# Ätiologie der Parodontalerkrankungen

M. Haas

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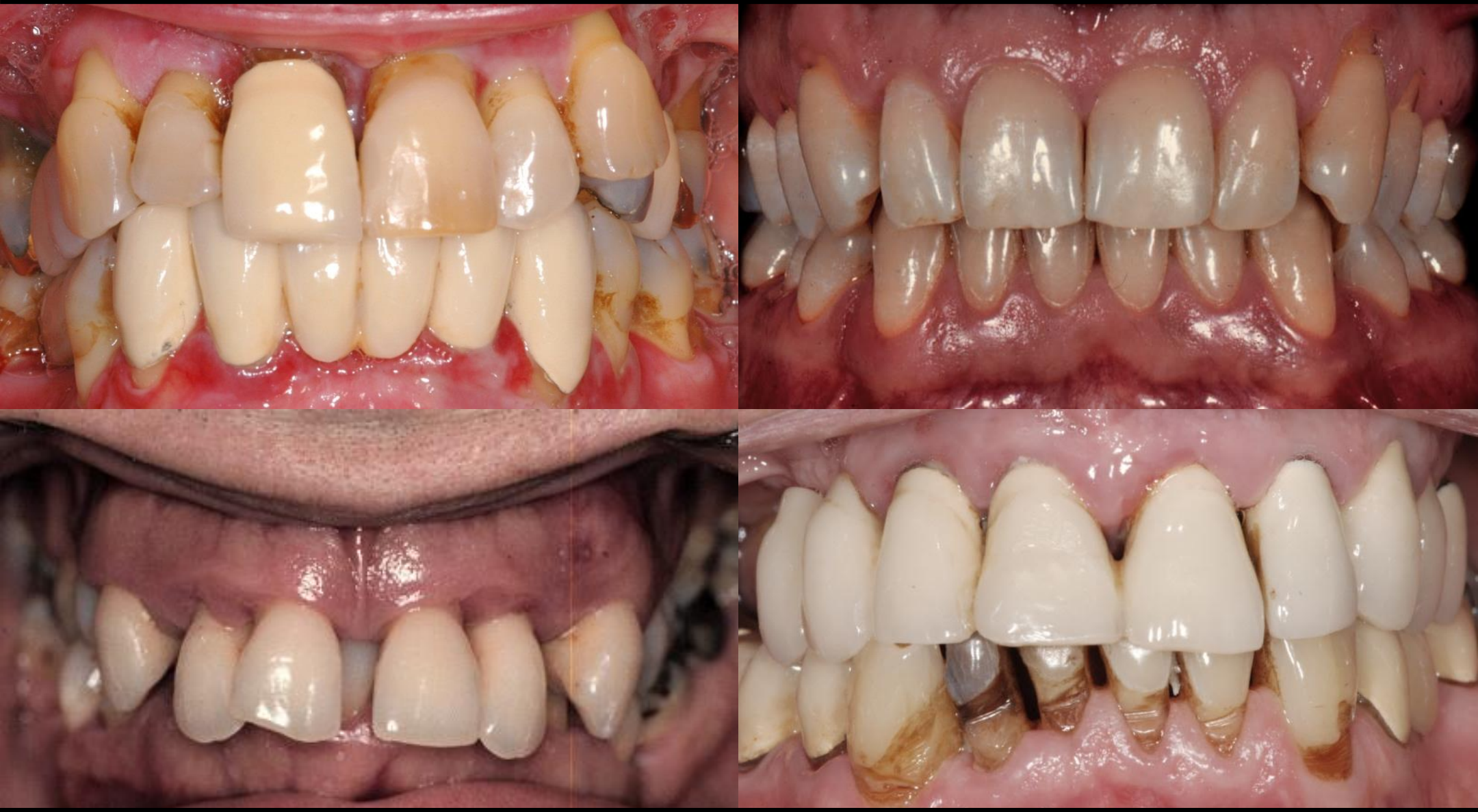
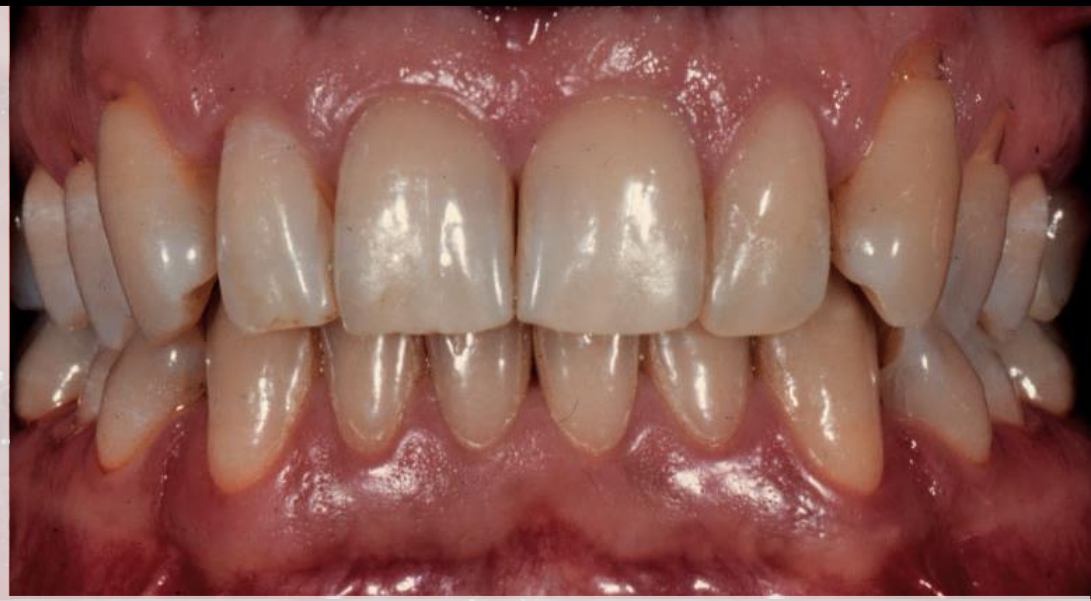


M. Haas Graz

# Ätiologie der Parodontalerkrankungen

Wirt X Mikroorganismen



- Karies
- Parodontalerkrankung

# Lebensqualität

Lebensqualität umfasst nach einer Definition der WHO (1947) das körperliche, psychische und soziale Befinden eines Individuums.

Parameter der Mundgesundheit als wesentlicher Bestandteil der Lebensqualität:

| | |
|---|---|
| Funktion | Kauen, Essen, Sprache |
| Schmerz | Schmerzfreiheit, physische Beeinträchtigungen |
| Ästhetik | Aussehen, Lachen, Lächeln |
| Psychosoziale Faktoren | Soziale Kontakte, Sorgen, Selbstbewusstsein |


WHO (1947) The Constitution of the World Health Organization. *WHO Chronicles.*

Osterman AC, Dowdy JD, Lindeman S, Türp JC, Swales J. Patterns in selfreported illness experiences: letters to a TMJ support group. *Int J Lang Commun Disord 1999;19:127-147.*

Slade GD, Strauss RP, Atchison KA, Kressin NR, Locker D, Reisine ST. Conference summary: assessing oral health outcomes-measuring health status and quality of life. *Community Dental Health 1998;15:3-7.*

Cushing AM, Sheiham A, Maizels J. Developing socio-dental indicators−the social impact of dental disease. *Community Dent Health 1986;3:3-27.*

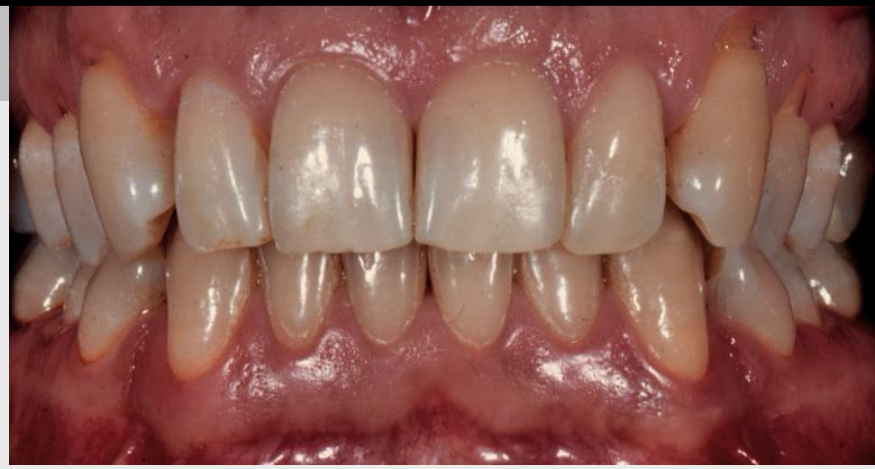
Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. *J Dent Educ 1990;54:680-687.*

Strauss RP, Hunt RJ. Understanding the value of teeth to older adults: Influences on the quality of life. *J Am Dent Assoc 1993;124:105-110.*

Leao A, Sheiham A. Relation between clinical dental status and subjective impacts on daily living. *J Dent Res 1995;74:1408-1413.*

Kressin NR. Associations among different assessments of oral health outcomes. *J Dent Educ 1996;60:501-507.*

# Parodontitis - eine plaqueinduzierte Erkrankung



Wissenschaftliche Studien beweisen, dass der Großteil parodontaler Erkrankungen entzündliche Ursachen aufweisen, verursacht durch bakterielle Plaque.

Gingivitis, Parodontitis und Karies können durch entsprechende Therapie und Prophylaxe zu über 90% erfolgreich behandelt bzw. vermieden werden.


Löe H, Theilade E, Jensen SB. Experimental gingivitis in man. *J Periodontol 1965;36:177-187.*

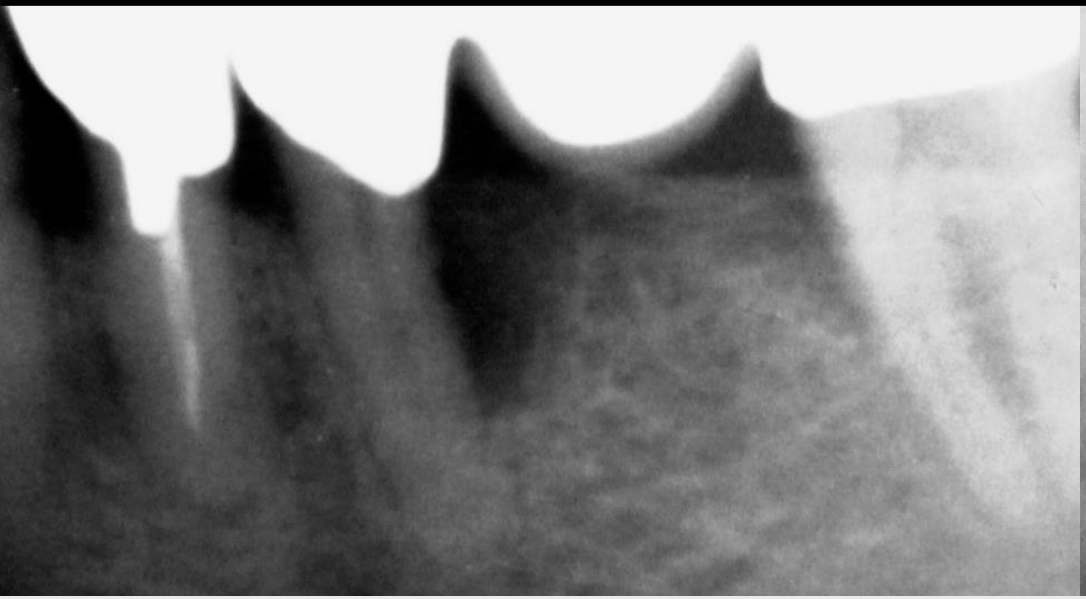
Listgarten MA, Socransky SS. Ultrastructural characteristic of a spirochete in lesions of acute necrotizing ulcerative gingivostomatitis (Vincent‘s infection). *Arch Oral Biol 1964;9:95.*

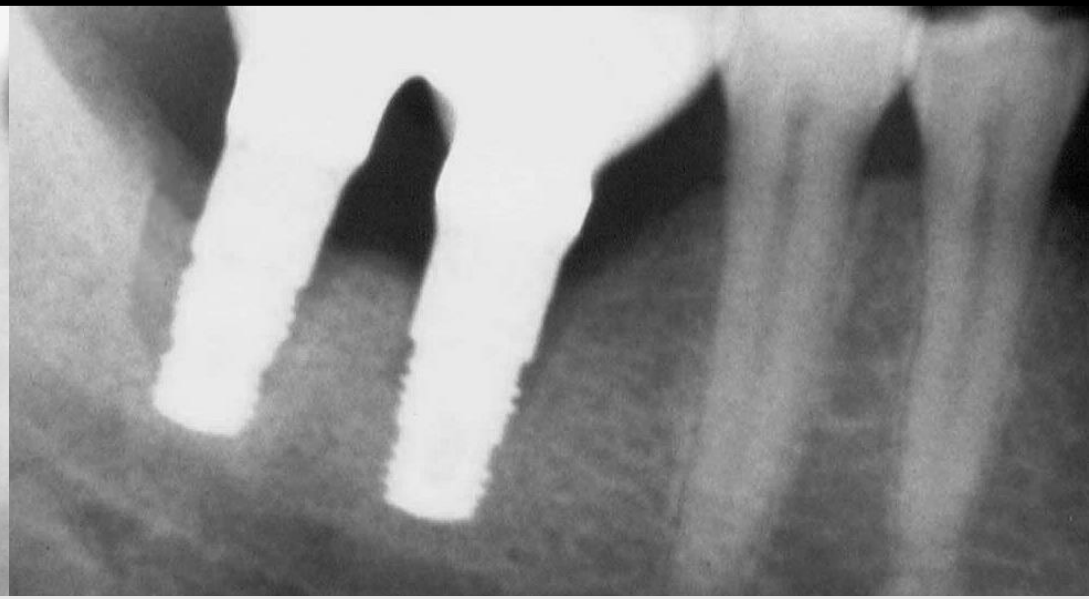
Axelsson P, Lindhe J. The effect of a plaque control program on gingivitis and dental caries in school children. *J Dent Res 1977; spec.Issue C 56:142.*

Axelsson P, Lindhe J. Effects of controlled oral hygiene procedures on caries and periodontal disease in adults. Results after 6 years. *J Clin Periodont 1981a;8:239.*

Axelsson P, Nyström B, Lindhe J. The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease in adults. Results after 30 years of maintenance. *J Clin Periodontol 2004;31:749-457.*

# Parodontitis und Periimplantitis

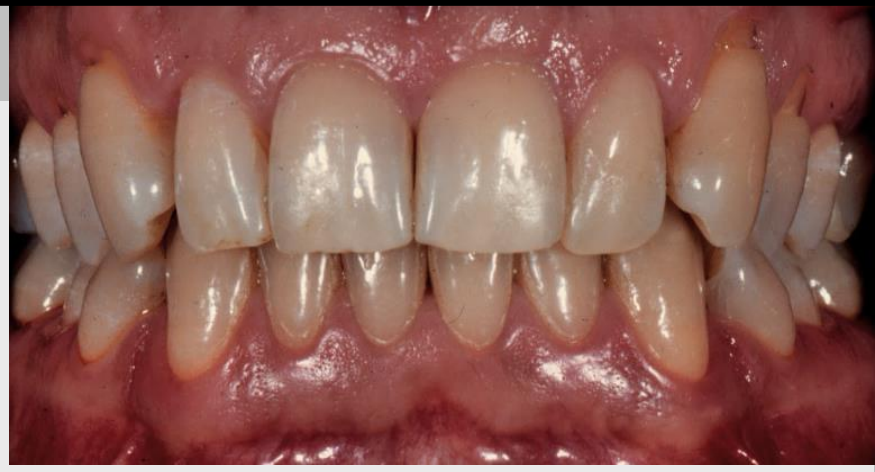




Untersuchungen im Auftrag der WHO zeigen eine Prävalenz der Parodontitis weltweit zwischen 42 und 56%.
Insgesamt leiden etwa 80% der Bevölkerung in Europa und Nordamerika an Erkrankungen der Gingiva und des Parodontiums. Zwei Drittel davon benötigen eine umfassende parodontale Behandlung.

Baehni PC, Bourgeois DM. Epidemiology of periodontal health and disease. In:Lang NP, Attström R, Löe H. Proceedings of the European workshop on mechanical plaque control. *Quintessenz Verlag, Berlin 1998;19-34.*
Miyazaki H, Pilot T, Leclercq MH, Barnes DE. Profiles of periodontal conditions in adults measured by CPITN. *Int Dent J 1991;41:67-73 / 74-80.*

# Mundgesundheit - Karies

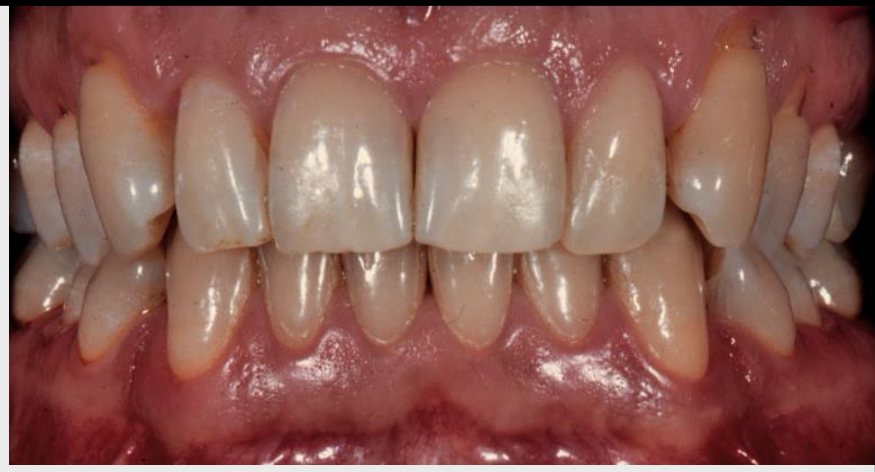


Durch die Säulen der Prävention (Mundhygiene, Fluoridierung, Ernährung, regelmäßige zahnärztliche Kontrollen) ist es in vielen Ländern zu einem Rückgang der Karies und generell zu einer Verbesserung der Zahngesundheit gekommen. Am Beispiel Deutschlands ist ersichtlich, dass 70% der Kinder unter 12 Jahren und 46% der Jugendlichen unter 15 Jahren ein Gebiss ohne Karieserfahrung aufweisen, die Erwachsenen bleiben jedoch nur zu etwa einem Prozent kariesfrei.


Eke PI, Dye BA, Wei L, Thornton-Evans GO, Genco RJ. Prevalence of periodontitsin adults in the United States: 2009 and 2010. *J Dent Res 2012;91(10):914-920.*

Jordan RA, Bodechtel C, Hertrampf K, Hoffmann T, Kocher T, Nitschke I, Schiffner U, Stark H, Zimmer S, Micheelis W. The Fifth German Oral Health Study (Fünfte Deutsche Mundgesundheitsstudie, DMS V) - rationale, design, and methods. *BMC Oral Health 2014;29;14(1):161.*

# Mundgesundheit - Parodontitis



Während in Skandinavien die Prävalenz der Parodontitis rückläufig ist, kommt es in Mitteleuropa (Deutschland, Ungarn) und in den USA zu einem Anstieg, insbesondere bei der aggressiven Form (10 bis 15% der Bevölkerung). Für Österreich liegen nur eingeschränkte Daten vor.


Hugoson A, Norderyd O. Has the prevalence of periodontitis changed during the past 30 years? *J Clin Periodontol 2008;35(Suppl8):338-345.*

Herman P, Gera I, Borbély J, Féjerdy P, Madléna M. Periodontal health of an adult population in Hungary: findings of a national survey. *J Clin Periodontol 2009;36(6):449-457.*

Holtfreter B, Kocher T, Hoffmann T, Desvarieux M, Micheelis W. Prevalence of periodontal disease and treatment demands based on a German dental survey (DMS IV). *J Clin Periodontol 2010;37(3):211-219.*

Eke PI, Dye BA, Wei L, Thornton-Evans GO, Genco RJ. Prevalence of periodontitis in adults in the United States: 2009 and 2010. *J Dent Res 2012 Oct;91(10):914-20.*

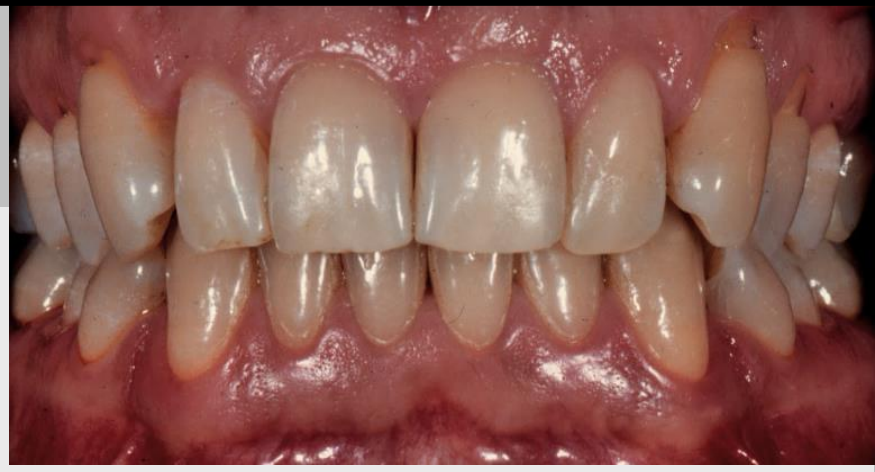
Bodenwinkler A, Kerschbaum J, Sax G. Mundgesundheit und Lebensqualität in Österreich 2010. 35- bis 44-Jährige, 65- bis 74-Jährige. GÖG/ÖBIG, Wien.

