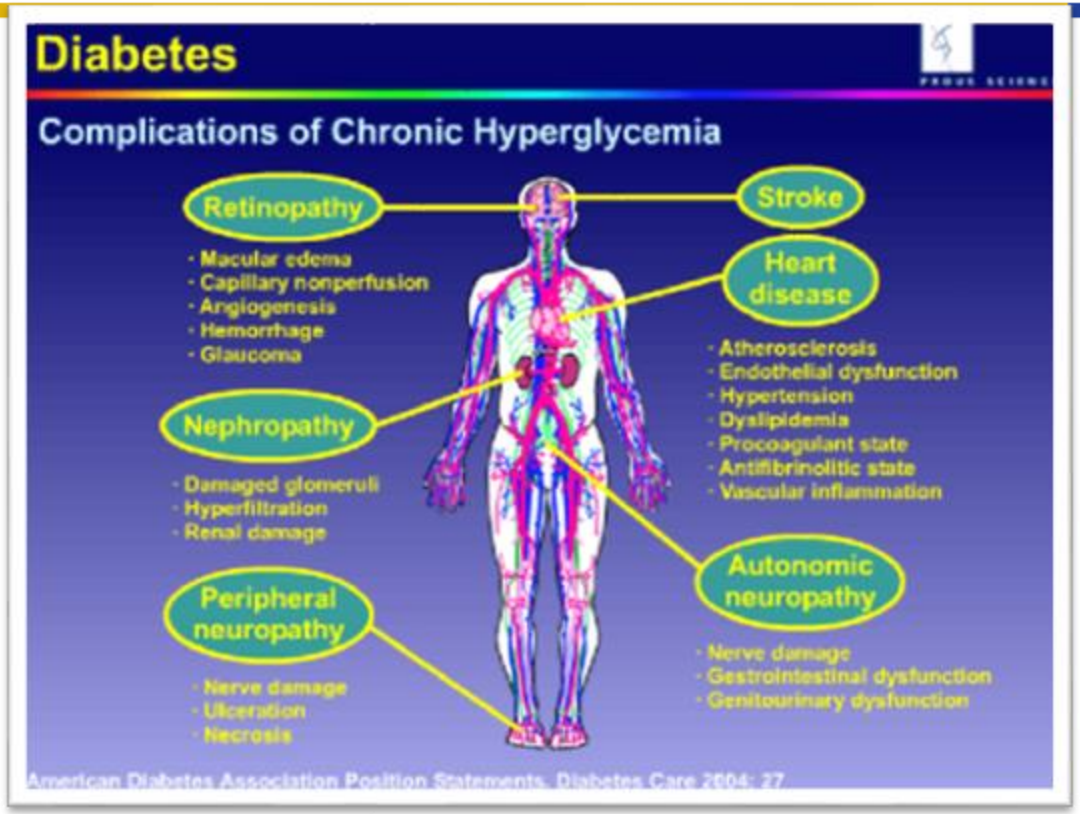
	HbA1c (percent)	Fasting Plasma Glucose (mg/dL)	Oral Glucose Tolerance Test (mg/dL)
Diabetes	≥ 6.5	≥ 126	≥ 200
Prediabetes	5.7 – 6.4	100 - 125	140 – 199
Normal	~ 5.7	≤ 99	≤ 139

HOW TO MEASURE GLYCEMIC CONTROL

- GLYCOSYLATED HAEMOGLOBIN MOLECULE (HbA1c)
- BINDING OF GLUCOSE TO HEMOGLOBIN
- % HbA1c INCREASES WITH HIGHER SERUM GLUCOSE DURING LIFE OF RBC
- LIFE SPAN OF RBC – 100-120 DAYS
- New measurements at 3-4 months



COMPLICATIONS AND TREATMENT



PERIODONTAL DISEASE **has been called the 6th complication of diabetes**
(Löe 1993)

Tratamento

- Redução das taxas de glicose a fim de prevenir sinais/sintomas e complicações
  - Controle glicêmico - manutenção de níveis controlados a fim de prevenir complicações

RELATIONSHIP BETWEEN DIABETES & PERIODONTAL DISEASE

RELATIONSHIP BETWEEN DIABETES & PERIODONTAL DISEASE

- Approximately **40%** of adult Pima Indians in Arizona have type 2 diabetes.

- A comparison of individuals with and without diabetes in this Native American tribe showed a clear increase in the prevalence of destructive periodontitis as well as a **15%** increase in edentulousness among patients with diabetes

RELATIONSHIP BETWEEN DIABETES & PERIODONTAL DISEASE

- Periodontitis' prevalence is increased in diabetics
- 2.8-3.4X increase in risk for periodontitis
- Poorly controlled (type 2 DM) had X11 increased risk for periodontitis compared to non-diabetic
- Glycemic control is related to periodontitis in a dose-response manner (the level of hyperglycemia is related to periodontitis)
- Diabetics with complications have poorer periodontal conditions
- Well controlled diabetics had similar risk for periodontitis to non-diabetics

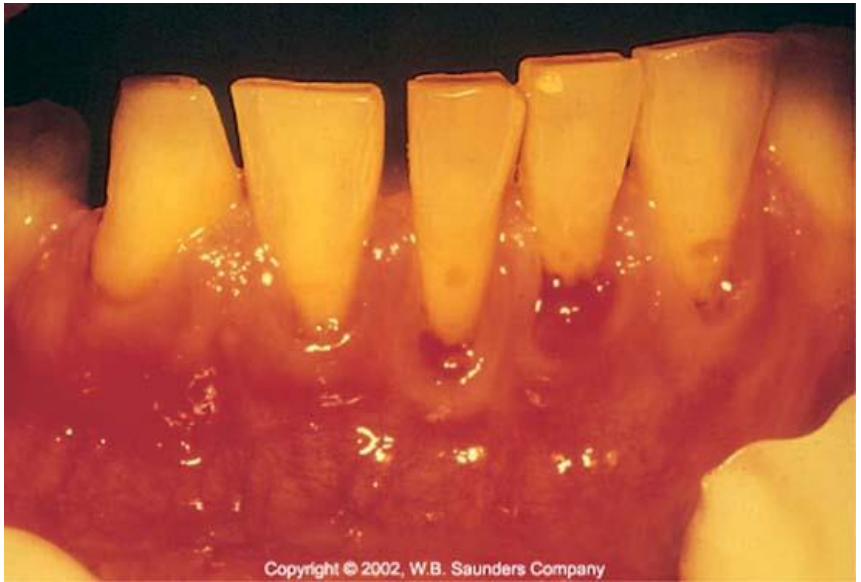
Diabetes → Periodontitis

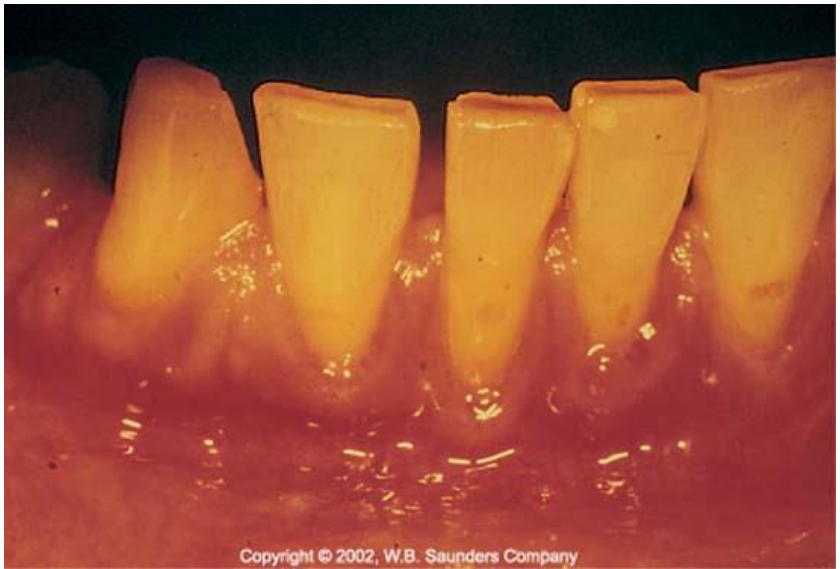
–Degree of glycemic/metabolic control

– Age

– Duration of DM

–Severity of DM - Complications





WHY ARE DIABETICS MORE SUSCEPTIBLE TO PERIODONTAL DISEASE?

DO DIABETICS HAVE DIFFERENT BACTERIA?

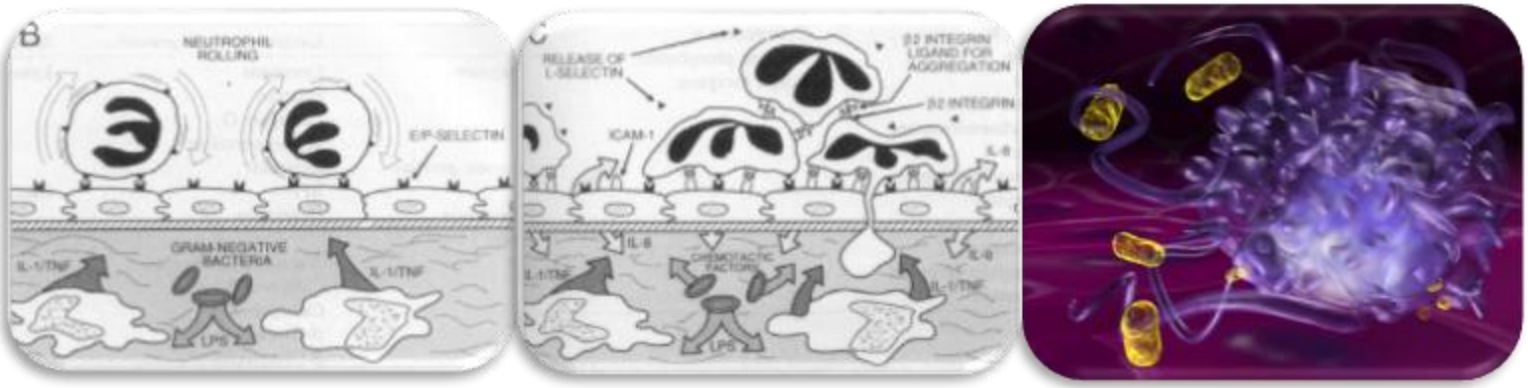
- Earlier studies in 1980s & 1990s (using culture) found higher levels of SPIROCHETES & MOTILE RODS in diabetics (vs healthy controls)
- More recent studies (using molecular techniques such as PCR) found similar levels of putative periodontal pathogens between diabetics & non-diabetics
- ***CONCLUDE: increase in susceptibility to periodontal disease in diabetics is NOT due to differences in composition of the microbiota***

HOST RESPONSE IN DIABETICS

Impaired neutrophil function:

- Impaired neutrophil adherence, chemotaxis & phagocytosis
  (produce less oxygen radicals)

- **Bacteria persists in periodontal pocket**



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Polymorphonuclear Leukocyte Function

The increased susceptibility of patients with diabetes to infection has been hypothesized as being caused by **polymorphonuclear leukocyte (PMN)** deficiencies that result in impaired **chemotaxis**, defective **phagocytosis**, or impaired **adherence**.[177,253] In patients with poorly controlled diabetes, the functions of PMNs, monocytes, and **macrophages** are impaired.[124] As a result, the primary defense mounted by PMNs against periodontal pathogens is diminished, and bacterial proliferation is more likely. No alteration of **immunoglobulin** A (IgA), G (IgG), or M (IgM) has been found in patients with diabetes.[219]

HOST RESPONSE IN DIABETICS

- Impaired immune response in periodontium of diabetics suggested in 1960s
- Structural changes: with sustained hyperglycemia, proteins become irreversibly glycated to form advanced glycation end products (AGEs)
- Formation of AGEs also occurs in the periodontium
- Higher levels found in diabetic patients
- AGEs activate a receptor known as **"receptor for AGEs" (RAGE)** found on the surface of smooth muscle cells, endothelial cells & monocytes/macrophages & gingival tissues of type 2 diabetics
- Hyperglycemia results in increased RAGE expression

(Frantzis et al. 1971; Schmidt et al. 1996; 1999)

Altered Collagen Metabolism

Chronic hyperglycemia impairs collagen structure and function, which may directly impact the integrity of the periodontium. Decreased collagen synthesis, osteoporosis, and a reduction in alveolar bone height have been demonstrated in diabetic animals.[97,233]

Chronic hyperglycemia adversely affects the synthesis, maturation, and maintenance of collagen and extracellular matrix. In the hyperglycemic state, numerous proteins and matrix molecules undergo a nonenzymatic glycosylation, thereby resulting in ***advanced glycation end-products (AGEs)***. The formation of AGEs occurs at normal glucose levels as well; however, in hyperglycemic environments, AGE formation is excessive. Many types of molecules are affected, including proteins, lipids, and carbohydrates. Collagen is cross-linked by AGE formation, which makes the collagen less soluble and less likely to be normally repaired or replaced. Cellular migration through cross-linked collagen is impeded, and, perhaps more importantly, tissue integrity is impaired as a result of damaged collagen that remains in the tissues for longer periods (i.e., collagen is not renewed at a normal rate).[113] As a result, collagen in the tissues of patients with poorly controlled diabetes is older and more susceptible to pathogenic breakdown (i.e., less resistant to destruction by periodontal infections).