Bruckmann C. Epidemiologie parodontaler Erkrankungen. *Stomatologie 2013;110:9-14.*

Schützhold S, Kocher T, Biffar R, Hoffmann T, Schmidt CO, Micheelis W, Jordan R, Holtfreter B. Changes in prevalence of periodontitis in two German population-based studies. *J Clin Periodontol 2015;42:121-130.*

Eke PI, Dye BA, Wei L, Slade GD, Thornton-Evans GO, Borgnakke WS, Taylor GW, Page RC, Beck JD, Genco RJ. Update on prevalence of periodontitis in adults in the United States: NHANES 2009 - 2012. *J Periodontol. 2015 Feb 17:1-18.*

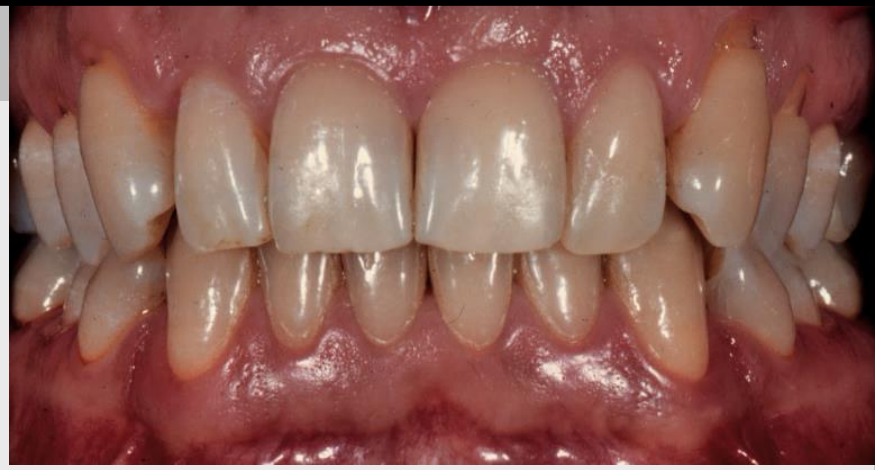
# Mundgesundheit - DMS V



81% der 12-Jährigen sind heute kariesfrei.
Seit 2005 hat sich bei den jüngeren Erwachsenen (35-44) die Zahl der Zähne mit Karieserfahrung um 30 Prozent reduziert.
In diesem Zeitraum hat sich auch die Prävalenz der chronischen Parodontitis bei den jüngeren Erwachsenen und den jüngeren Senioren (65-74) halbiert.
„Ernährung, Übergewicht, Diabetes, soziales Verhalten oder auch Stress sind nicht zurückgegangen.“

Jordan RA, Micheelis W. The Fifth German Oral Health Study (Fünfte Deutsche Mundgesundheitsstudie, DMS V). *Deutscher Zahnärzteverlag DÄV, ISBN 978-3-7691-0020-4, Köln 2016.*

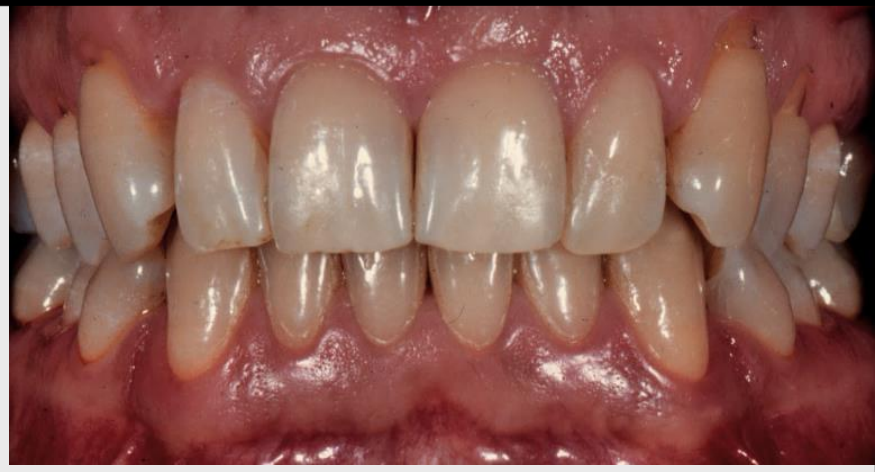
# Mundgesundheit



Die globalen Mundgesundheitsziele der WHO für das Jahr 2020 sprechen von einer Verringerung des Zahnverlustes, einer weiteren Verminderung der Zahnlosigkeit (<15% bei der Altersgruppe der 65- bis 74- Jährigen), einer funktionellen Dentition mit mindestens 20 Zähnen auch älterer Menschen und einer Reduktion schwerer parodontaler Erkrankungen altersabhängig auf 10 bis 20%.

Hobdell M, Petersen PE, Clarkson J, Johnson N. Global goals for oral health 2020. *Int Dent J 53:285-288.*

# Mundgesundheit



Neben der medizinischen Bedeutung eines gesunden Kauorganes ist gesundheitspolitisch die Kosteneffizienz von zentraler Bedeutung. Analysen verschiedener alternativer Behandlungsformen belegen hier die Notwendigkeit neuer spezialisierter Strategien. Sozioökonomisch ist der Benefit einer prophylaxeorientierten Therapie bewiesen.


Schwendicke F, Stolpe M, Plaumann A, Graetz C. Cost-effectiveness of regular *versus* irregular supportive periodontal therapy or tooth removal. *J Clin Periodontol 2016;43:940-947.*

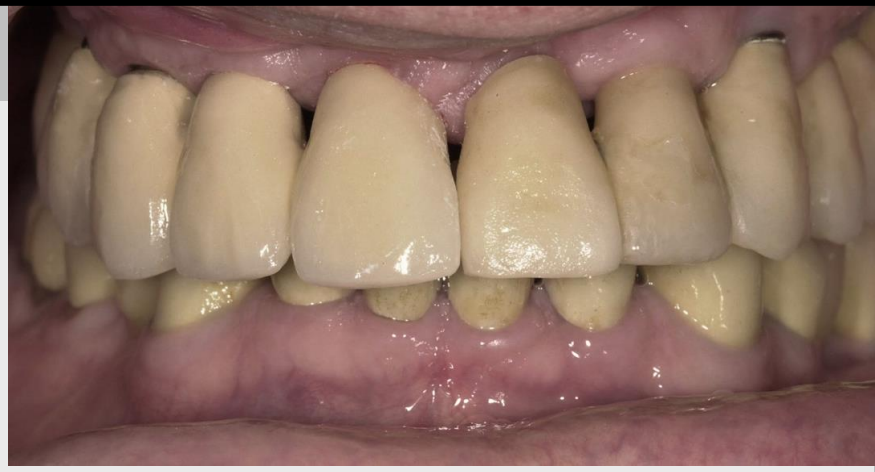
Pennington M, Heasman P, Gaunt F, Güntsch A, Ivanovski S, Imazato S, Rajapakse S, Allen E, Flemmig T, Sanz M, Vernazza C. The cost-effectivness of supporative periodontal care: a global perspective. *J Clin Periodontol 2011;38:553-561.*

Vernazza C, Heasman P, Gaunt F, Pennington M. How to measure the cost-effectivness of periodontal treatments. *Periodontology 2000 2012;60:138-146.*

Ide R, Hoshuyama T, Takahashi K. The effect of periodontal disease on medicaland dental costs in a middle-aged japanese population: a longitudinal study. *J Periodontol 2007;78:2120-2126.*

Braegger U. Cost-benefit, cost-effectivness and cost-utility analyses of periodontitis prevention. *J Clin Periodontol 2005;32(Suppl 6):301-313.*

# Mundgesundheit

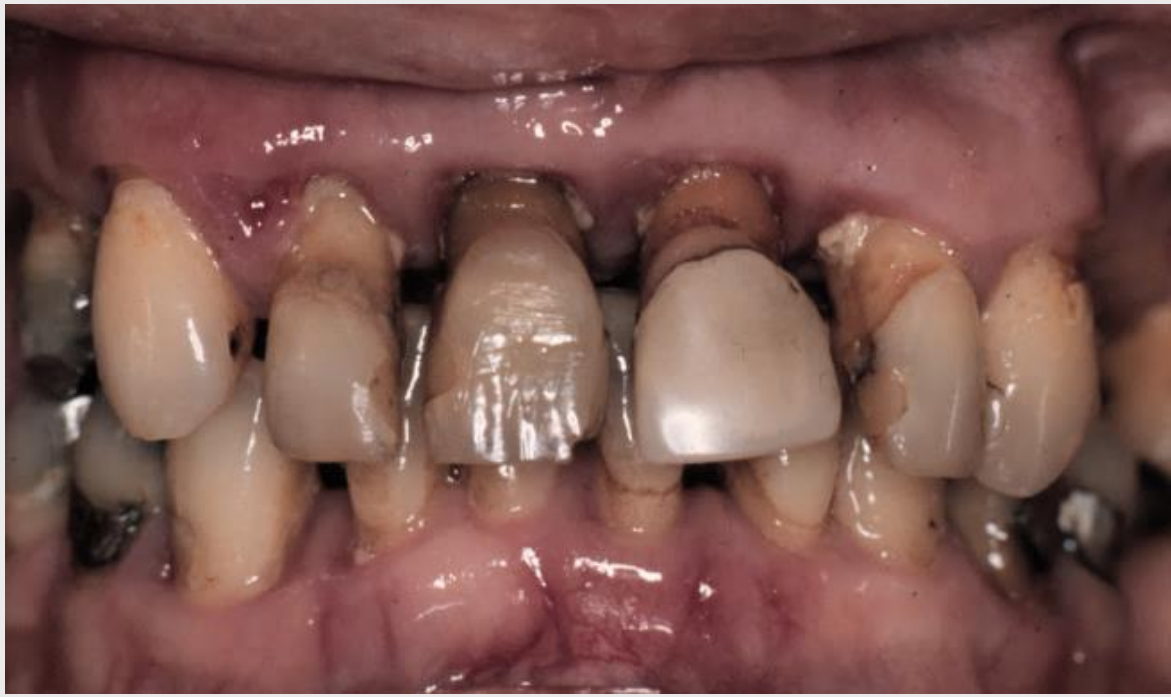


Zahlreiche Studien belegen die Realisierbarkeit dieser Ziele.
Mit entsprechenden Prophylaxe- und Nachsorgekonzepten können auch prothetisch-restaurativ behandelte Zähne über einen Zeitraum von bis zu 40 Jahren gesund erhalten werden.


Axelsson P, Nyström B, Lindhe J. The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease in adults. Results after 30 years of maintenance. *J Clin Periodontol 2004;31:749-457.*
Nevins M, Kim DM. Classical versus contemporary treatment planning for aggressive periodontal disease. *J Periodontol 2010;81(5):767-775.*
Heschl A, Haas M, Haas J, Payer M, Wegscheider WA, Polansky R. Maxillary rehabilitation of periodontally compromised patients with extensive one-piece fixed prostheses supported by natural teeth: a retrospective longitudinal study. *Clin Oral Investig 2012;(1)31.*

# Parodontitis - eine plaqueinduzierte Erkrankung?

Im offenen Ökosystem der Mundhöhle stehen mehrere Biozönosen im physiologischen Gleichgewicht:



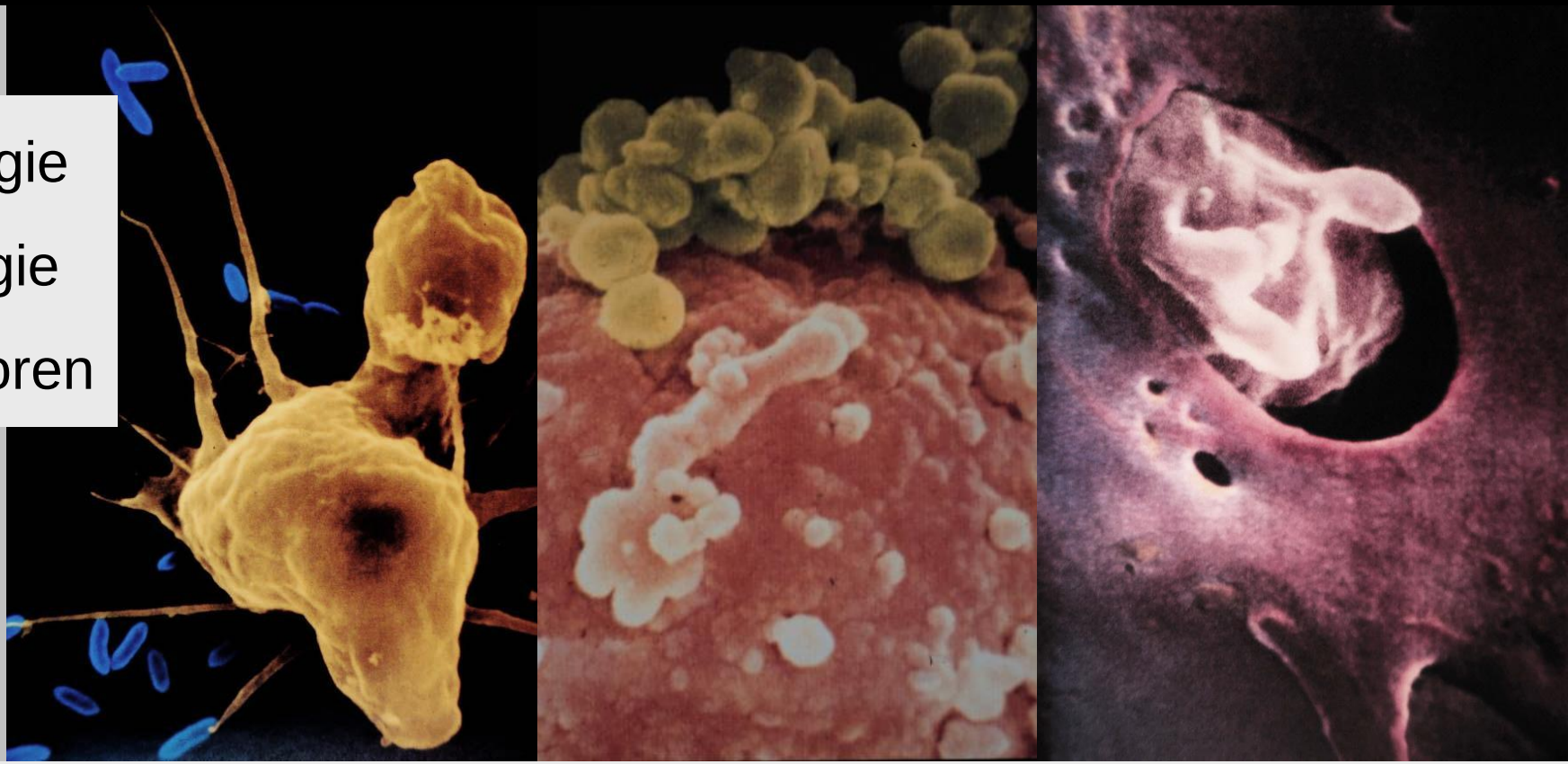
- ⇨ Schleimhautbesiedelnde Keime
- ⇨ Koronale Plaque
- ⇨ Marginale Plaque
- ⇨ Subgingivale Plaque

~ 20 von 400 Keimen der Mundhöhle induzieren Karies bzw. Parodontitis.

Plaque ⟷ Biofilm

# Parodontitis - eine Erkrankung des Wirtes?

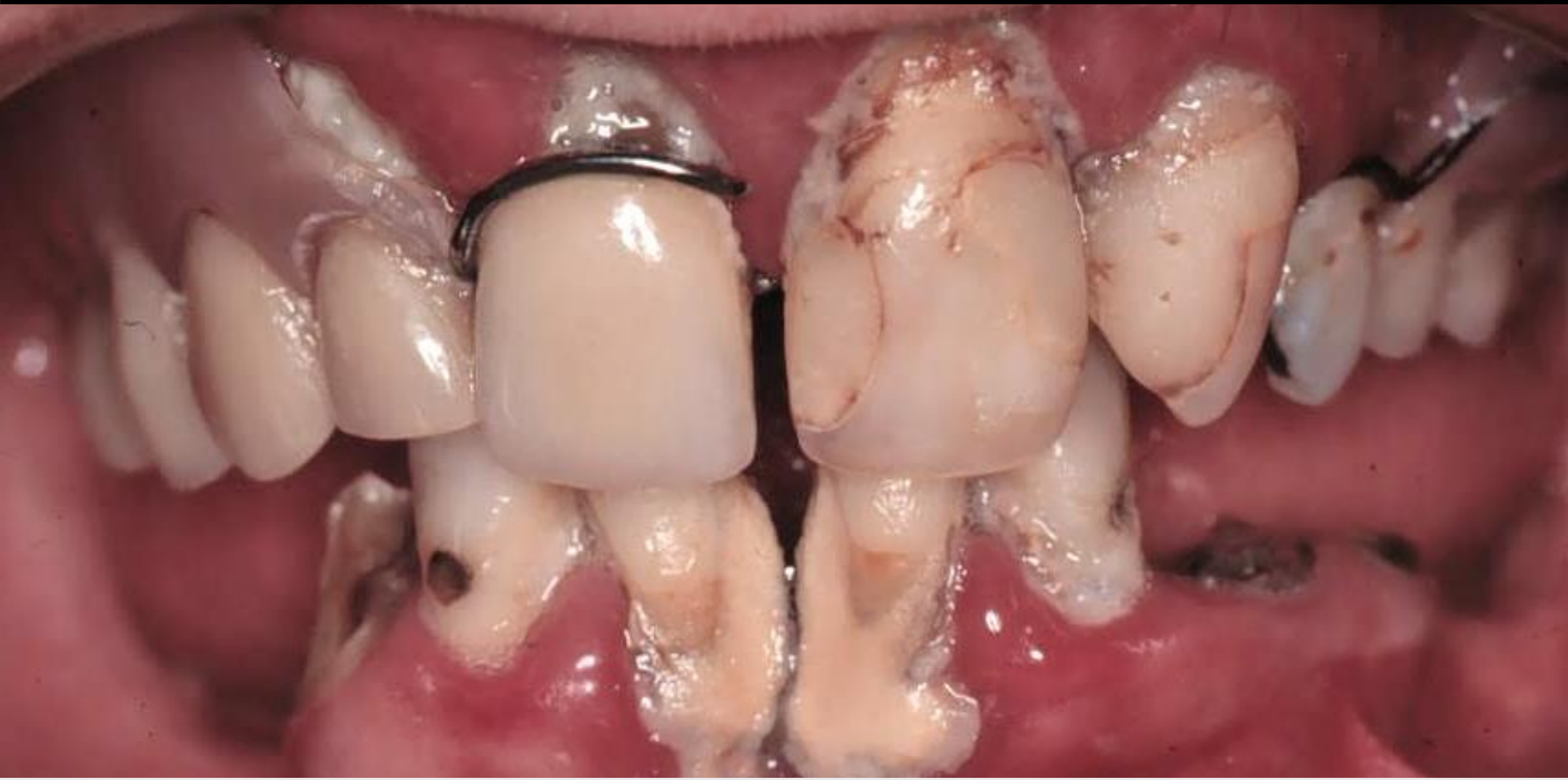
- Mikrobiologie
- Immunologie
- Risikofaktoren



Die Initiation und Progression der Parodontalerkrankungen wird durch lokale Milieuveränderungen, systemische Bedingungen und eventuell auch durch genetische Faktoren beeinflusst.

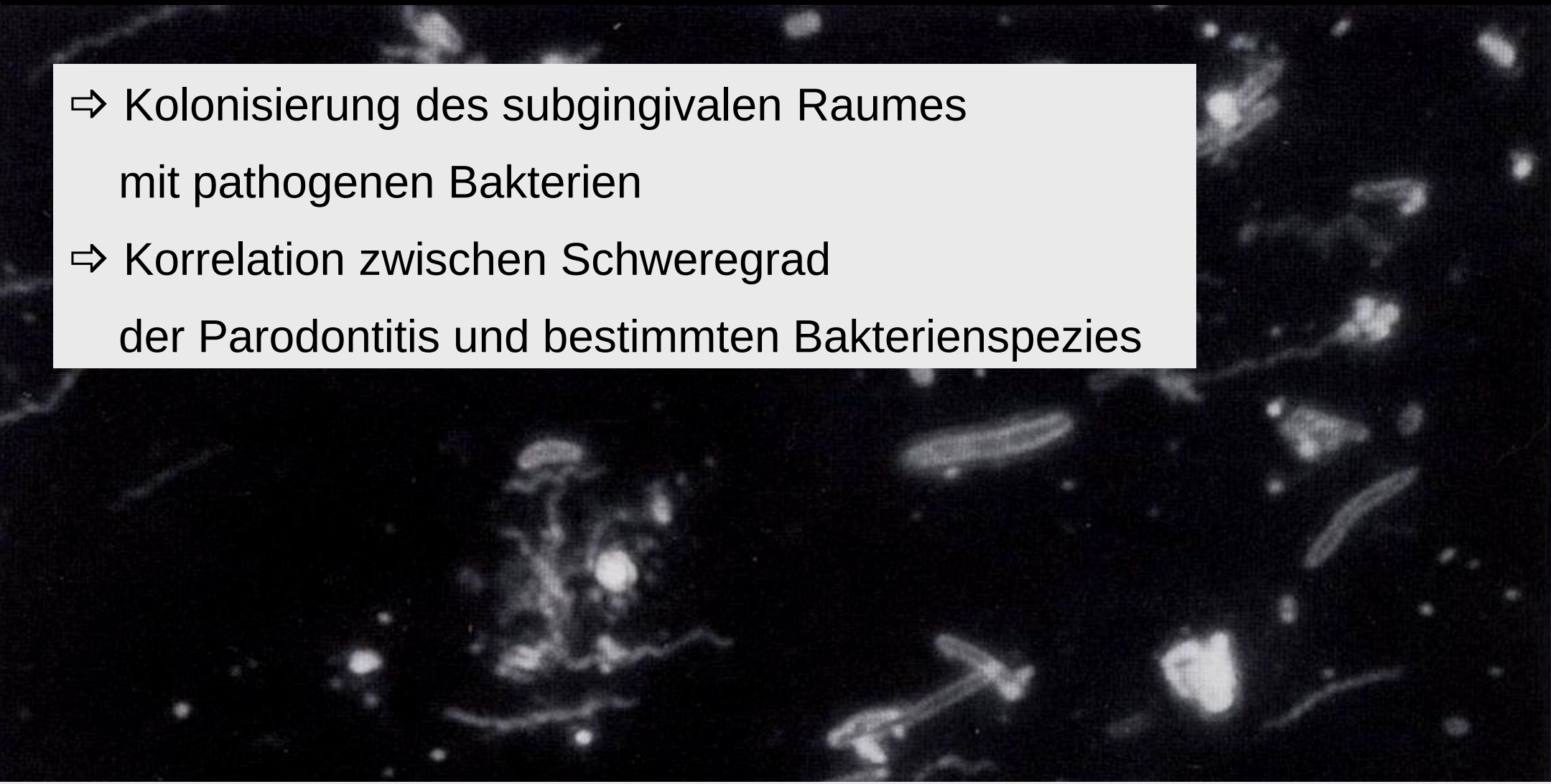
Genco RJ. Current view of risk factors for periodontal diseases. *J Periodontol 1996;67(10 Suppl):1041-1049.*

# Unspezifische Plaquehypothese



Zunahme der allgemeinen Plaquemenge führt per se zur Parodontitis.