AGEs and receptors for AGEs (RAGEs) play a central role in the classic complications of diabetes,[36] and they may play a significant role in the progression of periodontal disease as well. Poor glycemic control, with the associated increase in AGEs, renders the periodontal tissues more susceptible to destruction.[232] The cumulative effects of altered cellular response to local factors, impaired tissue integrity, and altered collagen metabolism undoubtedly play a significant role in the susceptibility of patients with diabetes to infections and destructive periodontal disease.

AGE-RAGE Interaction

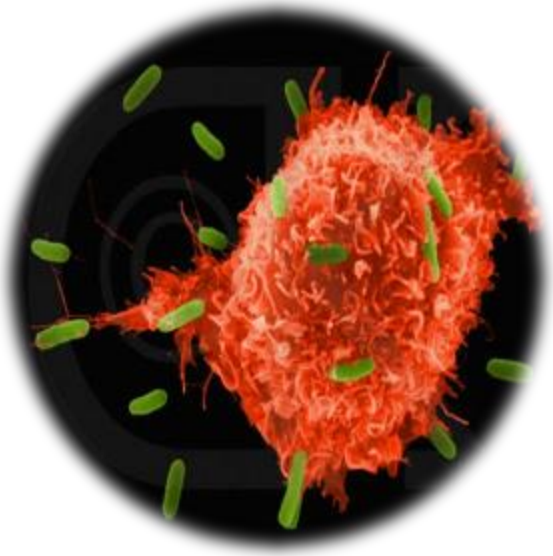
- Stimulates monocytes & macrophages to proliferate, upregulate pro-inflammatory cytokines such as IL-1β, PgE2 and TNF-α & produce free O2 radicals
- These free 02 radicals & pro-inflammatory cytokines contribute to the pathogenesis of periodontal disease
- Direct cell/host damage

(Schmidt et al. 1996; 1999; Engebretson et al. 2004; Katz et al. 2005)

HOST RESPONSE IN DIABETICS

- **Higher levels of inflammatory cytokines & mediators found in GCF of diabetics**

- **Monocytes & macrophages with a destructive phenotype**



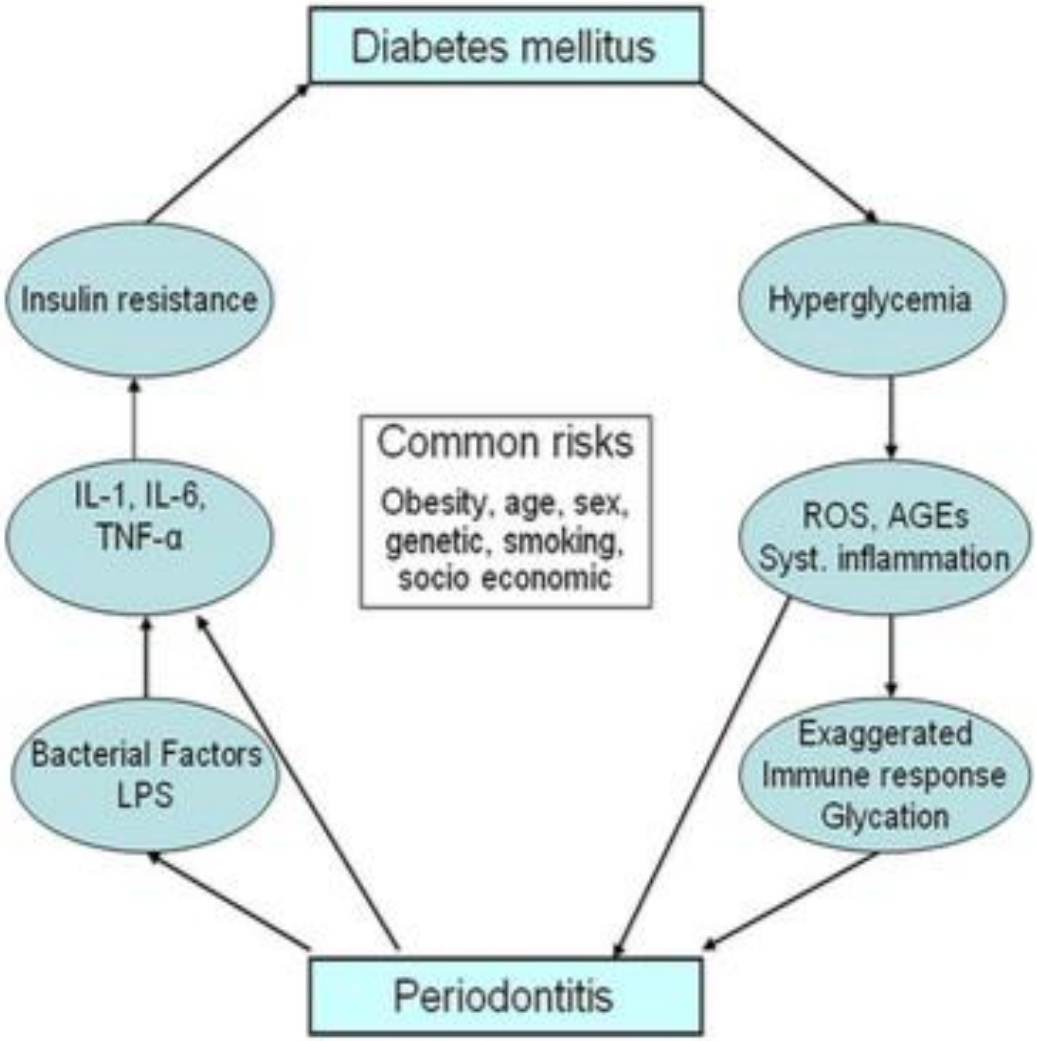


FIGURE 2 Conceptual model connecting diabetes with periodontitis, and showing possible pathogenic factors and risk factors. AGEs, advanced glycation end-products; IL, interleukin; LPS, lipopolysaccharides; ROS, reactive oxygen species; TNF-α, tumor necrosis factor-alpha

Kocher et al 2018

HEALING RESPONSE

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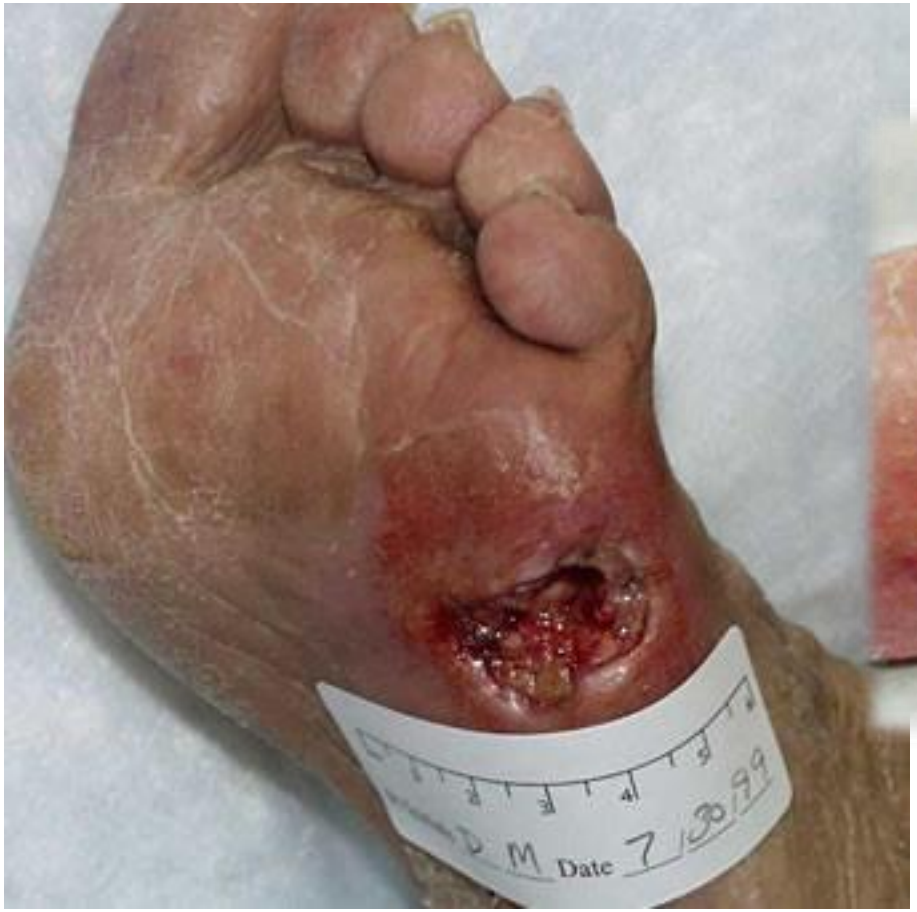
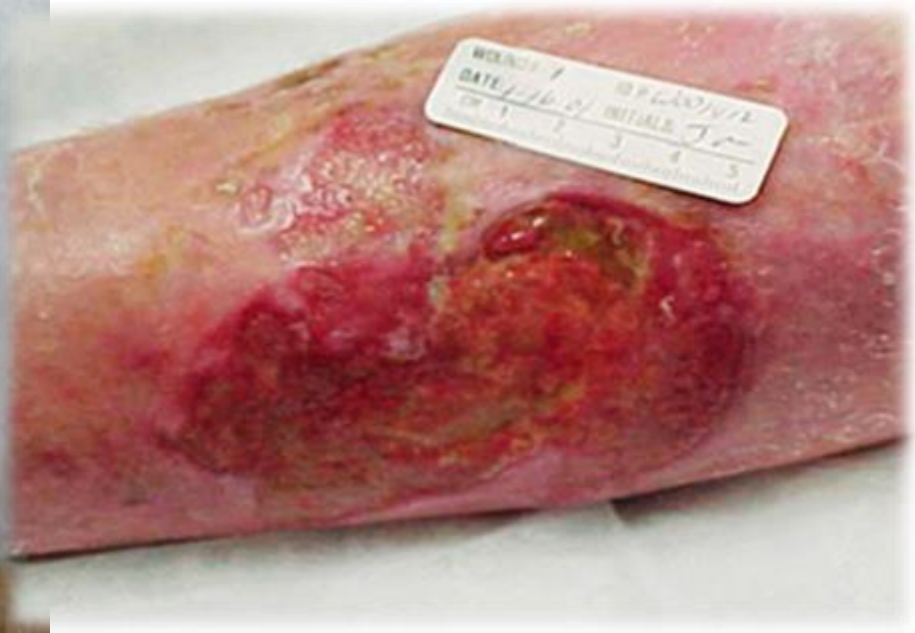
In a hyperglycemic state, repair process in periodontium is compromised due to:

- **Gingival fibroblasts produce less collagen & more MMPs**
- **Recently synthesized collagen is rapidly degraded by elevated levels of active MMPs**
- **Decreased osteoblast proliferation & collagen production**
- **Increased rate of apoptosis of fibroblasts & osteoblasts**

(Loder 1988; Inaba et al. 1999; Lu et al. 2003; Gooch et al. 2000; He et al. 2004; Liu et al. 2004)

HEALING RESPONSE



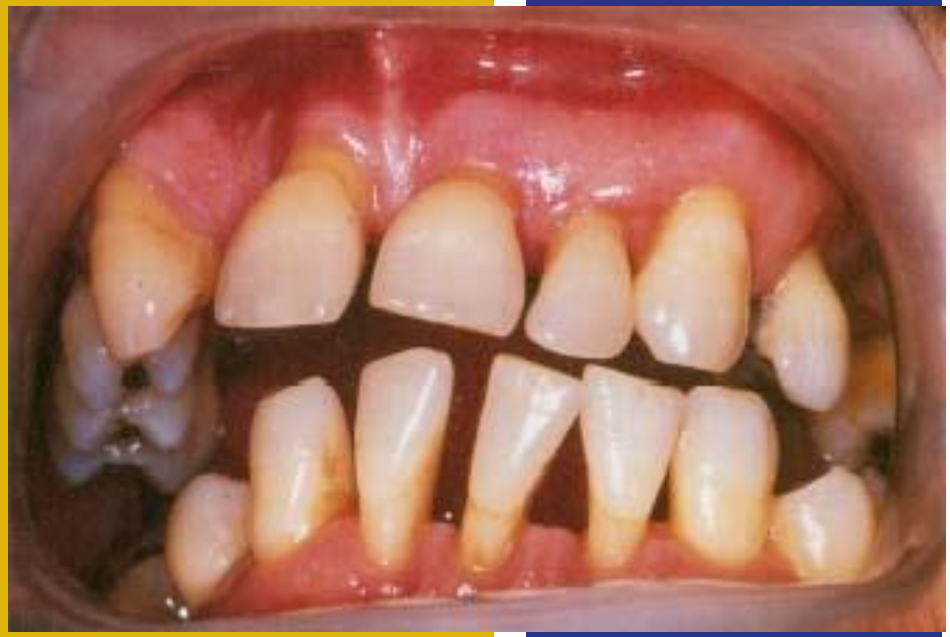


HOST RESPONSE IN DIABETICS

Together, the impaired immune response, poorer healing & increased destruction may explain the greater propensity of diabetics to have more severe periodontal disease

(Loder 1988; Inaba et al. 1999; Lu et al. 2003; Gooch et al. 2000; He et al. 2004; Liu et al. 2004)