# Spezifische Plaquehypothese



- ⇨ Kolonisierung des subgingivalen Raumes mit pathogenen Bakterien
- ⇨ Korrelation zwischen Schweregrad der Parodontitis und bestimmten Bakterienspezies

Socransky SS, Haffajee AD. Evidence of bacterial etiology: a historical perspective. In Socransky SS & Haffajee AD eds. Microbiology and immunobiology of periodontal diseases. *Periodontology 2000 1994;5:7-25.*

# Spezifische Plaquehypothese

- ⇨ Aggregatibacter actinomycetemcomitans
- ⇨ Porphyromonas gingivalis

- ⇨ Tannerella forsythensis
- ⇨ Prevotella intermedia
- ⇨ Treponema denticola
- ⇨ Fusobacterium nucleatum
- ⇨ Eikenella corrodens
- ⇨ Campylobacter rectus

Socransky SS, Haffajee AD. Evidence of bacterial etiology: a historical perspective. In Socransky SS & Haffajee AD eds. Microbiology and immunobiology of periodontal diseases. *Periodontology 2000 1994;5:7-25.*

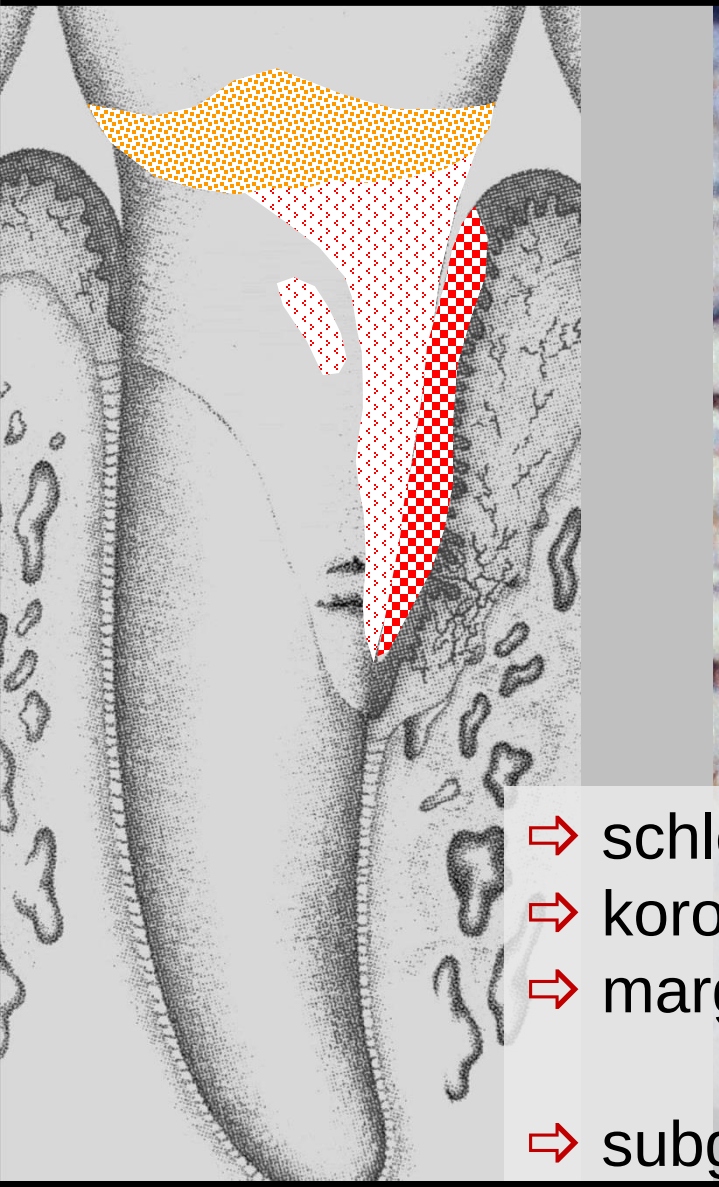
# Parodontale Erkrankungen

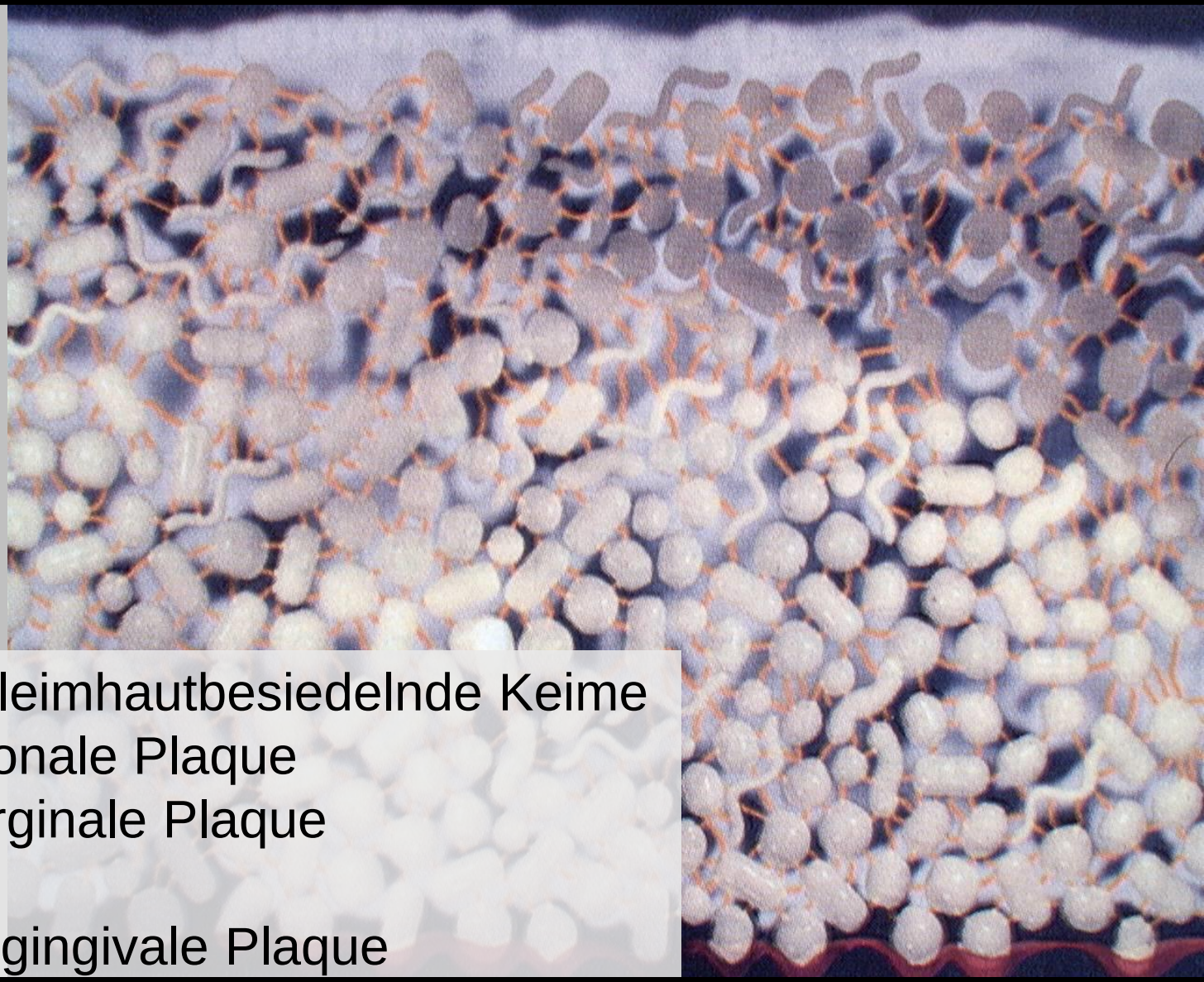
...viele Formen sind mit speziellen pathogenen Keimen verbunden.

Initialisierung und Progression werden von lokalen und allgemein systemischen Faktoren, sogenannten Risikofaktoren, modifiziert.

Genco RJ. Current view of risk factors for periodontal diseases. *J Periodontol 1996;67:1041-1049.*

# Mikroorganismen - Biofilme

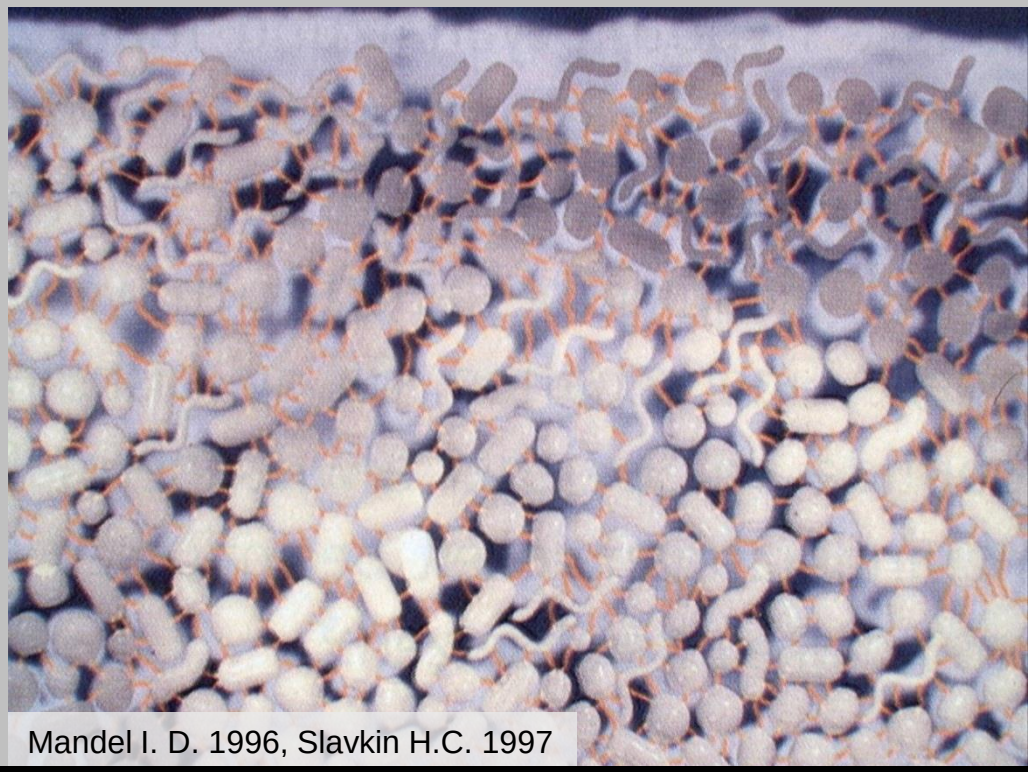




- ⇨ schleimhautbesiedelnde Keime
- ⇨ koronale Plaque
- ⇨ marginale Plaque
- ⇨ subgingivale Plaque

# Plaque - Biofilme

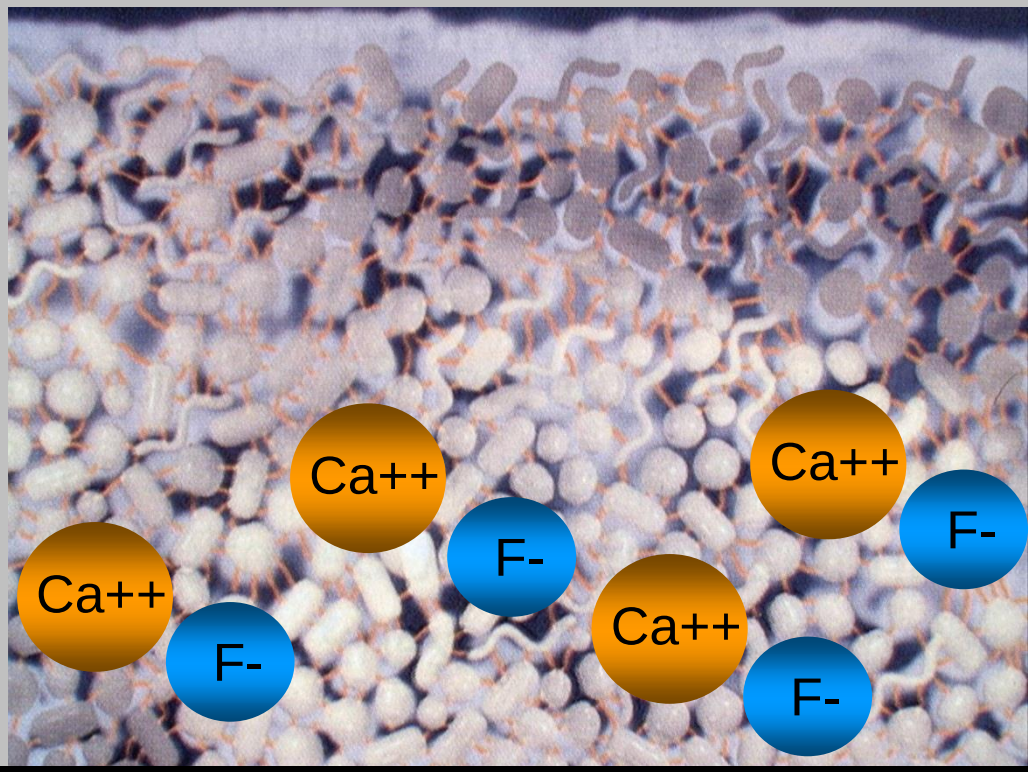
- Einlagerung von abgestorbenen zellulären Bestandteilen (Epithelzellen, Granulozyten, Erythrozyten…) in die Schleimschicht (Muzine aus dem Speichel) an der Zahnoberfläche mit darauf folgender Einlagerung der Mikroorganismen.
- Anheftung von Mikroorganismen an die Oberflächen intakter Zellen im Sulkus.
- Dynamisches System aus unter-schiedlichen, aber voneinander abhängigen Bewohnern.



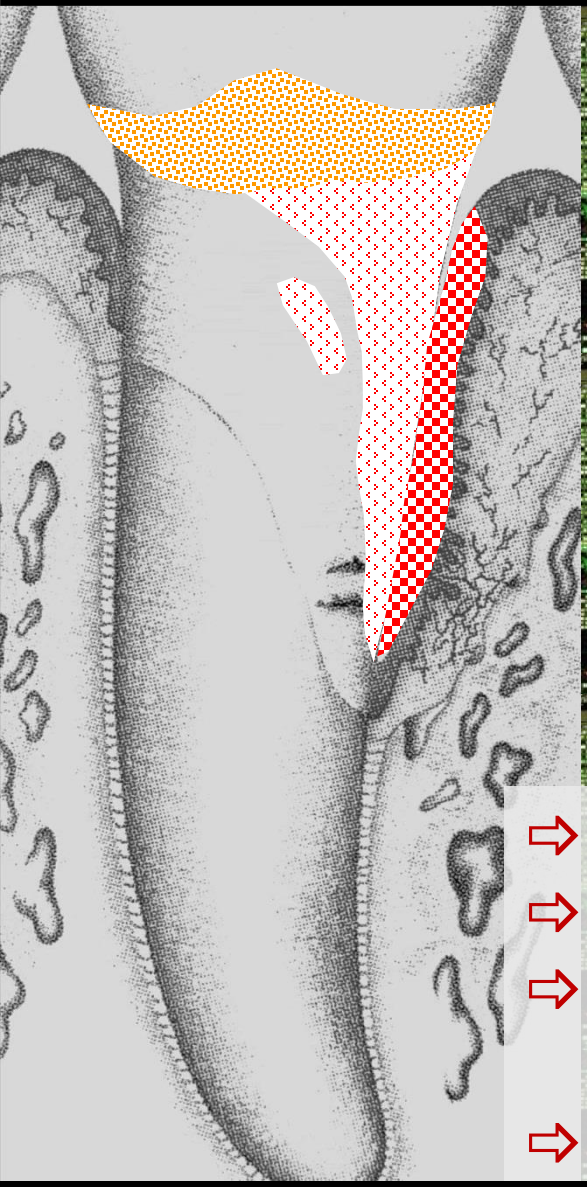
Mandel I. D. 1996, Slavkin H.C. 1997

# Plaque - Biofilme

- Die ersten Bakterien, die sich ansiedeln bestimmen das Milieu für die folgenden Bakterien, die sich wiederum an den Vorgängern anheften
- Aufbau der Matrix: Bakterien, Polysaccharide, Speichelproteine
- Schutzmechanismen der Bakterien gegen antibakterielle Wirkstoffe
- Schutz der Lebensgemeinschaft
- Austausch von Nährstoffen
- Austausch genetischer Informationen
- Synergismus oraler Bakterien



# Biofilme - Modell



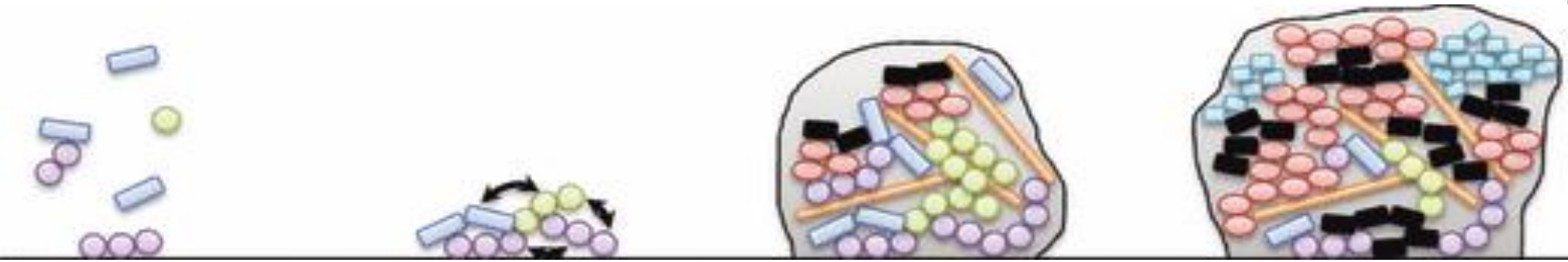
- schleimhautbesiedelnde Keime
- koronale Plaque
- marginale Plaque

- subgingivale Plaque

# Biofilme - Modell

# Stadien der Biofilm-Formation

The road to ruin: the formation of disease-associated oral biofilms



Adhesion

Communication

Matrix-enclosed communities

Disease

Jakubovics NS, Kolenbrander PE. The road to ruin: the formation of disease-associated oral biofilms. Oral Diseases 2010; 6(8):729-739.

# Mikrobielle Komplexe der subgingivalen Plaque

Reihenfolge der Kolonisierung

- Actinomyces odontolyticus
- Veillonella parvula

- Streptococcus intermedius, - sanguis, - oralis, - miti

- Eikinella corrodens
- Capnocytophaga species
- Campylobacter concisus
- Aggregatibacter actinomycetemcomitans serotype a

- Fusobacterium nucleatum
- Prevotella intermedia, P. nigrescens
- Parvimonas micra (Peptostreptococcus micros)
- Eubacterium nodatum
- Campylobacter rectus, C. showae, C. gracilis
- Streptococus constellatus

- Porphyromonas gingivalis
- Tannerella forsythensis (Bacteroides forsythus)
- Treponema denticola

⇨ Aggregatibacter actinomycetemcomitans serotype b

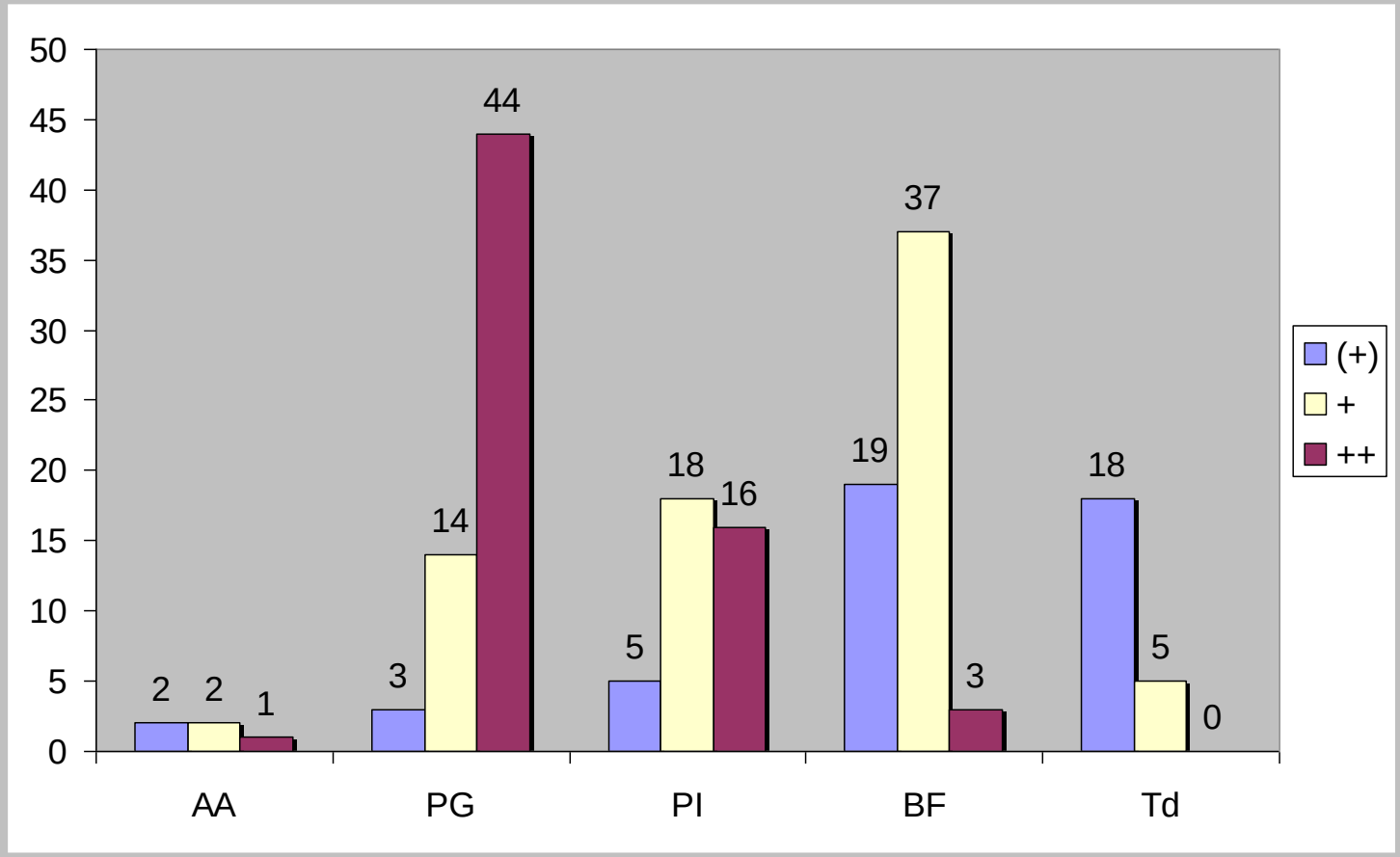
⇨ Selemonas noxia

⇨ Actinomyces naeslundii genospecies 2

Direkte Korrelation zwischen Taschentiefe bzw. Blutung auf Sondierung und den Keimen der roten Gruppe.

Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent RL Jr. Microbial complexes in subgingival plaque. *J Clin Periodontol 1998;25:134-144.*

# Keimspektrum refraktärer Erwachsenenparodontitis




Progression der Erwachsenenparodontitis korreliert mit dem Vorkommen von Porphyromonas gingivalis (Pg), Bacteroides forsythus (Bf), Treponema denticola (Td).

Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent RL Jr. Microbial complexes in subgingival plaque. *J Clin Periodontol 1998;25:134-144.*

# Keimspektrum

In einer Dentition ohne gingivale Entzündung kommt es nach 4 Tagen ohne Mundhygiene zu einem geringen Anstieg aller Mikroorganismen im Mittel von 140 x $10^5$ auf ca. 210 x $10^5$. Die am meisten dominanten Spezies am Tag 0 waren Actinomycesarten (50% aller Mikroorganismen). Eine signifikante Zunahme zeigten pathogene Keime bzw. Mikroorganismen der orangen Gruppe (Streptokokken, Capnocytophaga, Campylobacter, Fusobacteria und A. actinomycetemcomitans).

Ramberg P, Sekino S, Uzel NG, Socransky S, Lindhe J. Bacterial colonization during de novo plaque formation.
*J Clin Periodontol 2003;30:990-995.*

Fusobacterium, Campylobacter, Prevotella, Treponema, Eubacterium, B. forsythus etc. produzieren reichlich flüchtige Schwefelkomponenten. Diese Spezies, die der roten und orangen Gruppen angehören, lagen in höherer Anzahl in Sulfid-positiven Taschen vor.

Torresyap G, Haffajee AD, Uzel NG, Socransky SS. Relationship between periodontal pocket sulfide levels and subgingival species.
*J Clin Periodontol 2003;30:1003-1010.*

# Plaque - Biofilme

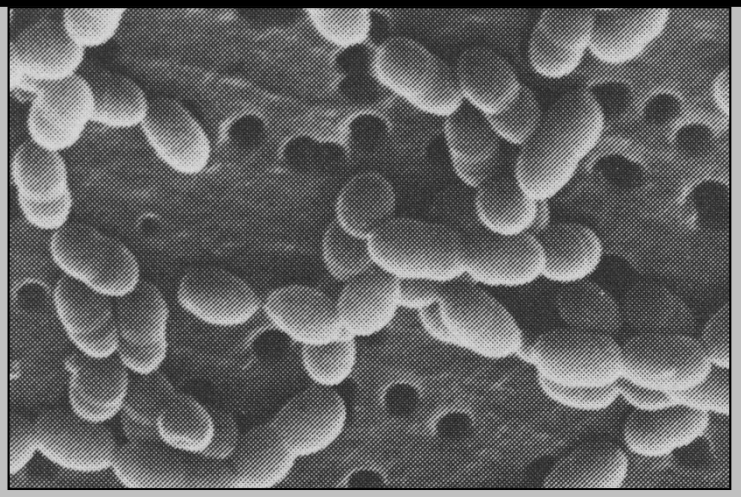
*Streptococcus mutans, Streptococcus viridans, Staphylococcus aureus, Pseudomonas aeroguinosa* produzieren Bacteriocine (Antibiotika), die das Wachstum anderer Mikroorganismen hemmen *(Lehner T. 1992).*

Im Vergleich zum Gesunden manifestieren sich beim Parodontitis-Patienten dabei unterschiedliche Wirkungsweisen. Speichelproteine (Mucin, Lysozym, Lactoferrin, Amylase, Peroxidase, Histatin ...) besitzen ebenfalls eine Hemmwirkung auf Bakterien und andere Mikroorganismen.

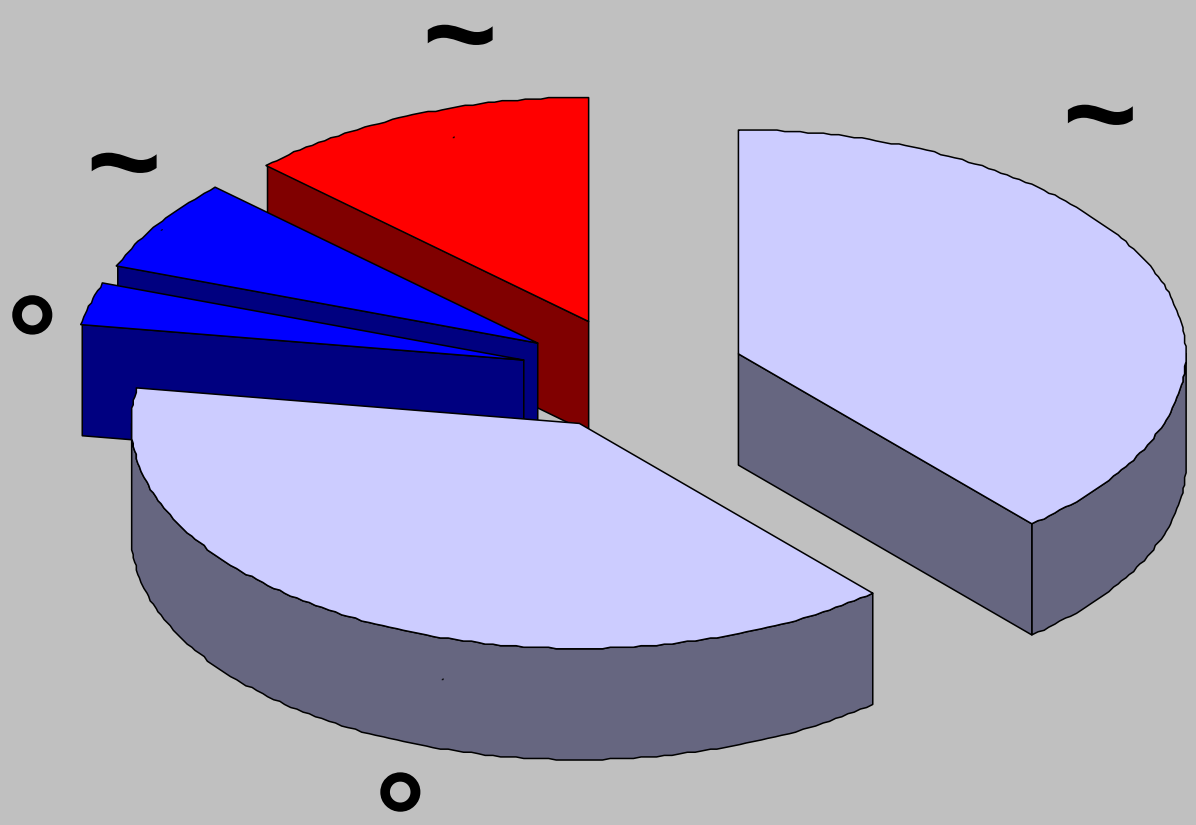
Nicht das Vorhandensein einzelner Bakterien ist krankheitsauslösend - es ist immer die Kombination bestimmter Mikroorganismen.

Immunglobulin A verhindert die Bakterienbesiedelung auf der Schleimhaut und den Zähnen *(Moss S. J. et al. 1998).* Das Problem der Kariesimpfung besteht in der Merkfähigkeit der immunisierenden Eigenschaften von Immunglobulin A.

# Keimspektrum bei gesunder Gingiva

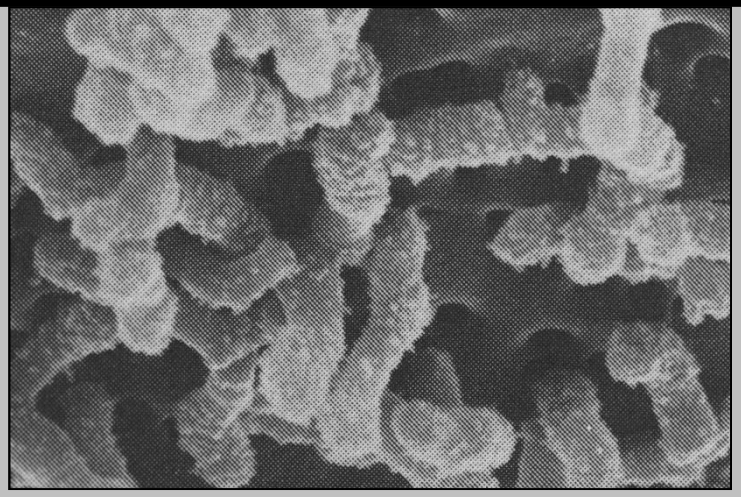


Streptococcus mutans
Actinomyces viscosus
A. naeslundi ...

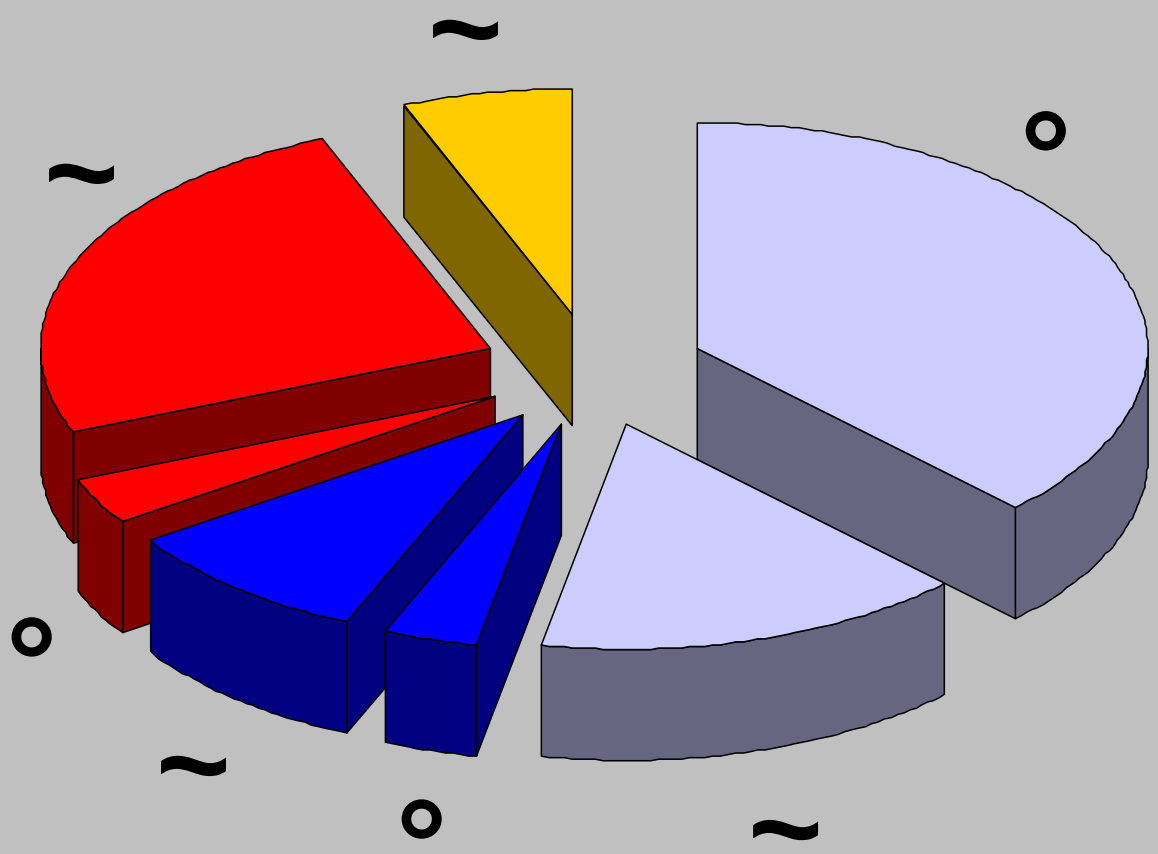



- + Kokken aerob °
- + Stäbchen aerob ~
- + Kokken anaerob °
- + Stäbchen anaerob ~
- - Stäbchen anaerob ~

# Keimspektrum bei Gingivitis

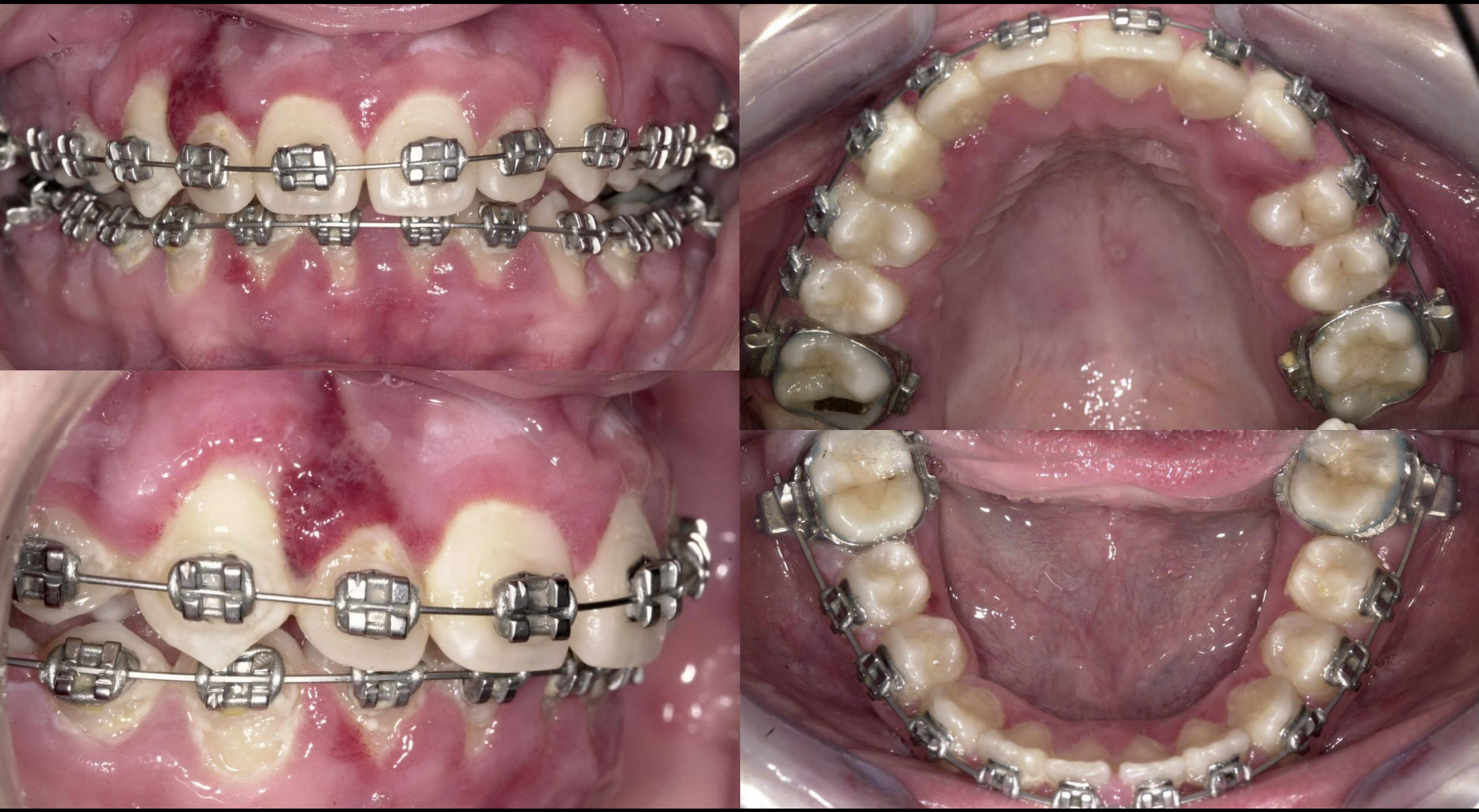


Actinomyces viscosus
Bacteroides melaninogenicus
Eikinella corrodens ...



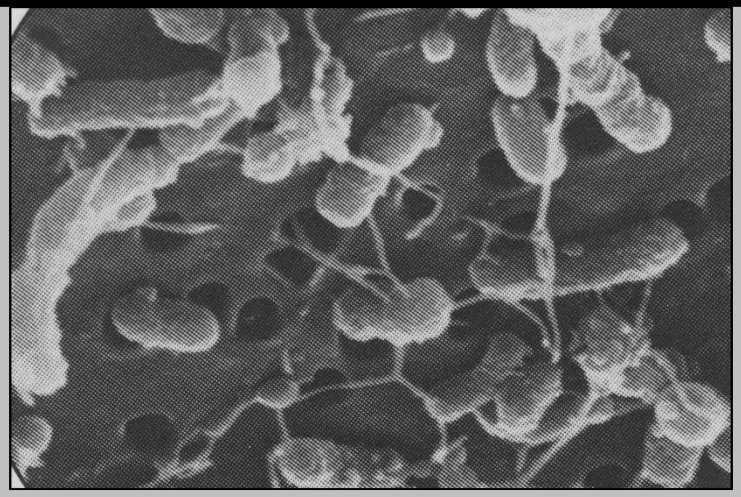

- + Kokken aerob °
- + Stäbchen aerob ~
- + Kokken anaerob °
- + Stäbchen anaerob ~
- - Kokken anaerob °
- - Stäbchen anaerob ~
- - Stäbchen aerob ~

# Keimspektrum bei Gingivitis

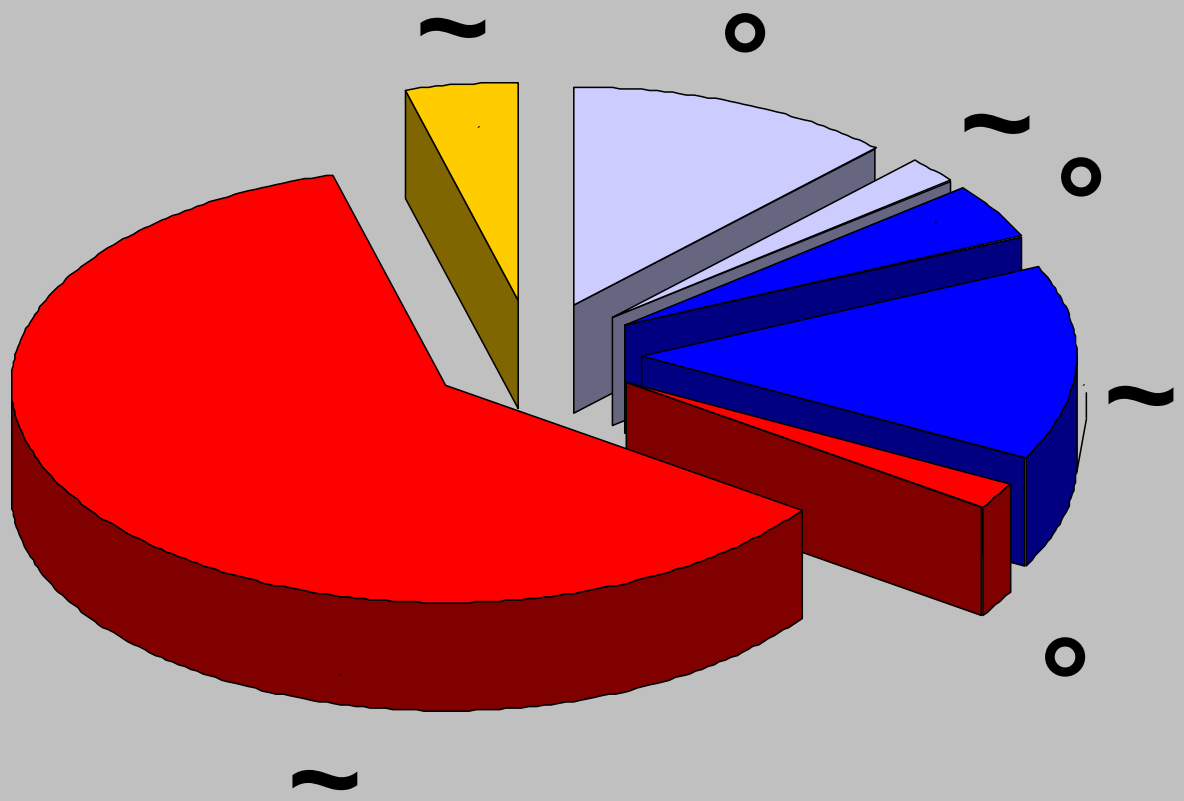


M. Haas Graz

# Keimspektrum bei aggressiver Parodontitis

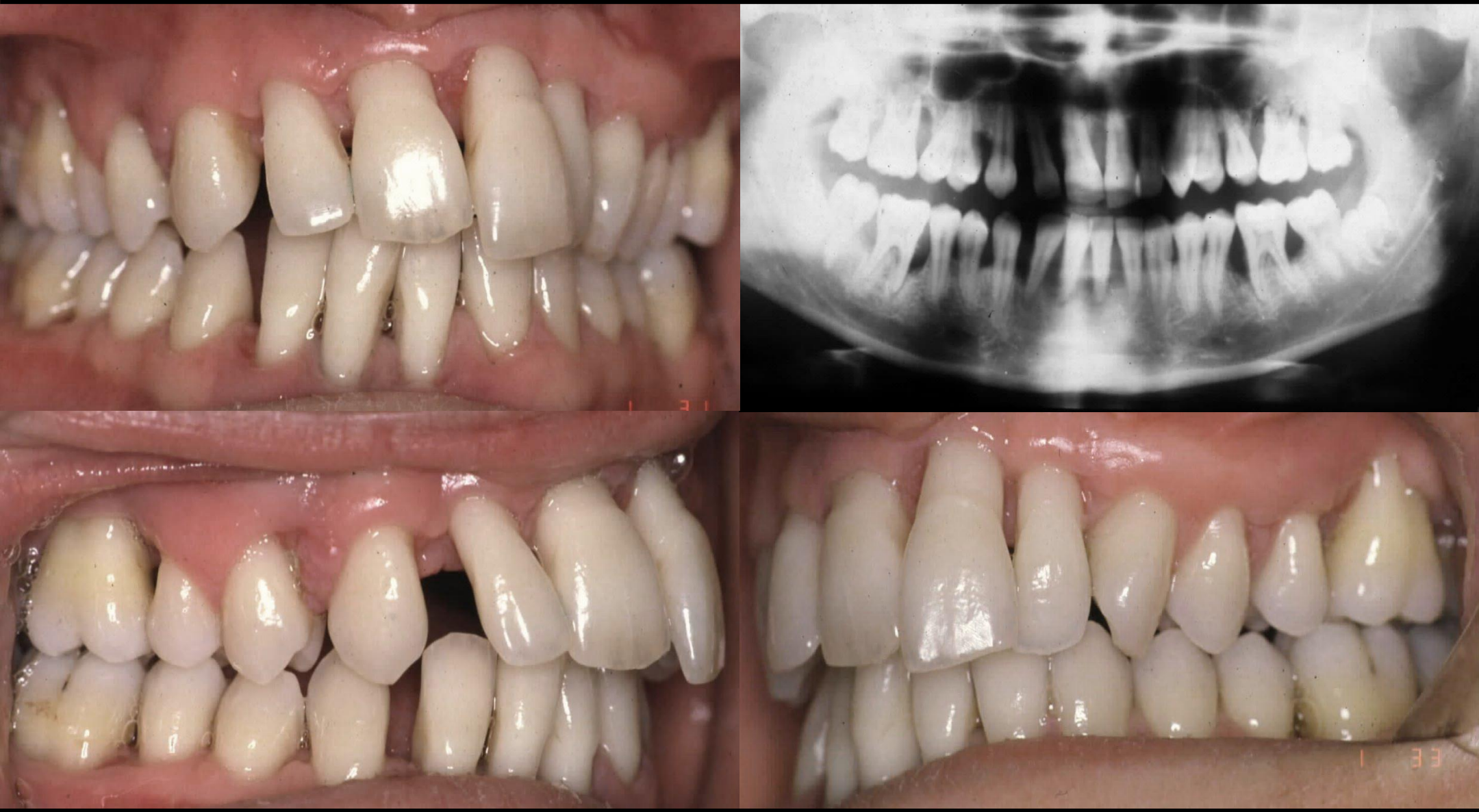


Aggregatibacter actinomycetemcomitans
Fusobacterium nucleatum
Treponema denticola …



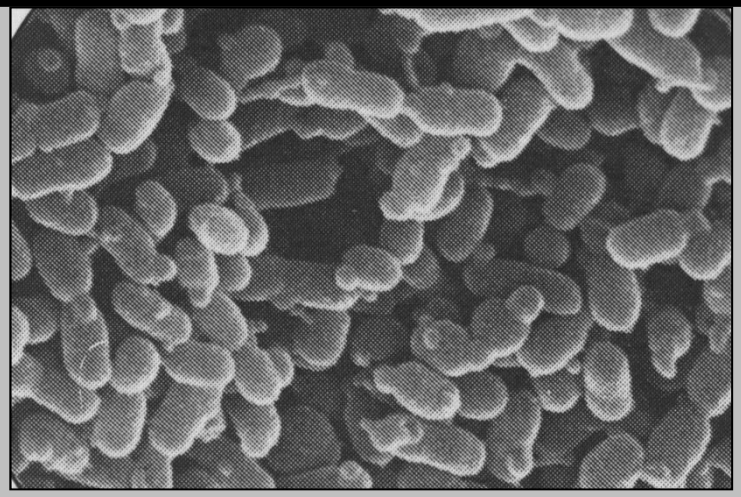

- + Kokken aerob °
- + Stäbchen aerob ~
- + Kokken anaerob °
- + Stäbchen anaerob ~
- - Kokken anaerob °
- - Stäbchen anaerob ~
- - Stäbchen aerob ~

# E. C. - 21,7 J - w - 12.11.1985

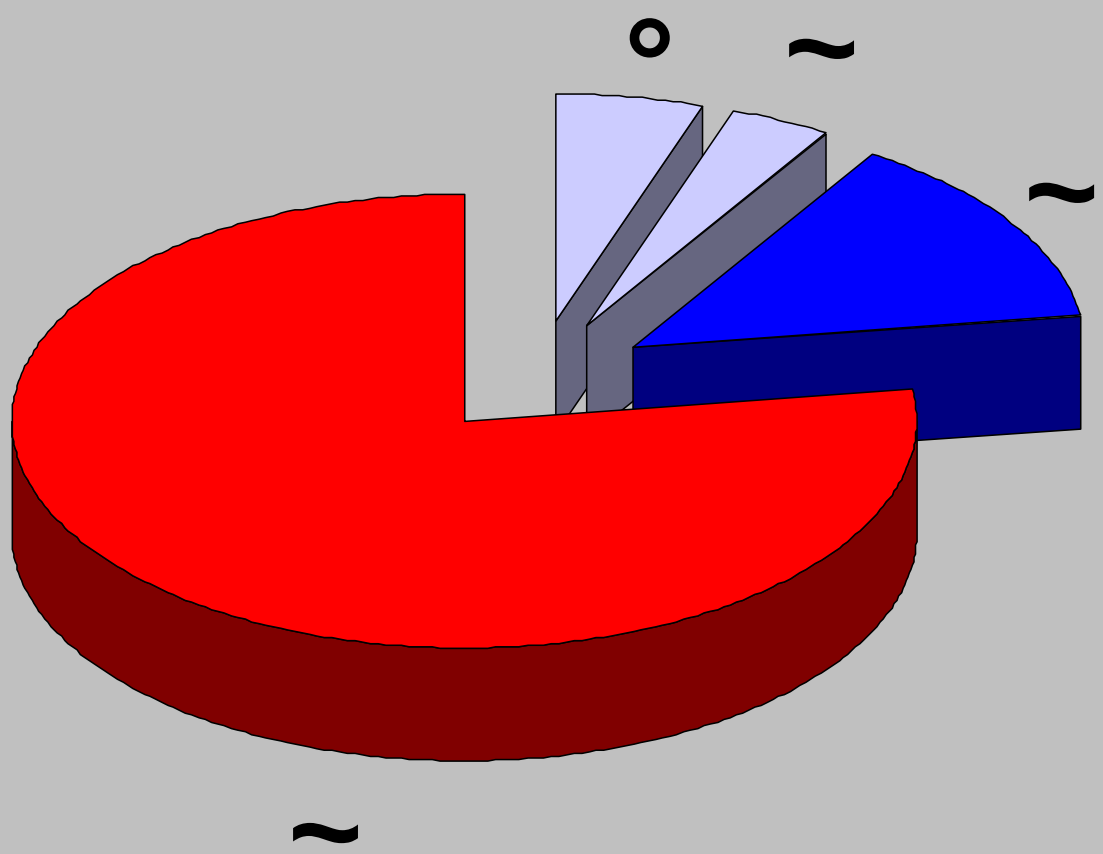


M. Haas Graz

# Keimspektrum bei aggressiver Parodontitis

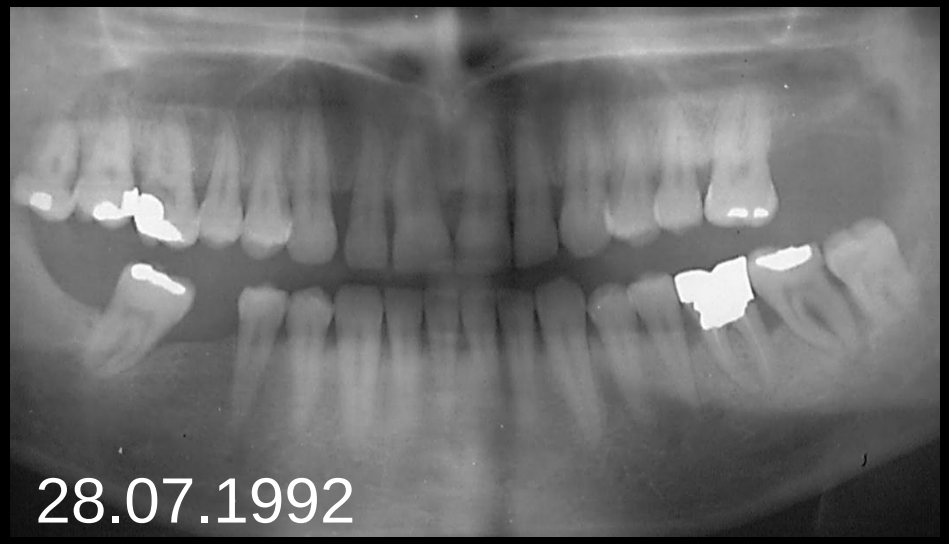


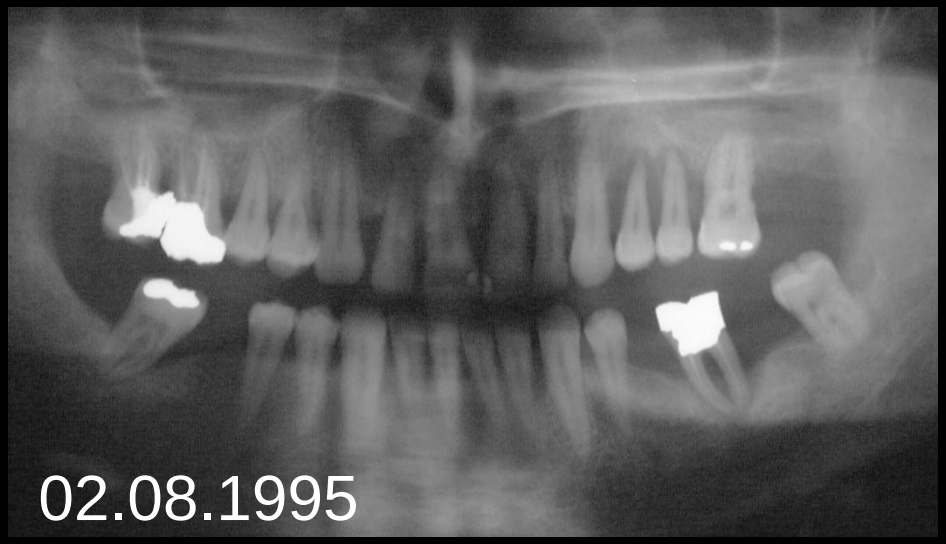
Porphyromonas gingivalis
Tannerella forsythensis
Treponema denticulum

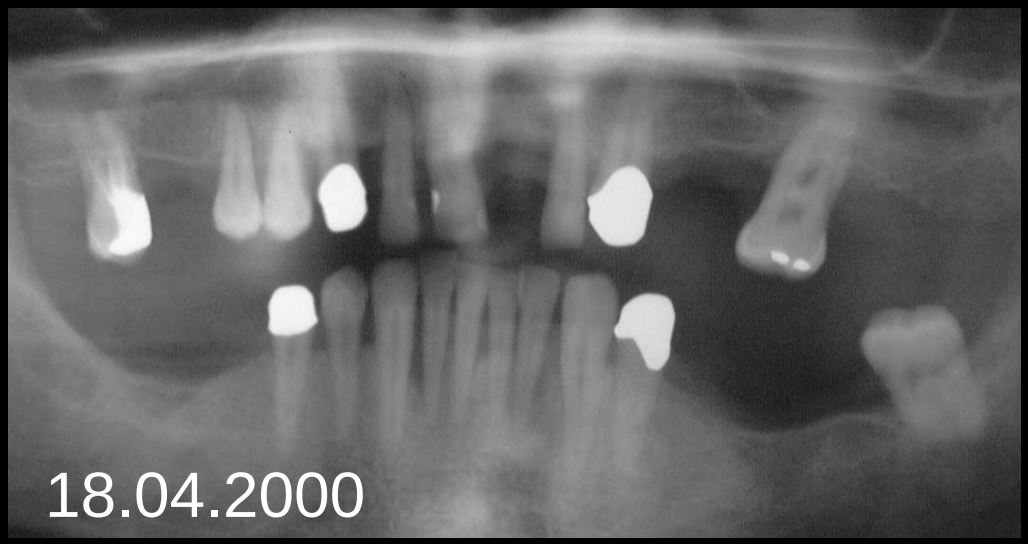



- + Kokken aerob °
- + Stäbchen aerob ~
- + Stäbchen anaerob ~
- - Stäbchen anaerob ~

# P. P. - 30,4 J - m



# Keimspektrum

nach Slots 1976, 1979, 1990, 2002, Lindhe 1983, Rams 1990, 1992, 2014, Umeda 2003

| | Grampositive Bakterien | |
|---|---|---|
| | aerob und fakultativ anaerob | anaerob |
| KOKKEN | Streptococcus (S. mutans, S. mitis)<br>Staphylococcus, Micrococcus | Streptococcus intermedius<br>Streptococcus constellatus<br>Peptostreptococcus micros<br>Peptococcus |
| STÄBCHEN | Actinomyces (A. naeslundi, A. viscosus)<br>Bacterionema, Rothia<br>Lactobazillus | Actinomyces (A. israeli)<br>Arachina, Eubacterium, Clostridium<br>Bifidobacterium, Propionibacterium |

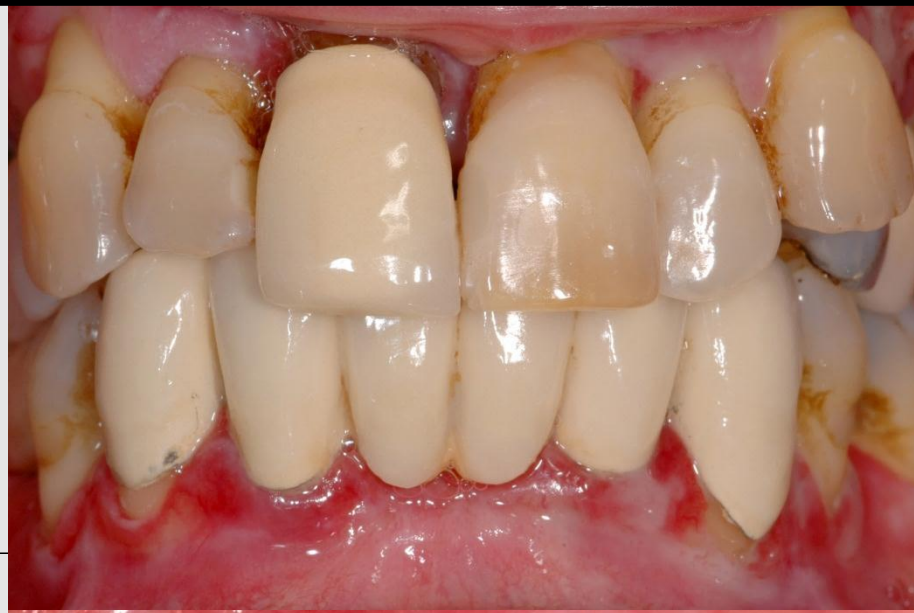
(parodontal pathogen)

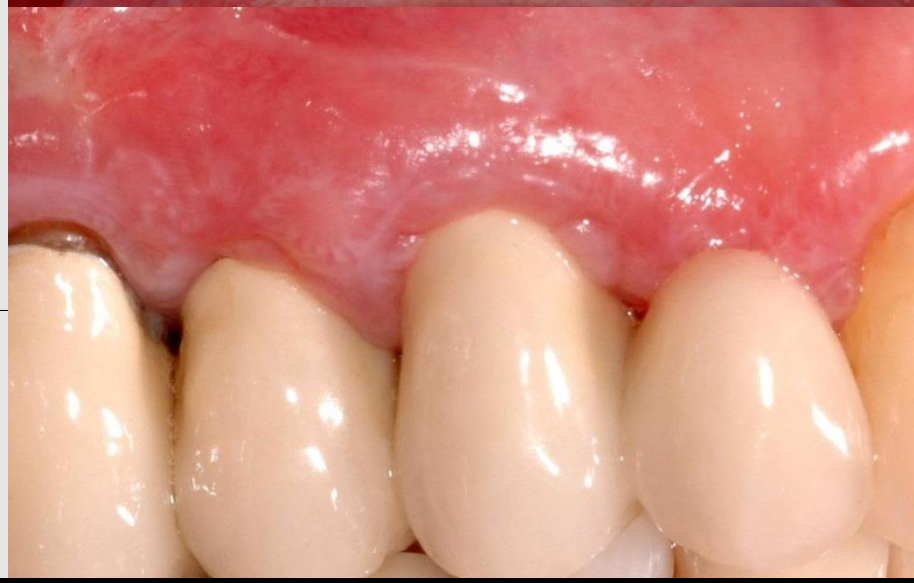
# Keimspektrum

| | Gramnegative Bakterien | |
|---|---|---|
| | aerob und fakultativ anaerob | anaerob |
| KOKKEN | Neisseria<br>Branhamella | Veillonella<br>Acidaminicoccus |
| STÄBCHEN | Aggregatibacter actinomycetemcomitans (Aa)<br>Capnocytophaga species (Cs)<br>Eikenella corrodens (Ec)<br>Haemophilus | Porphyromonas gingivalis (Pg)<br>Prevotella intermedia (Pi) / P. nigrescens<br>Bacteroides forsythus (Bf) =<br>Tannerella forsythensis (Tf)<br>Fusobacterium nucleatum (Fn)<br>Fusobacterium naviforme<br>Leptotrichia, Selemonas<br>Campylobacter rectus, Wolinella |
| | (parodontal pathogen) | Spirochäten: Treponema denticola (Td) |

# Keimspektrum

| | |
|---|---|
| BAKTERIEN | Mycoplasma<br>Helicobacter pylori in Biozönose mit<br>Tannarella forsythensis, Prevotella intermedia<br>Pseudomonas species<br>Klebsiellen<br>Enterobacter |
| VIREN | Zytomegalieviren (HCMV) in Kombination<br>mit Dialister pneumosintes<br>Epstein-Barr (EBV-1)<br>Herpesviren: Herpes simplex |
| ANDERE | Amöben: Entamöba histolytica<br>Protozoen: Trichomonas<br>Candida: Candida albicans |

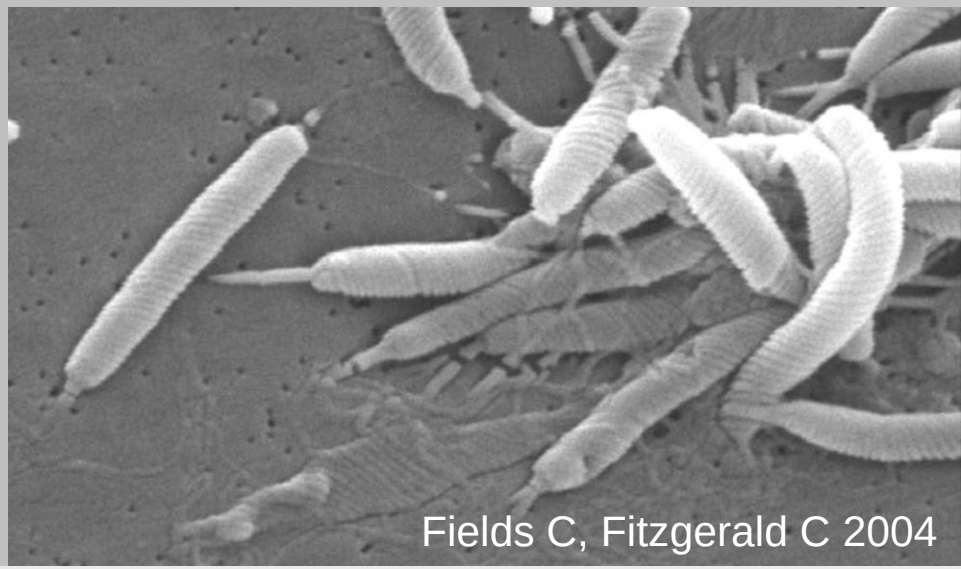




M. Haas Graz

# Keimspektrum - Helicobacter pylori

Helicobacter pylori, der per se nicht als parodontopathogen eingestuft wird, kann im Mund im Schutz der subgingivalen Plaque überleben, in enger Beziehung, einer Biozönose mit unseren Leitkeimen Tannarella forsythensis bzw. Prevotella intermedia. Zytokine des Helicobacter haben zellschädigende Wirkungen auf die Schleimhäute auch im Mund und es kann ausgehend von der Mundhöhle zu Reinfektionen im Magen kommen.




Conclusion: Tooth loss and wearing removable dental prosthesis were weakly to moderately associated with higher anti-*H. pylori* IgG titer levels in the general population of a European country.

Schwahn C, Samietz S, Mundt T, et al. Reducing uncertainty in estimating associations of oral exposures with *Helicobacter pylori* serology in the general population. J Clin Periodontol 2018;45:1056-1068.

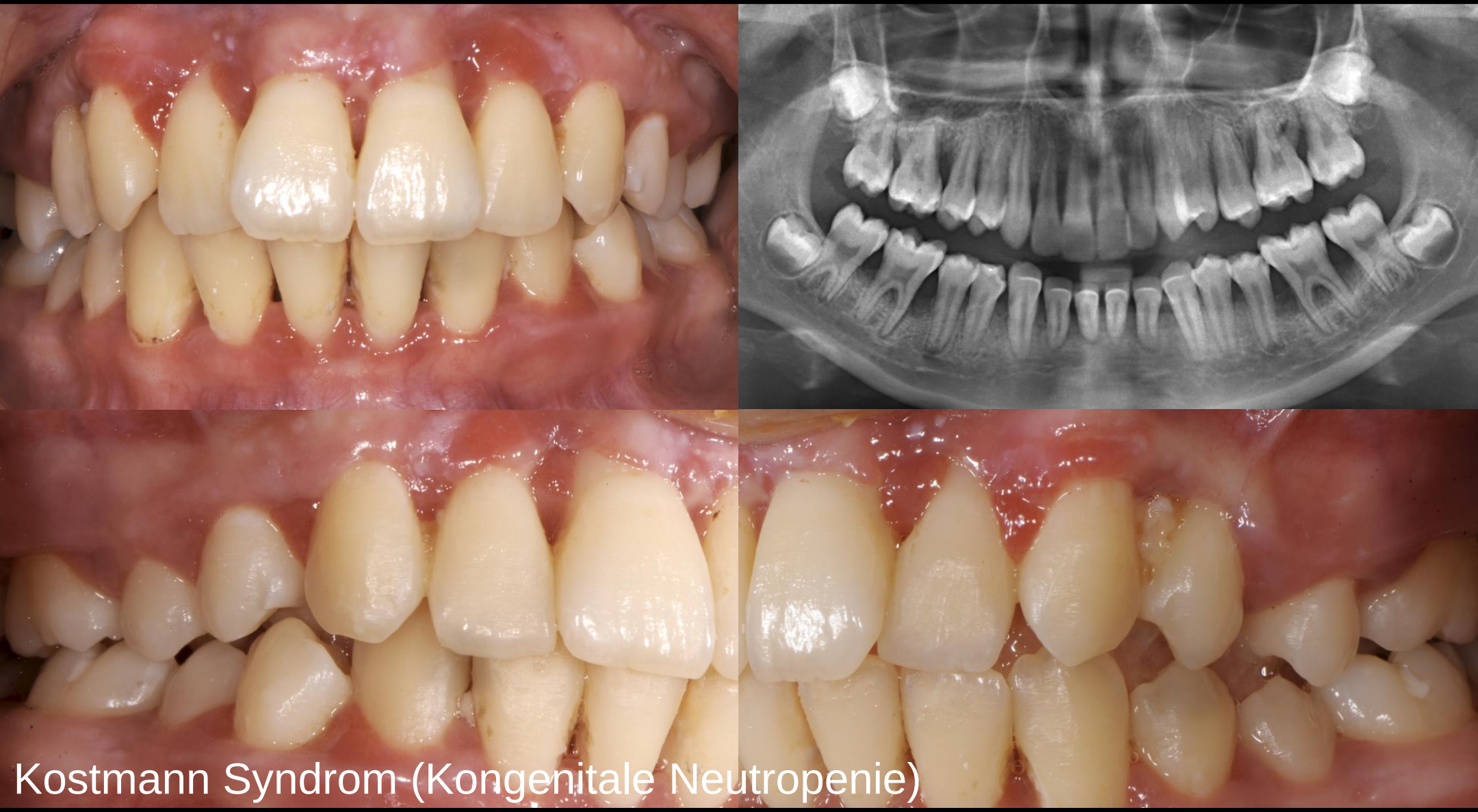
## Gingivale Veränderungen

- Hormonelle Veränderungen
- Autoimmunerkrankungen
- Hauterkrankungen
- Medikamente:
  - Cyclosporin A, Hydantoin
- Idiopathische Fibrose
- Epulis, Neoplasmen
- Verletzungen, Verätzungen
- Spezifische Infektionen:
  - Herpes, Aphten, Toxoplasmose...
- Allergien