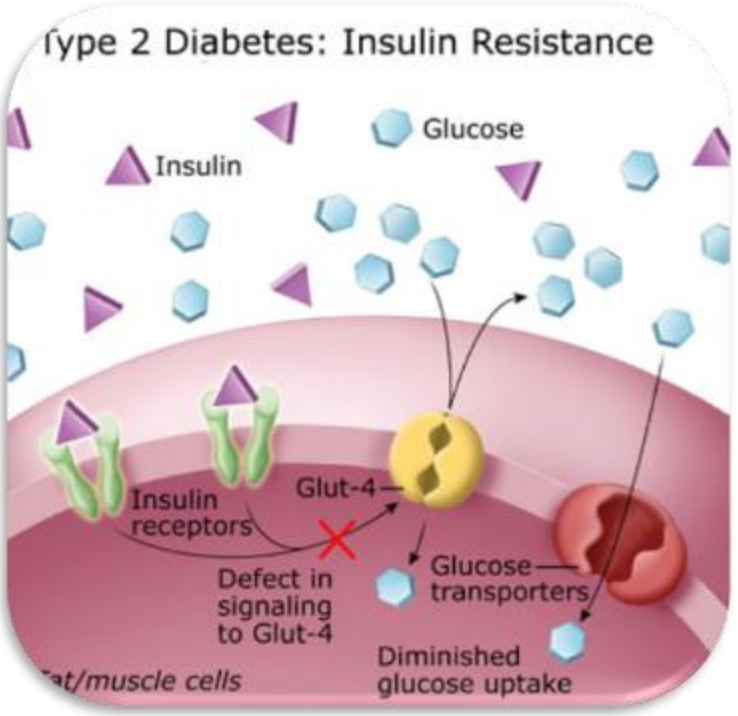
INFLUENCE OF PERIODONTAL DISEASE ON DIABETES



INFLUENCE OF PERIODONTAL DISEASE ON DIABETES

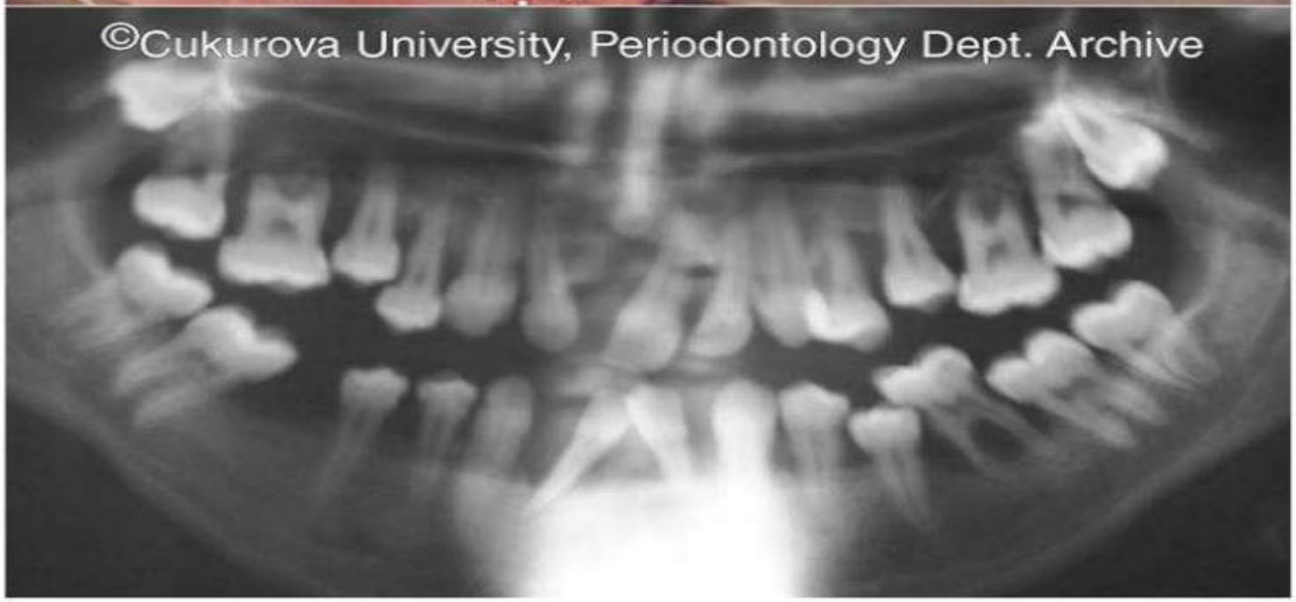
- **Proposed mechanism: periodontal infection may add to systemic inflammation which induces insulin resistance**

- **High levels of cytokines can affect efficacy of insulin receptor**



eFig. 7.109 Severe gingival inflammation and periodontal abscess occurred in a 26-year-old woman with type 1 diabetes mellitus. Notice the extrusion of the maxillary left central incisor caused by alveolar bone loss.

eFig. 7.110 Severe inflammation, pus formation, and periodontal breakdown occurred in a 34-year-old man with uncontrolled type 1 diabetes mellitus.



eFig. 7.111 Two views show the dentition of a 14-year-old girl who was referred with a complaint of tooth mobility. She had spontaneous loss of teeth #11, #31, #41, and #46 in the past 2 years. The patient had advanced bone loss despite a minimal amount of bacterial plaque and degree 3 mobility of many teeth. She was diagnosed with type 1 diabetes mellitus on consultation.

INFLUENCE OF PERIODONTAL DISEASE ON DIABETES

- **Periodontal infection contributes to poorer glycaemic control & increased risk for diabetic complications in diabetics**