## Parodontale Veränderungen

- Stoffwechselstörungen:
  - Diabetes, Hyperlipidämie
- Mangelernährung
- Blutzellerkrankungen:
  - Leukämien, Erythroblastenanämie
  - zyklische Neutropenie, M. Kostmann
- Genetisch bedingte Syndrome:
  - Down-Syndrom
  - Papillon-Lefèvre-Syndrom
  - Hypercholesterinämie
  - Hypophosphatasie

# S. K. - 13,8 J - w - 17.09.2012



Kostmann Syndrom (Kongenitale Neutropenie)

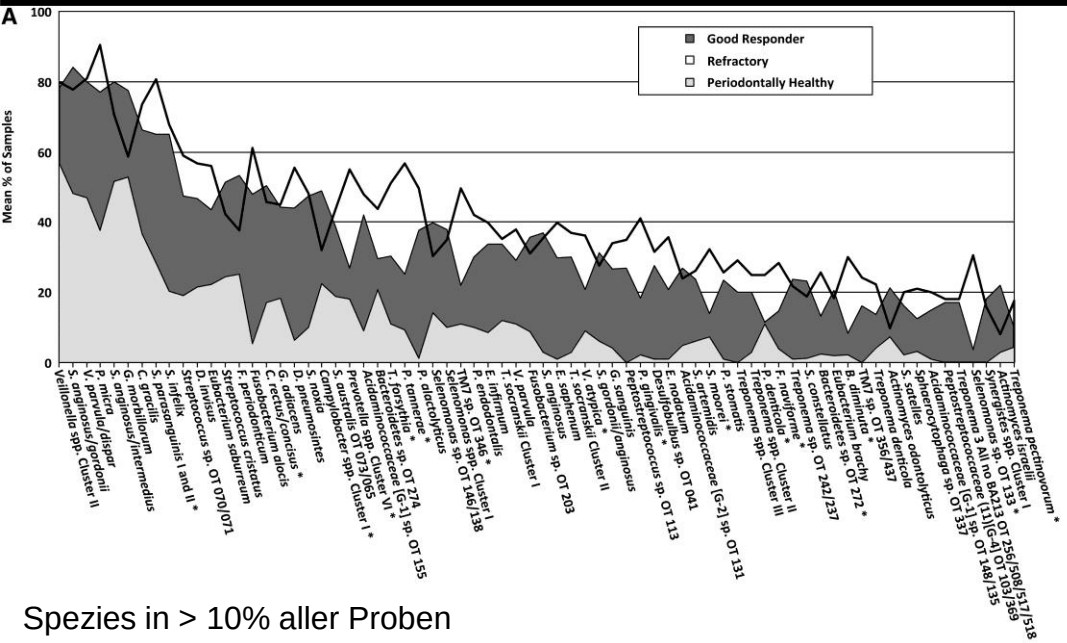
M. Haas Graz

# Keimspektrum verschiedener Parodontitisformen

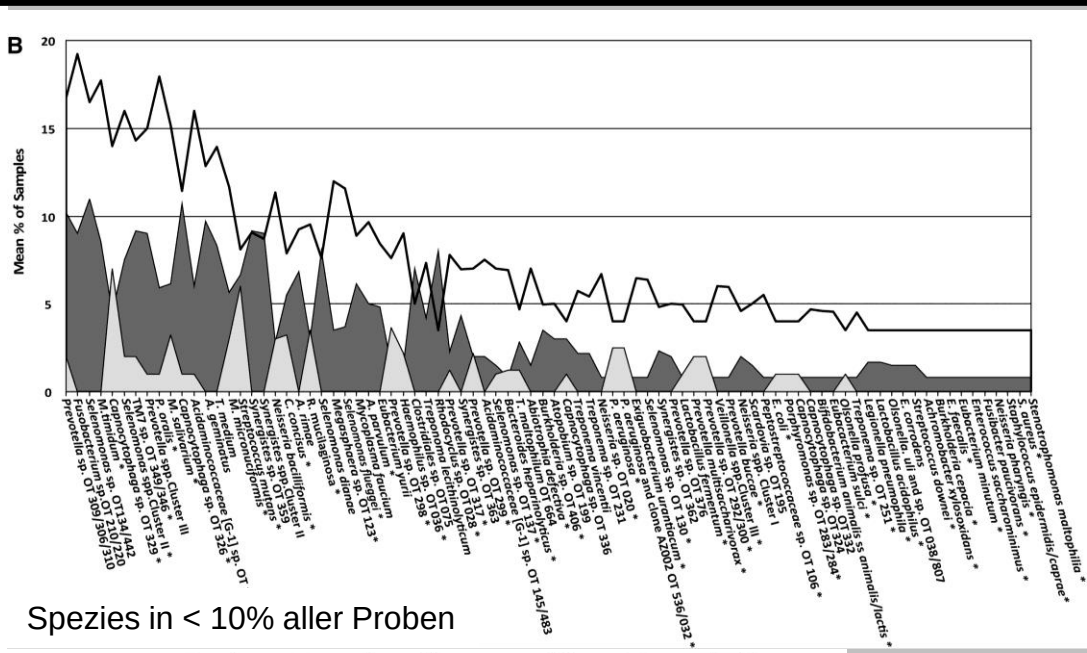
| Parodontitis | Juvenil | Early Onset | Adult | Refraktär | Misserfolge |
|---|---|---|---|---|---|
| Fusobacterium sp. | + | + + | + + + | + + | + + + |
| Aggregatibacter actinomyc. | + + + | + + | + + | + + | + + |
| Porphyromonas gingivalis | + - | + + + | + + + | + + | + + |
| Prevotella inter./ nigrescens | + + | + + + | + + + | + + + | + + + |
| Tannerella forsythensis | + - | + + | + + + | + + | + + |
| Camphylobacter rectus | + | + + | + + | + | + + + |
| Peptostreptokokkus micros | + - | + + | + + + | + + | + + + |
| Eubacterium species | - | + | + + | + | + |
| Treponema species | + + | + + + | + + + | + + | + + |
| ß-haemolys. Streptokokken | ? | + + | + + | + + | + |
| Candida sp. | - | - | - | + - | - |

Loesche 1985, Slots 1990, Doughtery 1993, Nowzari 1994, Nowzari 1995, Mombelli 1998, AAP 2000, Mombelli 2005, Heitz-Mayfield 2006

# Keimspektrum verschiedener Parodontitisformen




Spezies in > 10% aller Proben



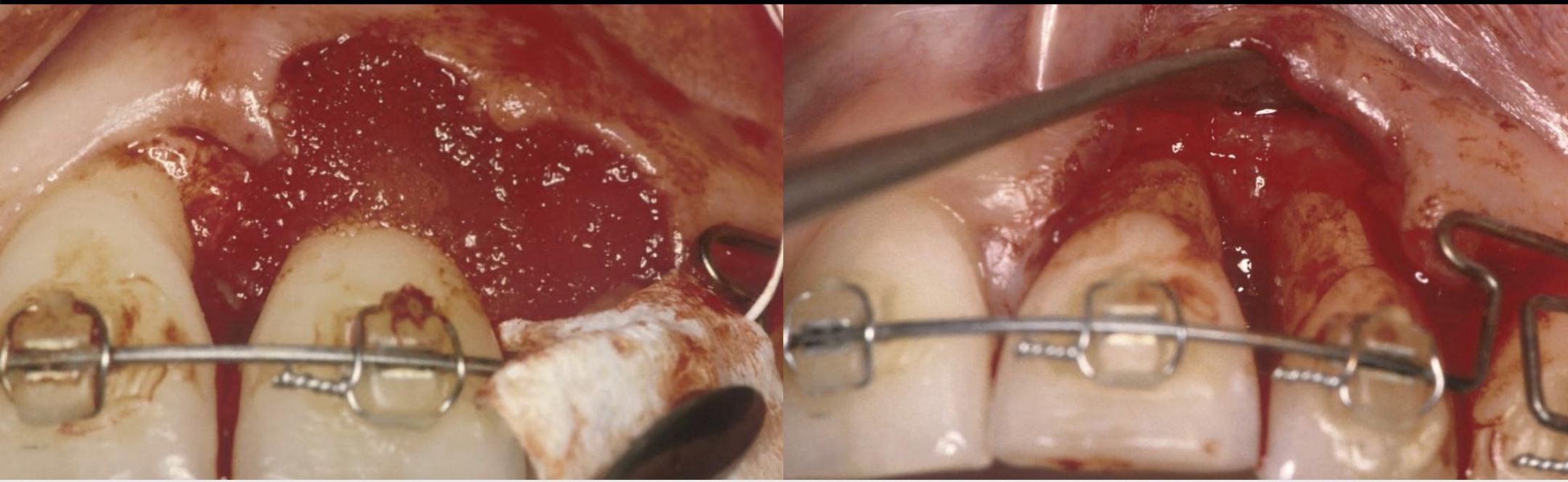

Spezies in < 10% aller Proben

Good Responder | Refractory | Periodontally Healthy

Patients with refractory periodontitis (RP) presented a distinct microbial profile compared to patients in the good responder (GR) and periodontally healthy (PH) groups.

Colombo APV, Boches SK, Cotton SL, Goodson JM, Kent R, Haffajee AD, Socransky SS, Hasturk H, Van Dyke TE, Dewhirst F, Paster BJ. Comparisons of subgingival microbial profiles of refractory periodontitis, severe periodontitis, and periodontal health using the human oral microbe identification microarray. *Periodontol* 2009;80:1421-1432.

# GTR und bakterielle Kolonisation

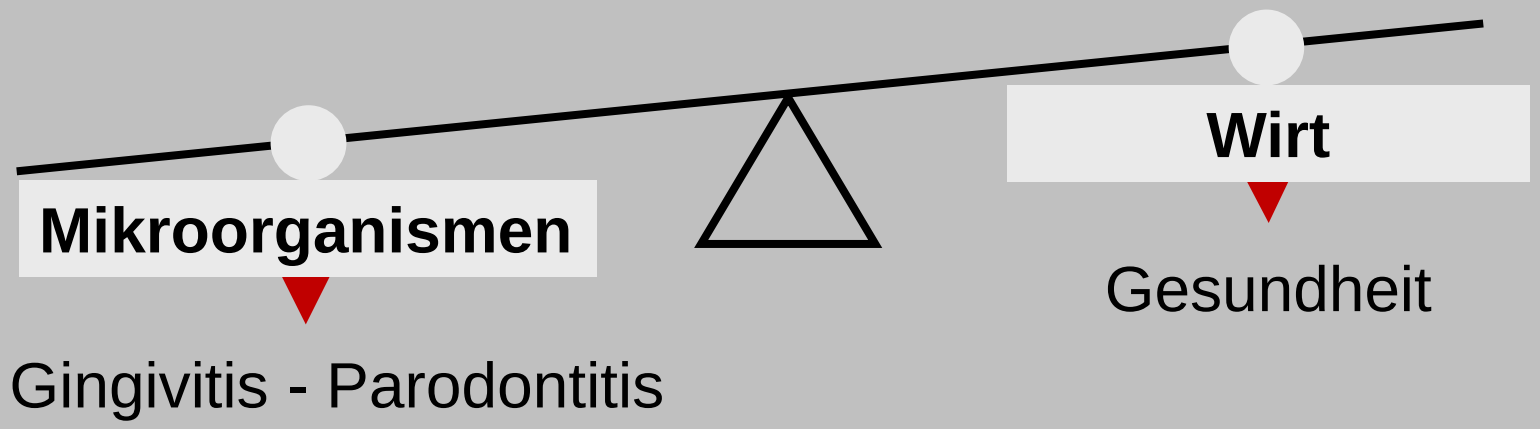


Die pathogene Kolonisation von nach dem GTR-Prinzip behandelten Stellen korreliert mit dem präoperativen Vorkommen der Mikroorganismen. Wenn die postoperative Kolonisation verhindert werden soll, ist die intraorale Suppression bzw. Eradikation der Mikroorganismen erforderlich.

Rüdiger SG, Ehmke B, Hommens A, Karch H, Flemmig TF. Guided tissue regeneration using a polylactic acid barrier. Part I: Environmental effects on bacterial colonization. *J Clin Periodontol 2003;30:19-25.*

# Entstehung der Parodontitis

EB

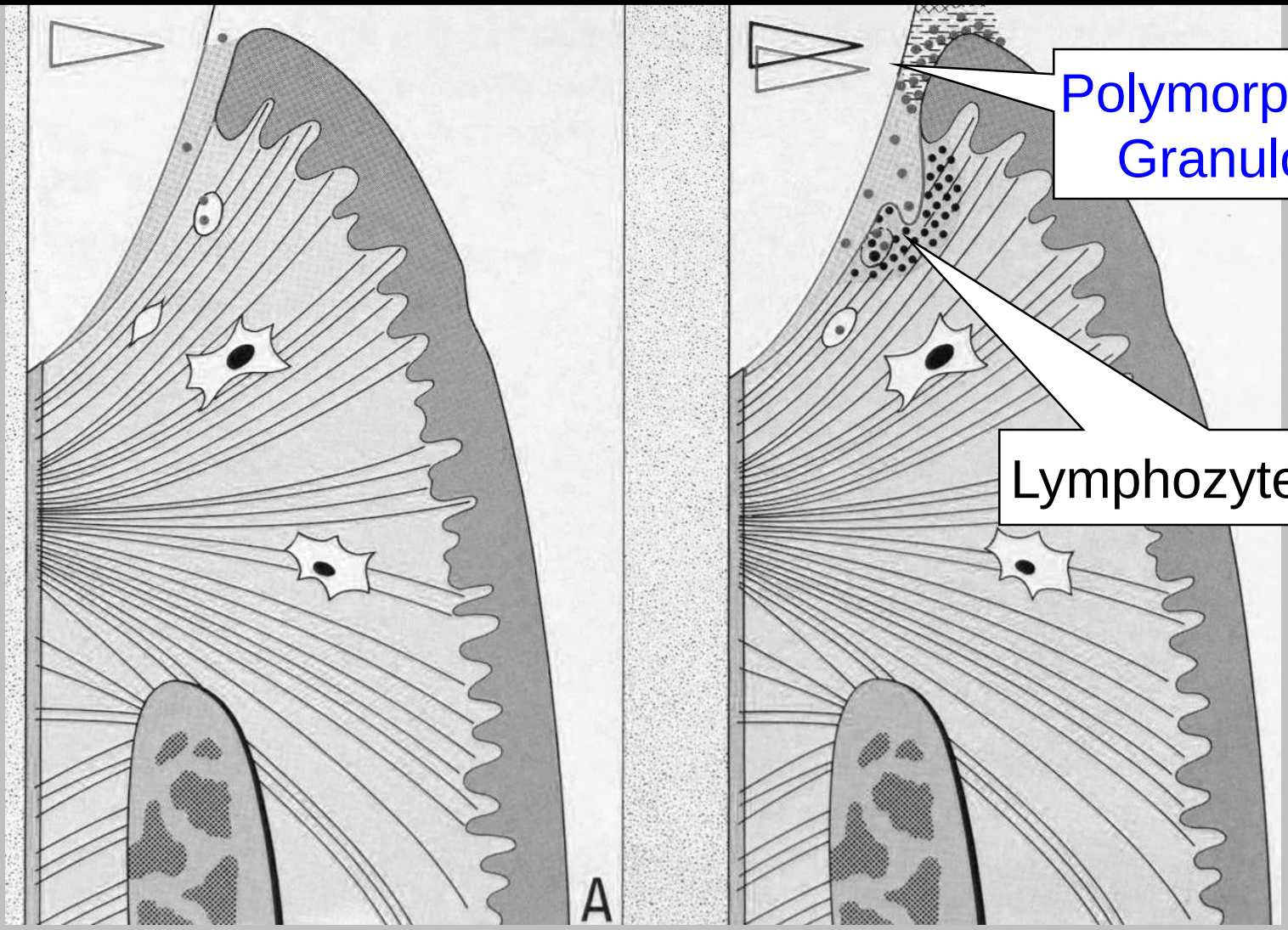



| Endogene Risikofaktoren | Exogene Risikofaktoren |
|---|---|
| Systemerkrankungen | Rauchen |
| Schwangerschaft | Alkohol - Medikamente |
| Genetische Faktoren | Lebenspartner - Familie |
| Genetisch bedingte Syndrome | Ernährung |
| Psychosoziale Faktoren | Psychosoziale Faktoren - Stress |

Heitz-Mayfield LJA. Disease progression: identification of high-risk groups and individuals for periodontitis. *J Periodontol 2005;32(6):196-192.*

# Entwicklung der Gingivitis und Parodontitis

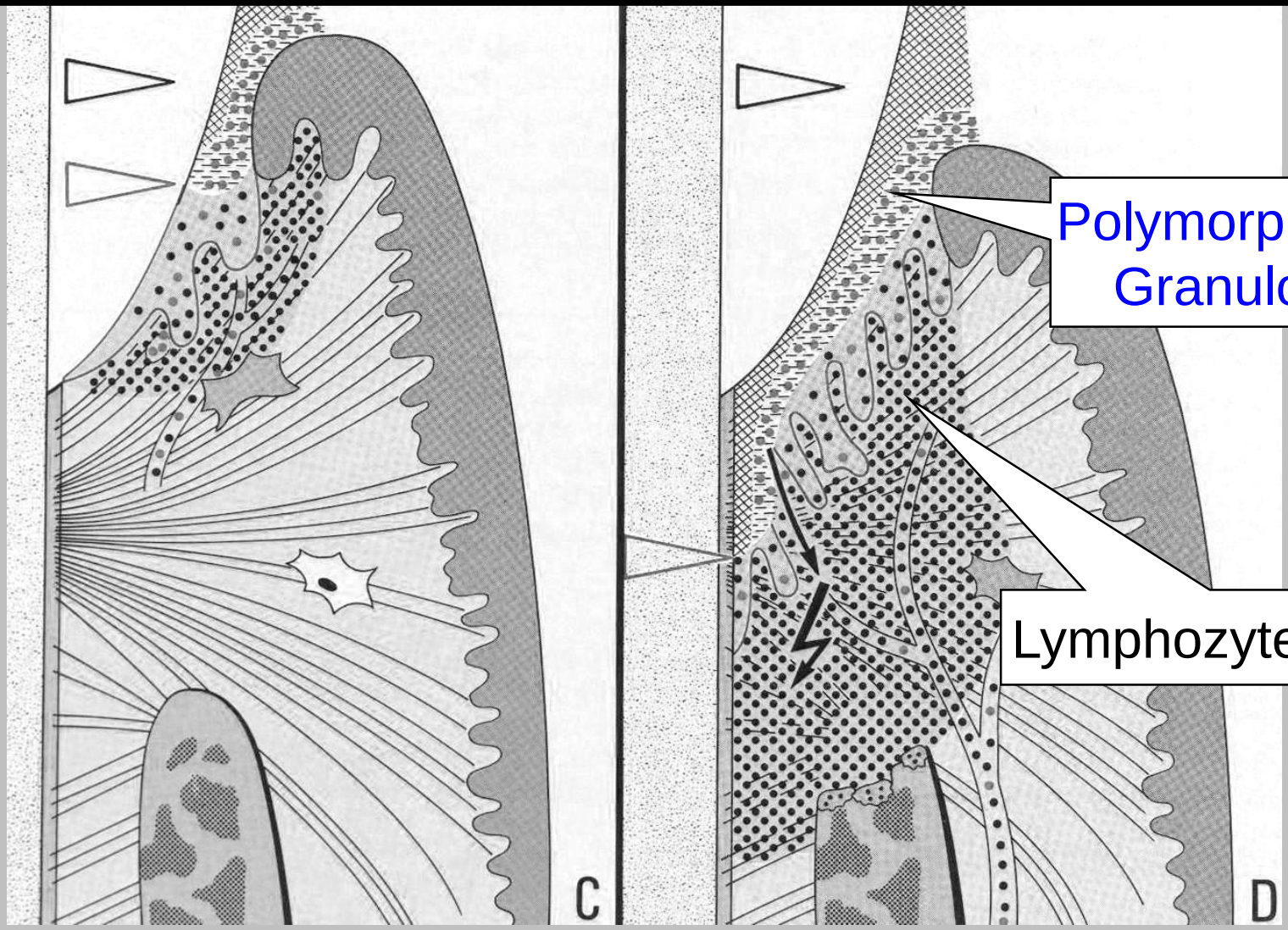
nach Rateitschak




**Gesunde Gingiva** **Initiale Gingivitis**

# Entwicklung der Gingivitis und Parodontitis

nach Rateitschak




**Etablierte Gingivitis** **Parodontitis**

# Einteilung parodontaler und periimplantärer Erkrankungen

| Parodontal gesund & gingivale Erkrankungen | Parodontitis | Andere Ursachen parodontaler Erkrankung |
|---|---|---|
| 1. Parodontal und gingival gesund<br>2. Gingivitis Biofilm-induziert<br>3. Gingivitis nicht Biofilm-induziert | 1. Nekrotisierende Parodontal-Erkrankungen<br>2. Parodontitis<br>3. Manifestation systemischer Erkrankungen | 1. Systemische Ursachen<br>2. Parodontaler Abszess und Paro- Endoläsionen<br>3. Mukogingivale Ursachen<br>4. Okklusales Trauma<br>5. Zahnbezogene und prothetische Faktoren |

## Periimplantäre Erkrankungen

| | | |
|---|---|---|
| 1. Periimplantär gesund<br>2. Periimplantäre Mukositis | 3. Periimplantitis | 4. Periimplantäre Defekte des Hart- bzw. des Weichgewebes |

Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, Mealey BL, Papapanou PN, Sanz M, Tonetti MS. A new classification scheme for periodontal and peri-implant diseases and conditions – Introduction and key changes from the 1999 classification.
*J Clin Periodontol. 2018;45:45(Suppl 20);S1-S8.*

# Einteilung parodontaler und periimplantärer Erkrankungen

## Parodontal gesund & gingivale Erkrankungen

1. Parodontal und gingival gesund
   a. Klinisch gingival gesund mit intaktem Parodontium
   b. Klinisch gingival gesund mit reduziertem Parodontium
      - ⇨ Stabiler Parodontitispatient
      - ⇨ Patient ohne Parodontitis
2. Gingivitis Biofilm-induziert
   a. Rein Biofilm-induziert
   b. Verbunden mit systemischen bzw. lokalen Risikofaktoren
   c. Medikamentös bedingte gingivale Veränderungen
3. Gingivitis nicht Biofilm induziert
   a. Genetische und entwicklungsbedingte Störungen
   b. Spezifische Infektionen
   c. Entzündliche und immunologische Verhältnisse
   d. Reaktive Prozesse
   e. Neoplasmen
   f. Metabolische & endokrinol. Erkrankungen
   g. Traumatische Läsionen
   h. Gingivale Pigmentation

Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, Mealey BL, Papapanou PN, Sanz M, Tonetti MS. *J Clin Periodontol. 2018.*

# Einteilung parodontaler und periimplantärer Erkrankungen

## Parodontitis

1. Nekrotisierende Parodontalerkrankungen
   a. Nekrotisierende Gingivitis  b. Nekrotisierende Parodontitis  c. Nekrotisierende Stomatitis
2. Parodontitis
   a. Stadium
      I. Initiale Parodontitis
      II. Moderate Parodontitis
      III. Schwere Parodontitis mit Risiko von weiterem Zahnverlust
      IV. Schwere Parodontitis mit Risiko von totalem Zahnverlust
   b. Ausdehnung / Verteilung: lokalisiert (<30%), generalisiert (>30%), Molar-Front Verteilung
   c. Grad: Risiko der Progression (Röntgen, CAL, Knochenverlust altersabhängig, erwarteter Erfolg)
      Grad A: langsame Progression
      Grad B: moderate Progression
      Grad C: rasche Progression
3. Manifestation systemischer Erkrankungen

Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, Mealey BL, Papapanou PN, Sanz M, Tonetti MS. *J Clin Periodontol. 2018.*

# Einteilung parodontaler und periimplantärer Erkrankungen

## Andere Ursachen parodontaler Erkrankungen

1. Systemische Ursachen
2. Parodontaler Abszess und Paro-Endoläsionen
3. Mukogingivale Ursachen
    a. Gingivaler Phänotyp
    b. Gingiva- bzw. Weichgewebs-Rezession
    c. Fehlende Gingiva
    d. Reduktion des Vestibulums
    e. Aberrierende Frenula und Muskeln
    f. Gingivaler Überschuss
    g. Abnormale Farbe
    h. Zustand der freiliegenden Wurzeloberfläche
4. Okklusales Trauma
    a. Primäres okklusales Trauma
    b. Sekundäres okklusales Trauma
    c. Orthodontische Kräfte
5. Zahnbezogene und prothetische Faktoren
    a. Lokalisierte zahnspezifische Faktoren
    b. Lokalisierte prothetische Faktoren

Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, Mealey BL, Papapanou PN, Sanz M, Tonetti MS. *J Clin Periodontol. 2018.*

# Progression der Parodontalerkrankungen

Aim: To understand degeneration of healthy sites and identify factors associated with disease progression in patients with chronic periodontitis.