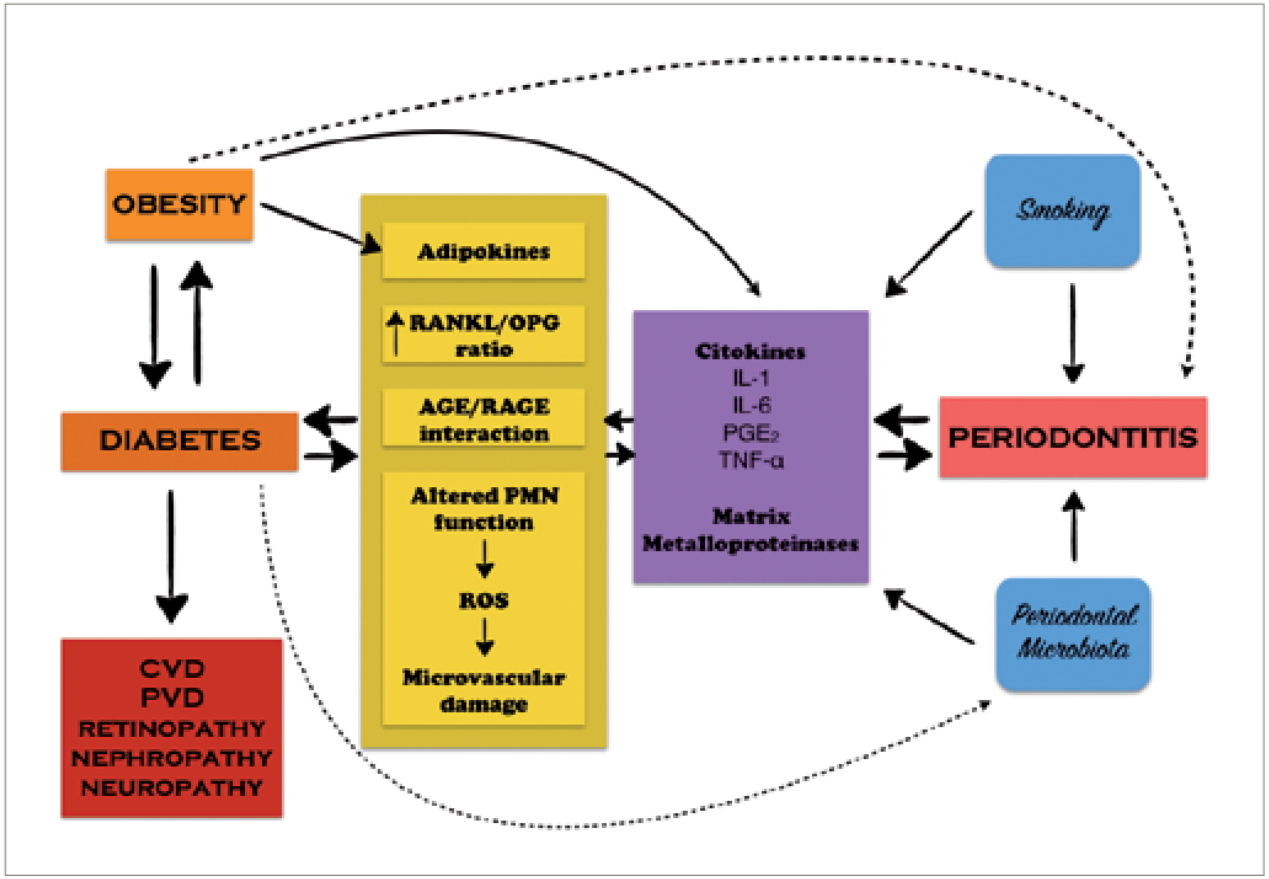
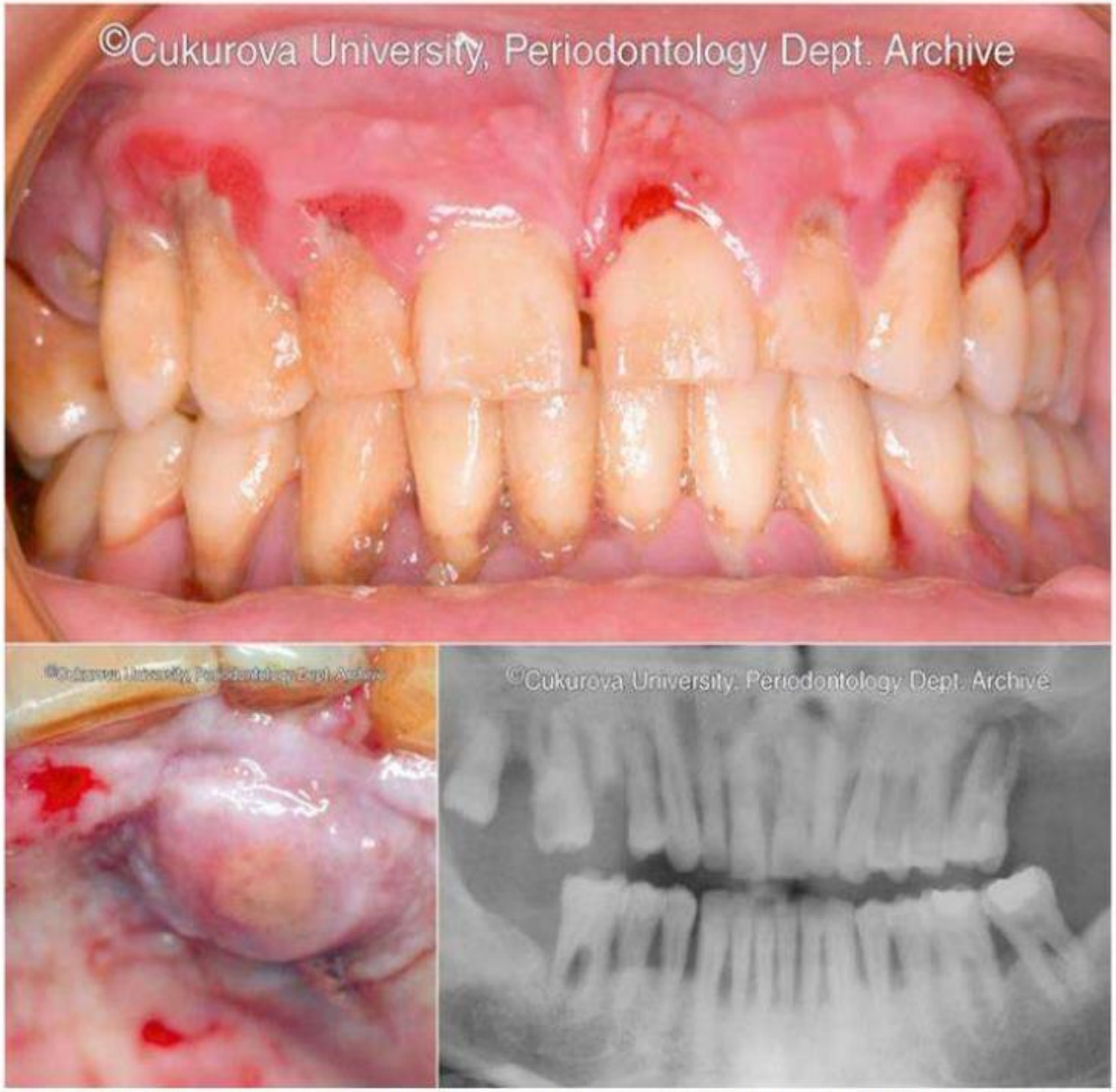
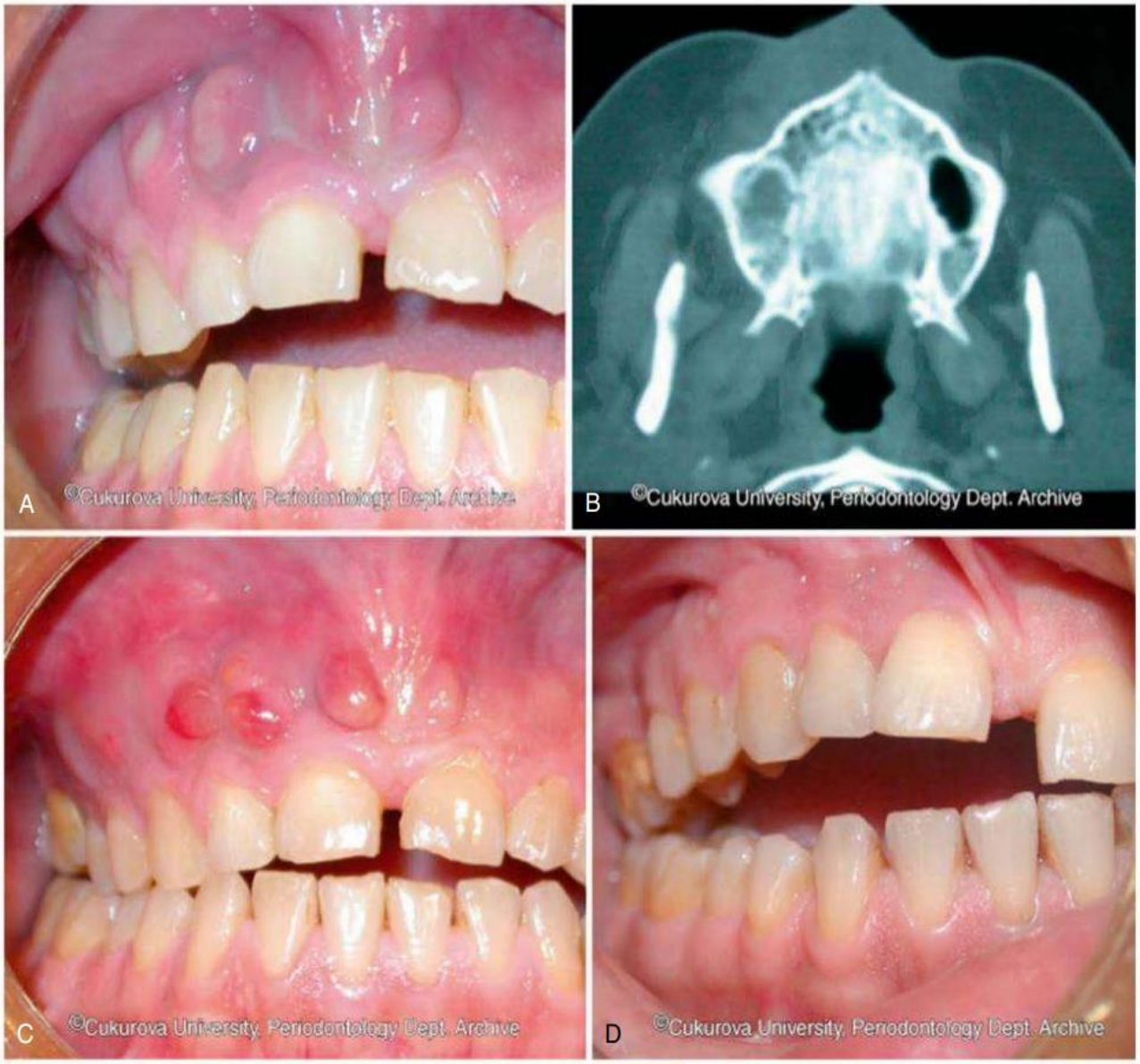


Figure 1

(Thorstensson et al. 1996; Saremi et al. 2005; Schultis et al. 2007)



eFig. 7.112 Three views show alveolar bone loss and severe inflammation with spontaneous bleeding, pus formation, and abscess in a 56-year-old man with type 2 diabetes mellitus who used external insulin for 12 years.



eFig. 7.113 A 28-year-old woman with uncontrolled type 1 diabetes mellitus was referred with complaints of rapid mobility of teeth, severe pain, spontaneous pus, and several abscesses. Her fasting glucose level was 486 mg/dL on the day of referral. (A) Although the lesions resembled abscesses of periodontal origin, the pocket depths and attachment levels were within normal levels. (B) The computed tomography findings and consultation with the infection department confirmed the diagnosis of osteomyelitis. (C) View of the patient after 1 week of blood glucose control in the intensive care unit and hyperbaric oxygen therapy. (D) Although the lesions healed uneventfully, severe malocclusion was evident at the 1-year follow-up examination.

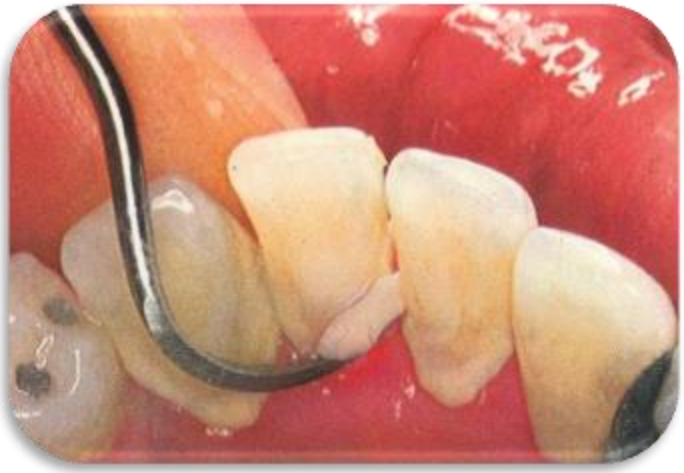
EFFECT OF PERIODONTAL TREATMENT IN DIABETICS

EFFECT OF PERIODONTAL TREATMENT IN DIABETICS

- Limited evidence

Non-surgical periodontal treatment:

- Short-term studies suggest healing response to be similar in diabetics (well-controlled) compared to non-diabetics
- Greater risk for relapse in poorly-controlled diabetics