Material and Methods: Data on healthy sites from 163 American and Swedish subjects were analysed using two- three-state (health, gingivitis, chronic periodontitis) Markov models based on BOP, and either CAL + BOP or PD + BOP.

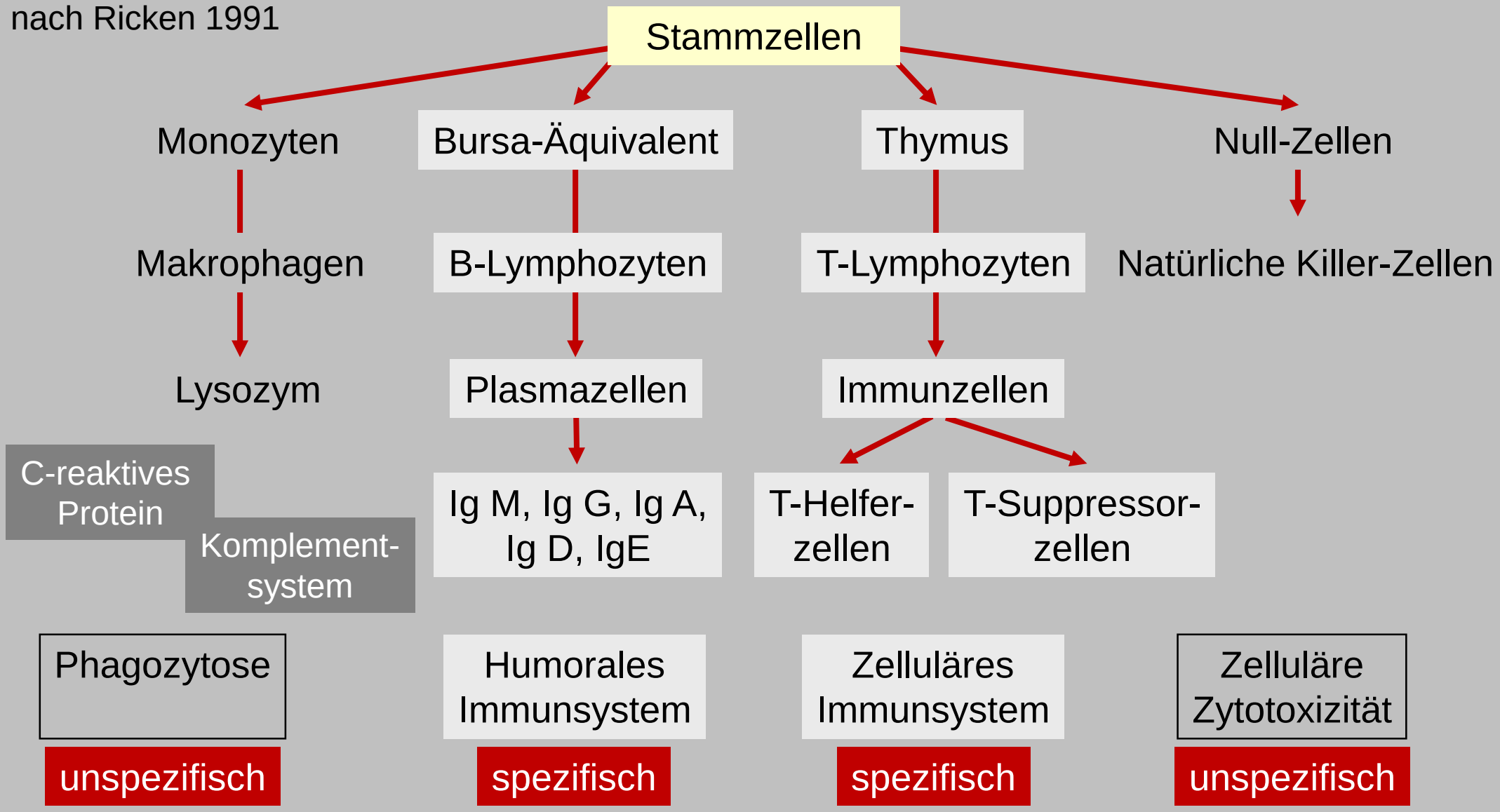
Results: In 2 years, 10% (CAL + BOP) and 3% (PD + BOP) of healthy sites developed chronic periodontitis. On average, healthy sites remained healthy for 32 months before transiting in both models. Most transitions (87–97%) from health were to the gingivitis state. The expected duration of the gingivitis lesion was 4–5 months and sites recovered with a high probability (96–98%). Disease severity as measured by number of sites with CAL/PD > 4 mm at baseline and smoking, were associated with fast progression from health to chronic periodontitis within 6 months as were gingival redness in the PD + BOP model only. With age, the rate of disease progression to gingivitis decreased.

Conclusion: Transition probabilities for gingivitis and chronic periodontitis were higher with CAL + BOP than with PD + BOP. Smoking and disease severity were significant predictors for fast progression.

Mdala I, Olsen I, Haffajee AD, Socransky SS, Thoresen M, de Blasio BF. Comparing clinical attachment level and pocket depth for predicting periodontal disease progression in healthy sites of patients with chronic periodontitis using multi-state Markov models. *J Clin Periodontol 2014;41: 837–845.*

# Komponenten des Immunsystems

nach Ricken 1991



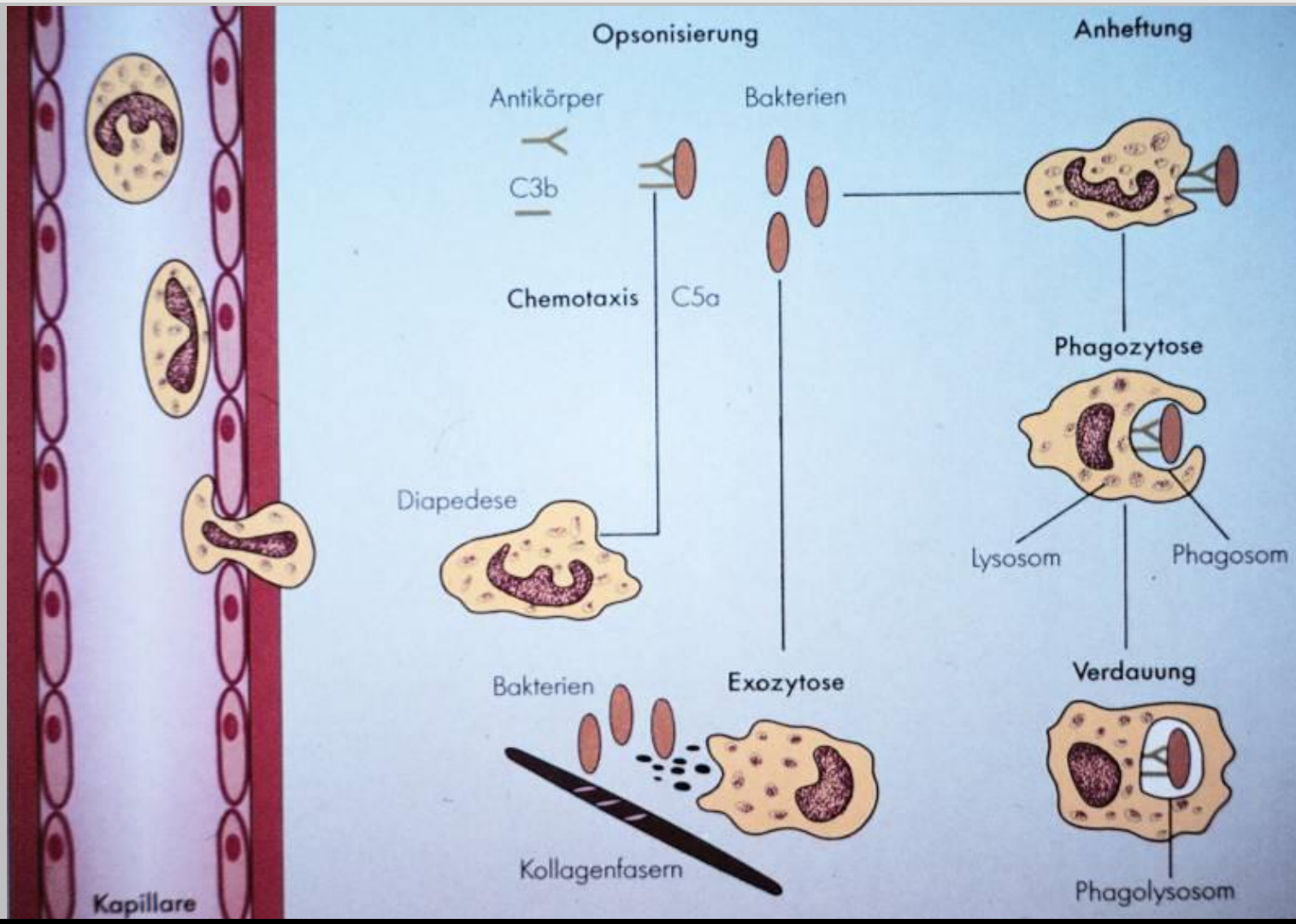
# Phlogogene Mechanismen

- Sekretorische System
- Neutrophile Granulozyten
- Antikörper
- Komplementsystem
- Leukozyten und Monozyten
- Immunregulatorische System

# Polymorphkernige neutrophile Granulozyten (PMN)

Erste und wichtigste Abwehrlinie der parodontalen Gewebe

- Phagozytose und Exozytose lysosomaler Enzyme
- Antimikrobiell



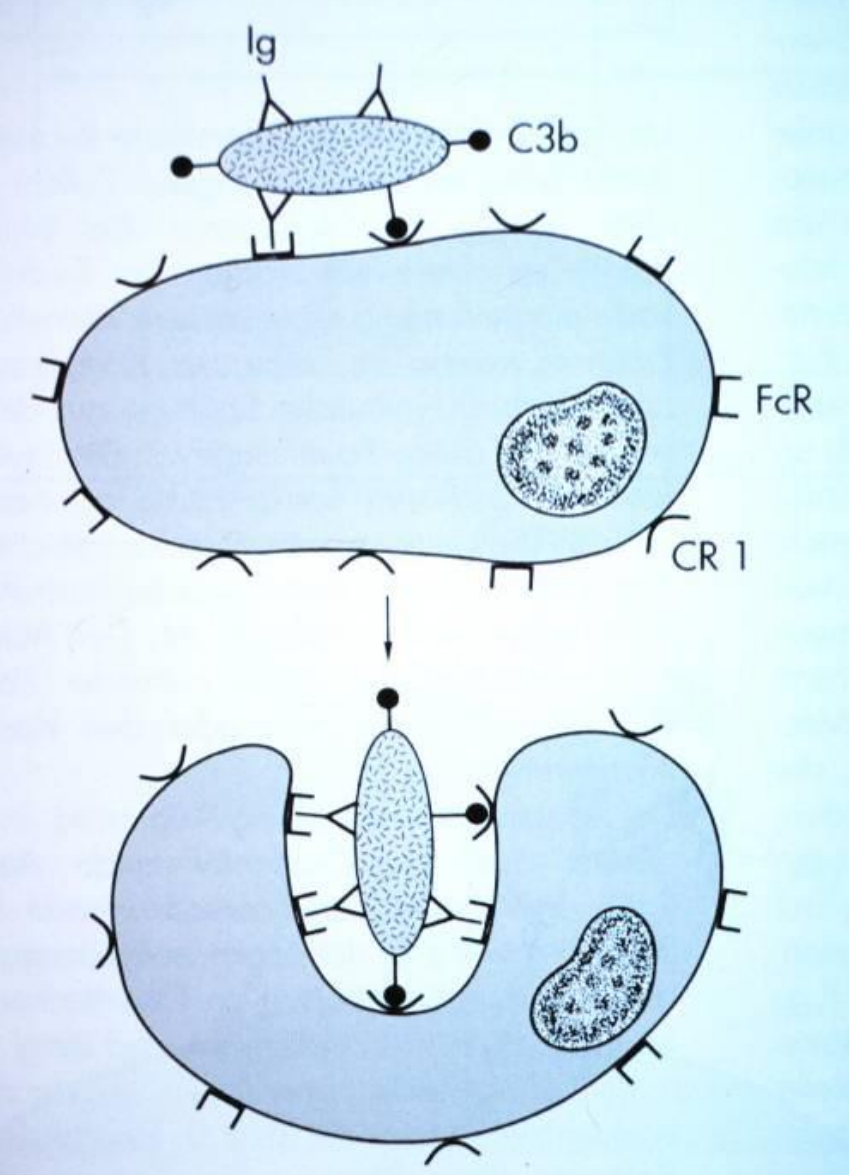
# Komplementsystem

System von Serumproteinen:

antibakteriell, Chemotaxis,

Aktivierung phagozytierender Zellen.

Komplementproteine haben möglicherweise das Potential zwischen Parodontitisformen bzw. gesund und krank differenzieren zu können.




Monefeld K. et al. *J Clin Periodontol 1995, 22:45-51*.

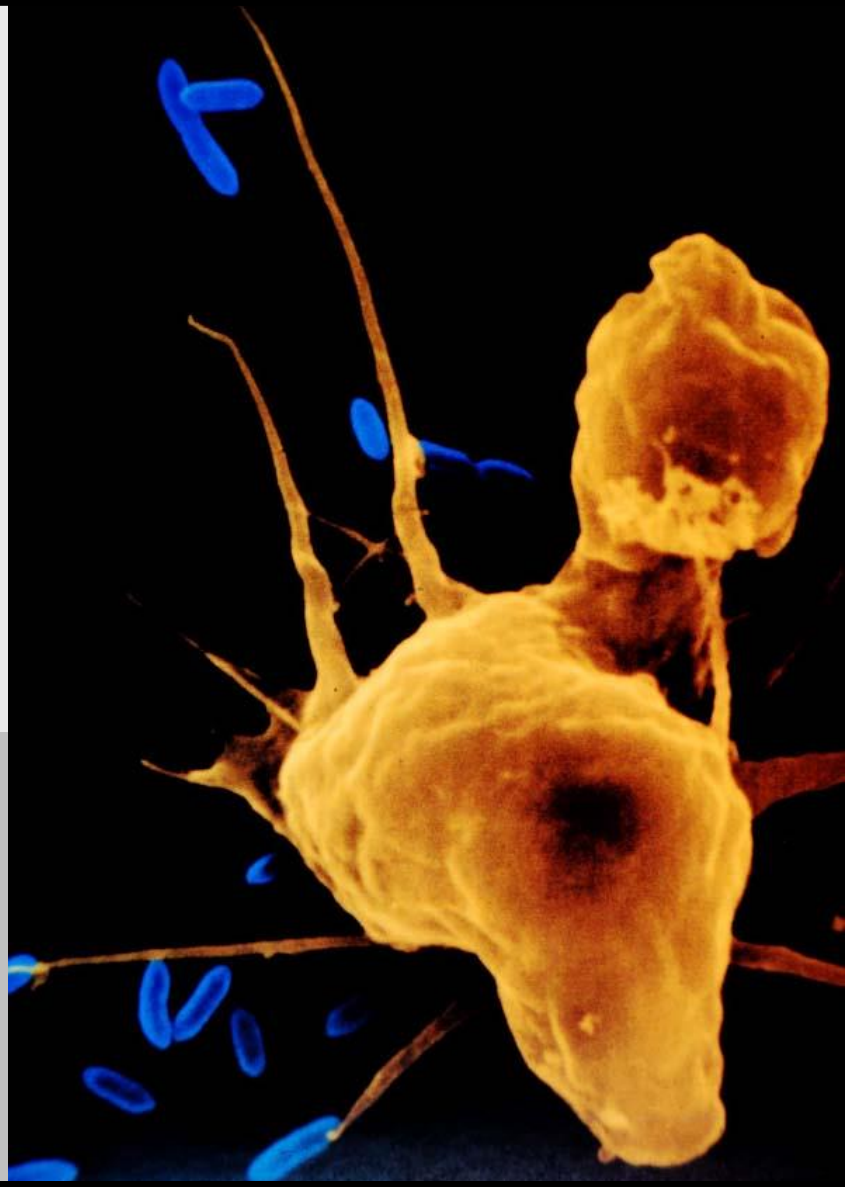
# Makrophagen

- Zweite Quelle der Phagozytose
- Modulierend und regulierend:

  durch Ausschüttung von Zytokinen,

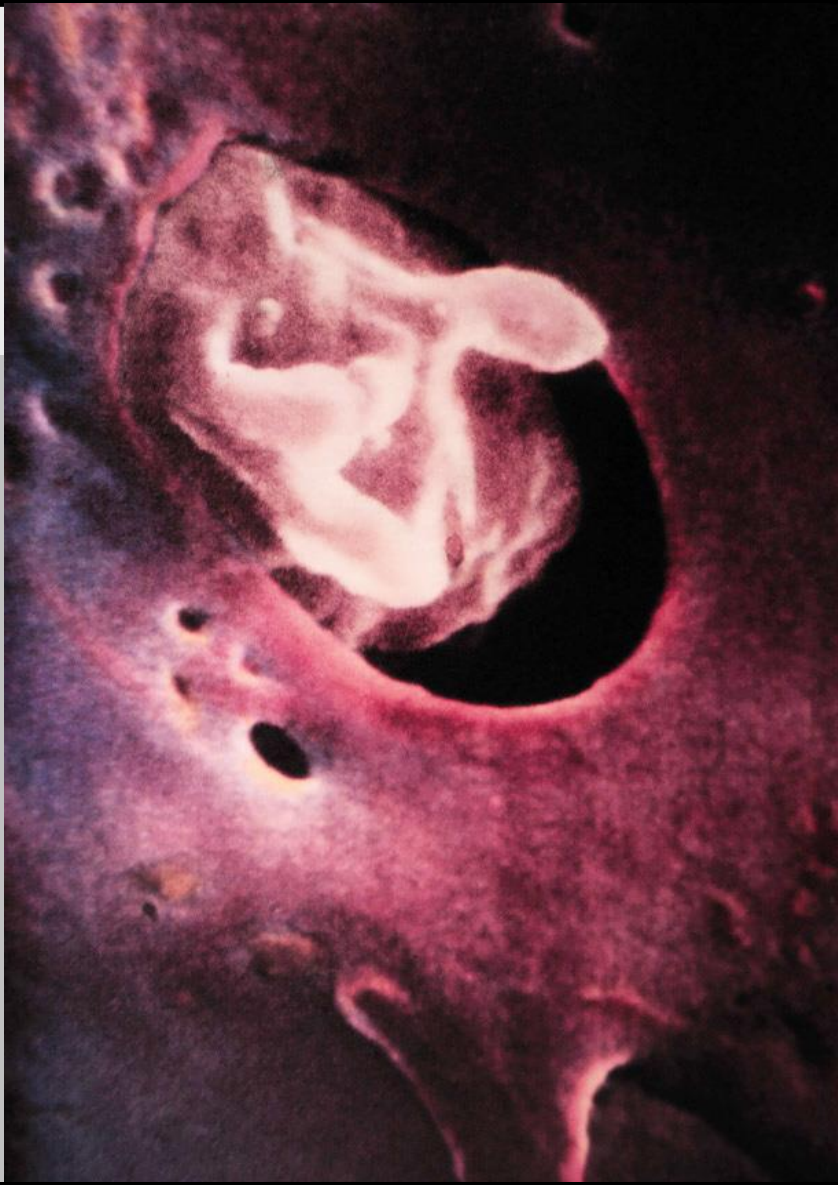
  Komplement und Prostatglandinen wird die

  Entzündung inganggesetzt.
- Antigen - Präsentation



# B-Lymphozyten oder B-Zellen (humorale Abwehr)

B-Lymphozyten werden durch Kontakt mit einem Antigen aktiviert und differenzieren zu antikörper-produzierenden Plasmazellen.