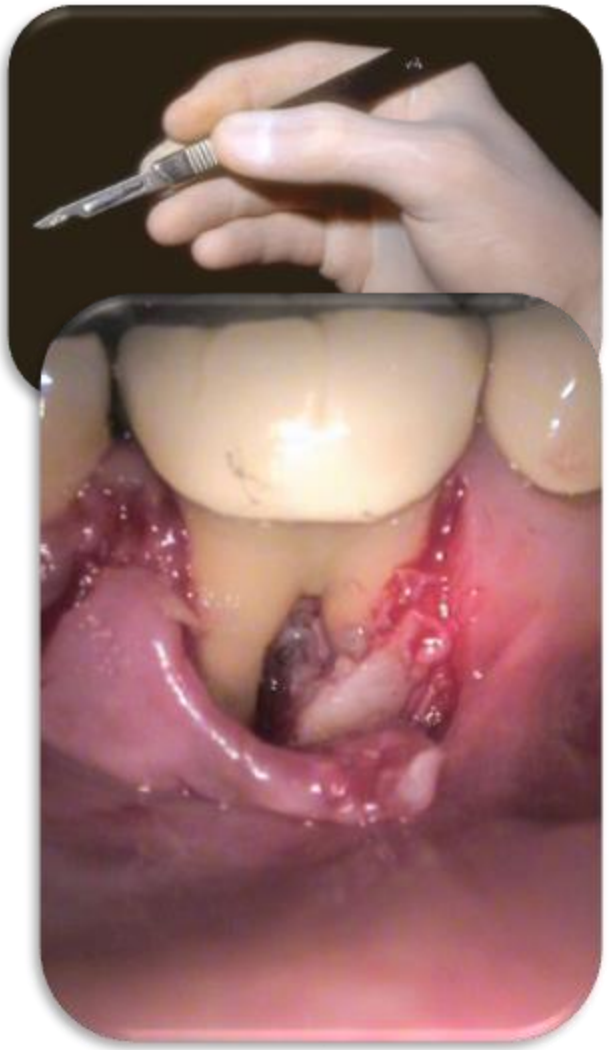


EFFECT OF PERIODONTAL TREATMENT IN DIABETICS

- Limited evidence

Surgical periodontal treatment:

- Healing response similar in diabetics (well-controlled) compared to non-diabetics
- But diabetics may have an increased risk for post-surgical infection & impaired wound healing
- No studies on efficacy of regenerative treatment in diabetics (since they are often excluded in clinical trials)



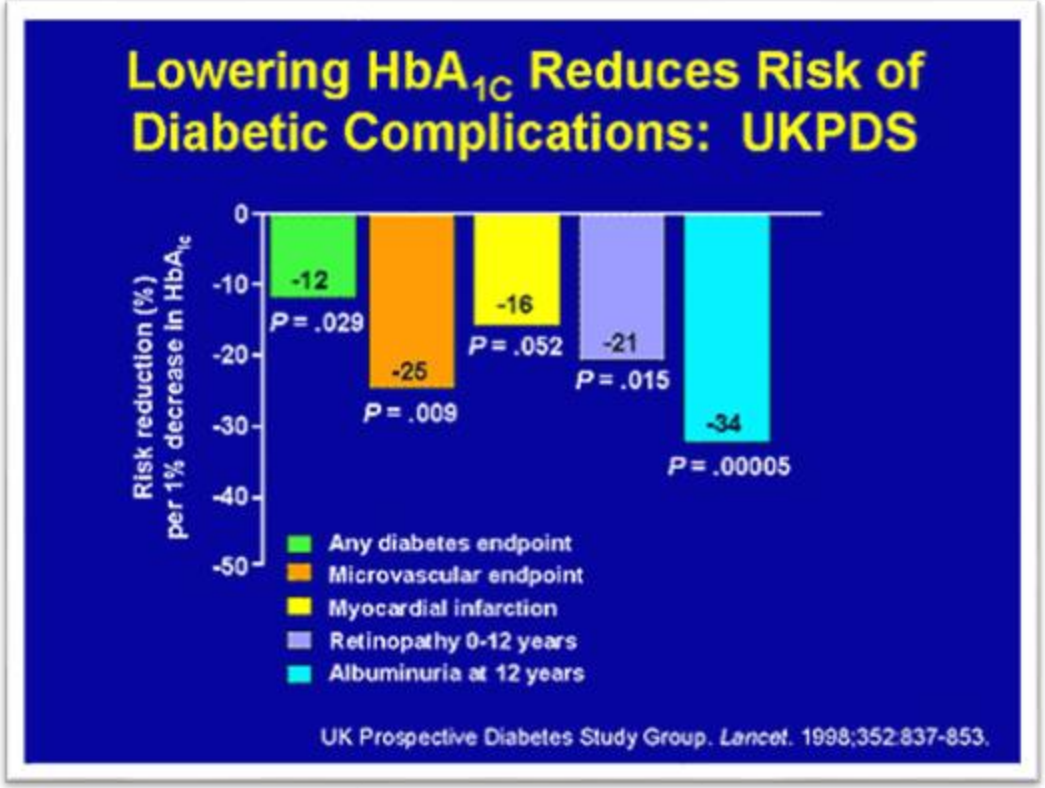
INFLUENCE OF PERIODONTAL TREATMENT ON DIABETES

INTERVENTION TRIALS

- More studies (4/7) reported significant benefit of periodontal treatment
- Improvements in glycaemic control after SRP +/- adjunctive systemic antibiotics of approx 1% in HbA1c (eg. 9 to 8%)

IMPACT OF CHANGE IN HbA1c LEVELS

- UK Prospective Diabetes Study (1993, 1998) showed that every percentage point decrease in HbA1c (eg. 9 to 8%) was associated with 25% reduction in diabetes-related deaths



PERIODONTAL MANAGEMENT OF THE DIABETIC PATIENT

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Educate patients & their physicians:

- Diabetes (Type I, II & GDM) can affect periodontal health
- Depends on diabetic control
- Uncontrolled diabetics are at higher risk of periodontal destruction & also present with more severe periodontal disease
- Diabetics have an altered host response to bacteria & poorer healing response
- Periodontal infections can worsen glycaemic control & increase risk for diabetic complications

- 2 way relationship

PERIODONTAL MANAGEMENT OF THE DIABETIC PATIENT

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- Evidence is limited, but with periodontal treatment diabetics heal just as well as non-diabetics
- Disease recurrence may be higher in diabetics especially in patients with uncontrolled diabetes
- **PRA risk assessment – increase frequency of SPT (3/12)**
- Treatment of periodontal infections in diabetics MAY have a significant role in improving glycaemic control & POTENTIALLY reduce the burden of diabetic complications

Tervonen et al. 1991; Wesfelt et al. 1996; Tervonen & Karjalainen 1997; Christgau et al. 1998, da Cruz et al. 2008

Dental Implants and Diabetes

Emerging evidence that diabetics have more chance to develop biological complications (mucositis and peri-implantitis).

Higher failure rates.

No evidence of contra-indication to implant placement (unless uncontrolled diabetes)

Glycemic control should be maintained.

Wagner *et al.*
International Journal of Implant Dentistry (2022) 8:1
https://doi.org/10.1186/s40729-021-00399-8

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REVIEW Open Access

Systematic review on diabetes mellitus and dental implants: an update

Juliane Wagner*, Johannes H. Spille, Jörg Wiltfang and Hendrik Naujokat

- Dental implant procedures represent a safe way of oral rehabilitation in patients with prediabetes or diabetes mellitus, as long as appropriate precautions can be adhered to.
- Accordingly, **under controlled conditions there is still no contraindication** for dental implant surgery in patients with diabetes mellitus or prediabetic conditions.

Our lecture today…

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Thank you!!!

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