# T-Lymphozyten oder T-Zellen (zelluläre Abwehr)

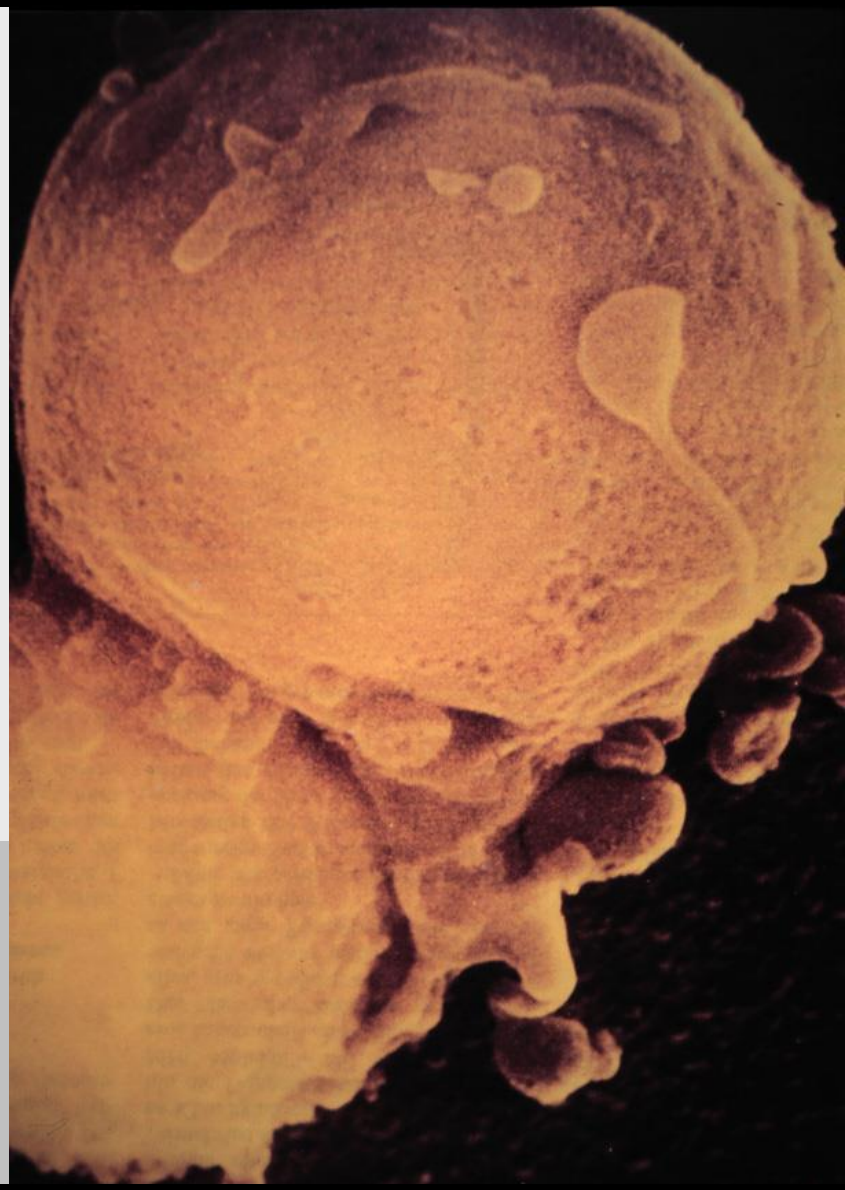
Entstehung im Thymus - differenzieren zu:

- Th-Lymphozyten

  (T-Helferzellen, T4-, CD4-Zellen)
- Ts-Lymphozyten

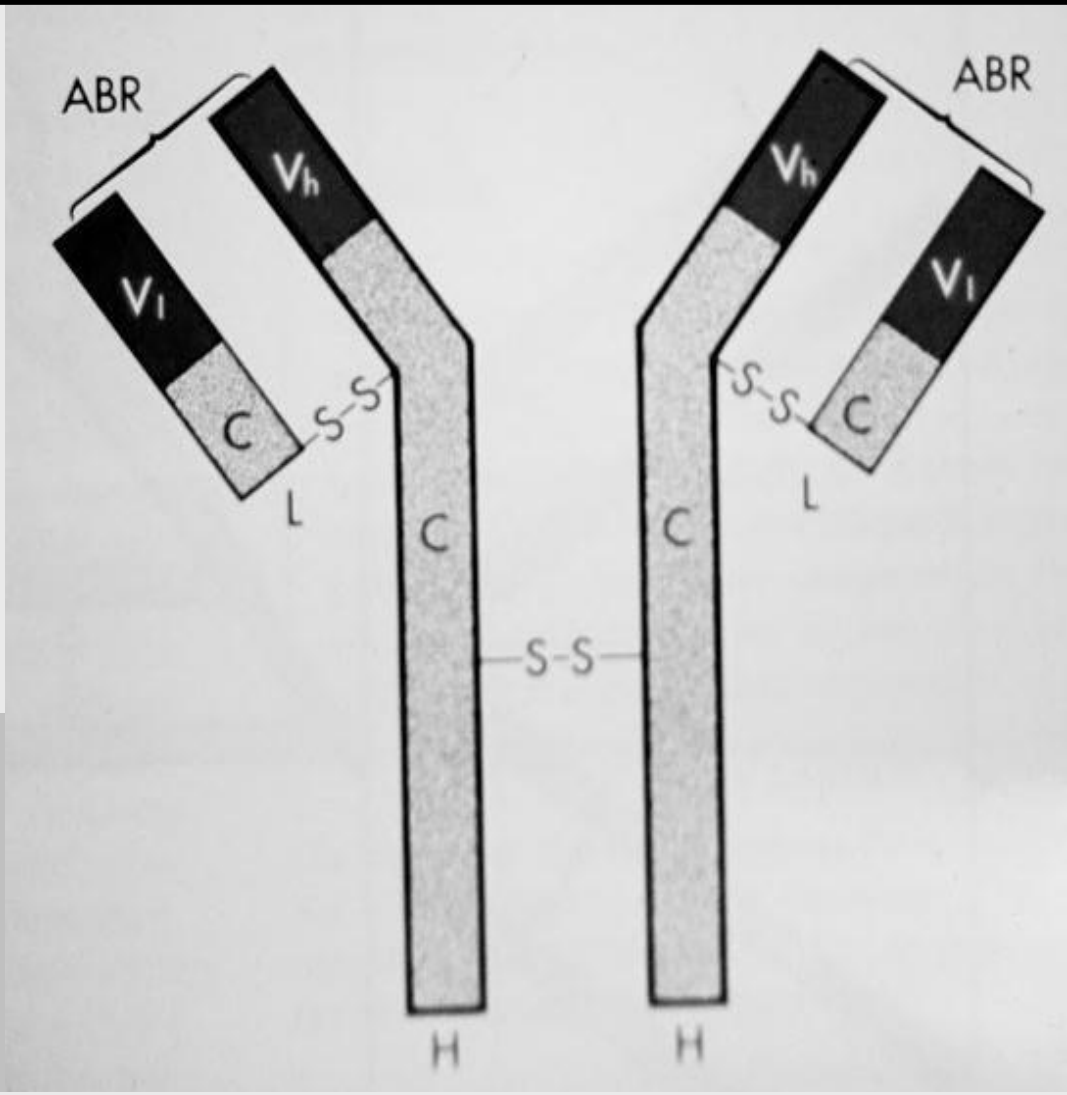
  (Suppressorzellen, T8-, CD8-Z.)
- Zytotoxische T-Lymphozyten

  (Killerzellen)



# Immunglobuline

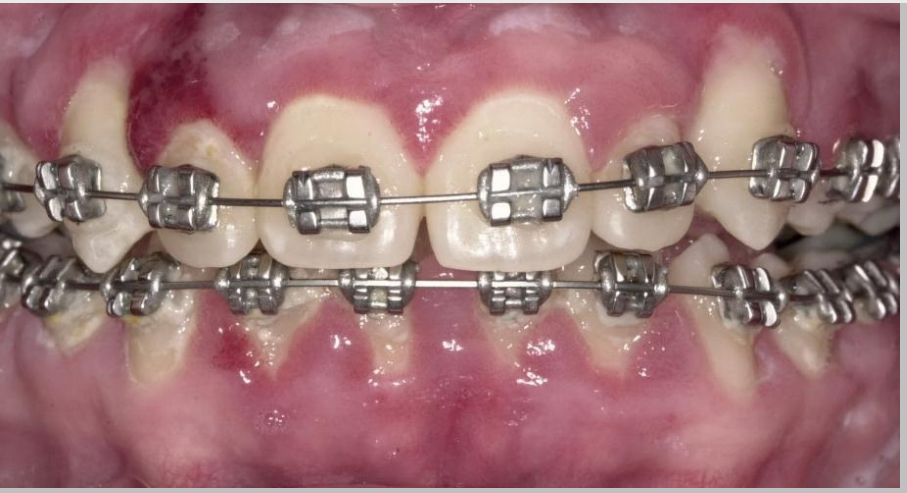
Ig sind in B-Lymphozyten und Plasmazellen gebildete Proteine, die Antikörperaktivität besitzen. Sie beeinflussen das Anheften spät-besiedelnder Bakterien an die junge Plaque (Koaggregation).

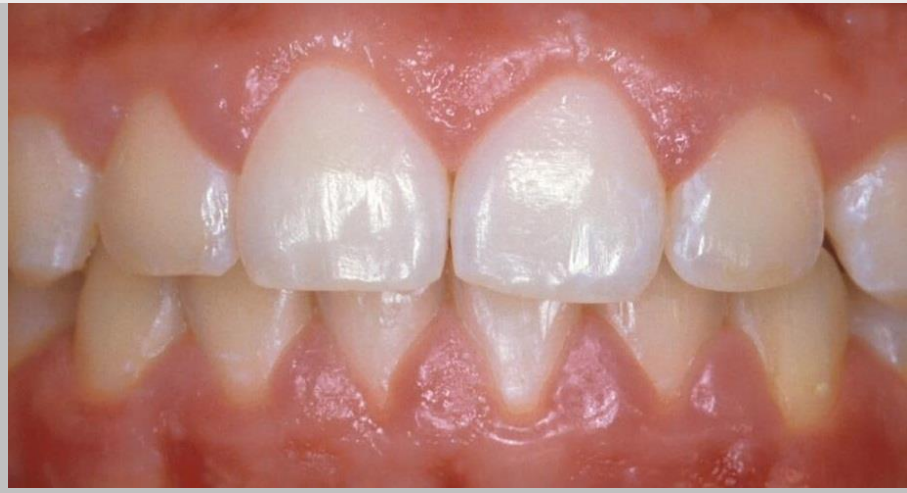



Diagnose: im Serum und Sulcusfluid

# Plaqueinduzierte Gingivitis oder Parodontitis

- ⇨ Plaqueakkumulation führt zu unterschiedlichen Entzündungsreaktionen der Gingiva.
- ⇨ Signifikante Unterschiede der GCF (gingival crevicular fluid volume) bei ähnlicher Plaque-Zusammensetzung bei Gingivitis und Parodontitis (RCT) .
- ⇨ Identifizierung zweier Subpopulationen: „high-responder“ bzw. „low-responder“






Trombelli L, Farina R, Minenna L, Carrieri A, Scapoli C, Tatakis DN. Experimental gingivitis: reproducibility of plaque accumulation and gingival inflammation parameters in selected populations during a repeat trial. *J Clin Periodontol 2008;35:955-960.*

Trombelli L, Scapoli C, Tatakis DN, Minenna L. Modulation of clinical expression of plaque-induced gingivitis: response in aggressive periodontitis subjects. *J Clin Periodontol 2006;33:79-85.*

Trombelli L et al. Modulation of clinical expression of plaque-induced gingivitis. I.Background review and rationale. II.Identification of "high-responder" and "low-responder" subjects. III.Response of "high responders" and "low responders" to therapy. *J Clin Periodontol 2004;31:229-259.*

# Parodontitis - Good Responder

Background: This study compares the changes to the subgingival microbiota of individuals with "refractory" periodontitis (RP) or treatable periodontitis (good responders [GR]) before and after periodontal therapy by using the Human Oral Microbe Identification Microarray (HOMIM) analysis.

Results: The majority of species evaluated decreased in prevalence in both groups after treatment; however, only a small subset of organisms was significantly affected. Species that increased or persisted in high frequency in RP but were significantly reduced in GR included *Bacteroidetes* sp., *Porphyromonas end.*, *Porphyromonas ging.*, *Prevotella* spp., *Tannerella fors.*, *Dialister* spp., *Selenomonas* spp., *Catonella m.*, *Eubacterium* spp., *Filifactor al.*, *Parvimonas m.*, *Peptostrept.* sp. OT113, *Fusobact.* sp. OT203, *Pseudoramibacter alactol.*, *Streptoc. Interm.* or *Streptoc. Const.*, and *Shuttlesworthia sat.* In contrast, *Capnocytophaga sput.*, *Cardiobacterium hom., Gemella haemol.*, *Haemophilus parainfl.*, *Kingella oralis*, *Lautropia m.*, *Neisseria e.*, *Rothia dent.*, *Streptoc austr.*, and *Veillonella* spp. were more associated with therapeutic success.

Conclusion: Persistence of putative and novel periodontal pathogens, as well as low prevalence of beneficial species was associated with chronic refractory periodontitis.

Colombo APV, Bennet S, Cotton SL, Goodson JM, Kent R, Haffajee AD, Socransky SS, Hasturk H, Van Dyke TE, Dewhirst FE, Paster BJ. Impact of periodontal therapy on the subgingival microbiota of severe periodontitis: comparison between good responders and individuals with refractory periodontitis using the human oral microbe identification microarray. *J Periodontol 2012;83:1279-1287.*

# Plaqueinduzierte Gingivitis oder Parodontitis

- ⇨ Parameter für die Entwicklung einer Gingivitis oder Parodontitis:

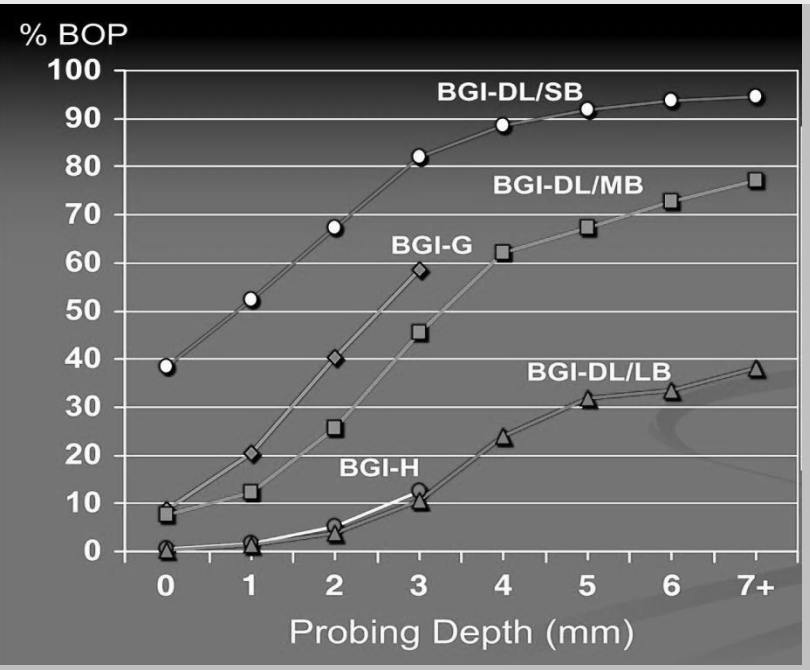
  genetische Faktoren, anatomische Verhältnisse, Faktoren der Immunantwort?

- ⇨ Bei allen Formen von experimentell-induzierter Gingivitis führte mechanische Plaque-Kontrolle in Kombination mit AmF/SnF2- haltigen Zahnpasten und Spüllösungen zur Wiederherstellung gesunder gingivaler Verhältnisse.


Trombelli L et al. Modulation of clinical expression of plaque-induced gingivitis. I.Background review and rationale. II.Identification of "high-responder" and "low-responder" subjects. III.Response of "high responders" and "low responders" to therapy. *J Clin Periodontol 2004;31:229-259.*

# BGI-Gruppen (Biofilm-Gingival-Interface)

The purpose was to identify new clinical categories that represented distinct biologic phenotypes based upon DNA checkerboard analyses of eight plaque bacteria, serum immunoglobulin G (IgG) titers to 17 bacteria, and the gingival crevicular fluid (GCF) levels of 16 inflammatory mediators. Five BGI clinical conditions were defined using probing depths (PDs) and bleeding on probing (BOP) scores.




| n=6.768 | | PD | BOP | % |
|---|---|---|---|---|
| BGI-H | Healthy | <4 | <10 | 14,3 |
| BGI-G | Gingivitis | <4 | >10 | 15,1 |
| BGI-DL/LB | DeepLesion/LowBOP | >4 | <10 | 18,0 |
| BGI-DL/MB | DeepLesion/ModerateBOP | >4 | <50 | 39,7 |
| BGI-DL/SB | DeepLesion/SevereBOP | >4 | >50 | 12,9 |


Offenbacher S, Barros SP, Singer RE, Moss K, Williams RC, Beck JD. Periodontal disease at the biofilm-gingival interface. *J Periodontol 2007;78:1911-1925.*

Offenbacher S. Commentary: clinical implications of periodontal disease assessments using probing depth and bleeding on probing to measure the status of the periodontal-biofilm interface. *J Int Acad Periodontol 2005;7(4S):157-161.*

# Plaqueinduzierte Gingivitis oder Parodontitis

Background: The aim of this human investigation is to explore the relationship of gingivitis with salivary biomarkers, periodontal pathogens, and interleukin (IL)-1 polymorphism after a transient inflammatory burden.

Results: Mean PI, GI, and PBS values were significantly increased during induction and decreased during resolution as measured at 35 days ($P$ <0.01), although no differences were observed between IL-1 groups. Participants were stratified as either “high” or “low” responders based on inflammatory response (high: GI >1.5; low: GI ≤1.5). Baseline levels of salivary IL-6 and IL-8 demonstrated the highest ability to discriminate between high and low responders (area under the curve [AUC] of 0.81 and 0.72, respectively). Salivary biomarkers, matrix metalloproteinases (MMPs), and bacterial biofilm were combined to generate receiver operating characteristic curves. High levels of IL-6 and MMP-1 at baseline demonstrated the strongest ability to predict high responders .

Conclusion: In this proof-of-concept investigation, we identified specific biomarker and microbial signatures that are associated with gingival inflammation.

Lee A, Ghaname CB, Braun TM, Sugai JV, Teles CP, Loesche WL, Kornman KS,Giannobile WV,Kinney JS. Bacterial and salivary biomarkers predict the gingival inflammatory profile. *J Periodontol 2012;83:79-89.*

# Plaqueinduzierte Gingivitis oder Parodontitis

Zellinfiltrat bei Gingivitis:

wird von Monozyten und T-Lymphozyten dominiert.

Zellinfiltrat bei progressiver Parodontitis:

wird von B-Lymphozyten und Plasmazellen dominiert.

Ein Ungleichgewicht zwischen T-Zellen und Makrophagen könnte zusammen mit anderen Faktoren (Stress, Ernährung, genetische Disposition, anatomische Verhältnisse) den Verlauf der Erkrankung (Gingivitis - Parodontitis) bestimmen.

# Ursachen der Gewebedestruktion

- ⇨ Zytotoxische Mechanismen
- ⇨ Enzymatische Mechanismen
- ⇨ Phlogogene Mechanismen

Von Bakterien produzierte organische Säuren, Schwefelwasserstoff, Ammoniak und andere toxische Amine haben die Fähigkeit Zellen zu töten.

# Zytotoxische Mechanismen

Endotoxin: Bestandteil des Lipopolysaccharid - Proteinkomplexes (LPS) in der Zellwand gramnegativer Bakterien.

- ⇨ Toxische Wirkung auf Fibroblasten und Leukozyten
- ⇨ Komplementaktivierung, Aktivierung von Mediatoren
- ⇨ Gewebenekrotisierung - Knochenresorption
- ⇨ Freisetzung von Zytokinen und anderen immunomodulierenden Substanzen

Leukotoxin: Zellwandbestandteil des A. actinomycetemcomitans: Toxische Wirkung auf Fresszellen - Polymorhkernige neutrophile Granulozyten (PMN) und Makrophagen durch Veränderung der Zellwandpermeabilität und sofortiger osmotischer Lyse.

Iwase M et al. Effects of cautions and osmotic protectants on cytolytic activity of A.a.-Leukotoxin. *Infekt Immun 1990;58:1782-1788.*

# Enzymatische Mechanismen

Proteolytische Enzyme, die die extrazelluläre Matrix des parodontalen Stützgewebes schädigen, stammen aus Bakterien und körpereigenen Zellen:

Kollagenasen (Aa, Pg, Pi)

Hyaluronidase, Phosphatase, Phospholipase

Der durch körpereigene Zellen induzierte Kollagenabbau findet intra- oder extrazellulär statt.

# Enzymatische Mechanismen

Intrazellulärer Kollagenabbau ist im gesunden Parodont ein physiologisches Phänomen - Kollagenturnover durch Phogozytose und lysosomale Verdauung von Fibroblasten, Makrophagen, Osteoblasten, Osteoklasten und Epithelzellen.

Extrazellulärer Kollagenabbau (Schädigung der extrazellulären Matrix) durch Metalloproteinasen (MMPs: Kollagenasen, Gelatinase) und Serinproteasen (Elastase, Kathepsin) ist ein pathologisches Phänomen.

Lee W et al. Evidence of a direct relationship between neutrophil collagenase activity and periodontal tissue destruction in vivo: role of active enzyme in human periodont. *J Periodontol Res 1995;30:23-33.*
Jin LJ et al. Granulocyte elastase in gingival crevicular fluid: improved monitoring of the site-specific response to treatment in patients with destructive parodontitis. *J Clin Periodont 1995;22:240-246.*

# Abbaumechanismen

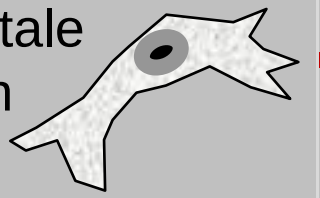
| | Aa | Pg | Tf (Bf) | Td | Fn | Ec | Cs |
|---|---|---|---|---|---|---|---|
| Lipopolysaccharid (LPS) | ■ | | | ■ | ■ | | |
| Leukotoxin | ■ | | | | | | |
| Kollagenasen | | ■ | ■ | ■ | | | |
| Proteasen | | ■ | ■ | ■ | | | |
| Adhäsine | | | | | ■ | | |
| Chemotaxis-Inhibitor | | | | | ■ | | |
| Toxine | | | | | | ■ | ■ |
| Fibroblasten-Inhibitor | | | | | | ■ | ■ |
| Abbau von IgG und IgA | | | | | | | ■ |
| bei Systemerkrankungen | | | | | | | ■ |
| | | | | | | | |
| Fakultativ im Weichgewebe | ■ | ■ | | ■ | ■ | | |

# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau


Bakterielle Antigene

LPS
(Lipopolysaccharide)

Parodontale Zellen



Mediatoren

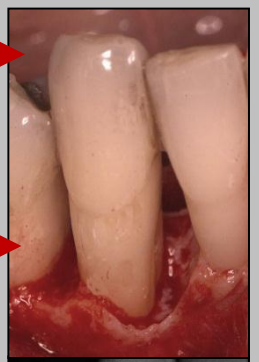
Zellinfiltrat

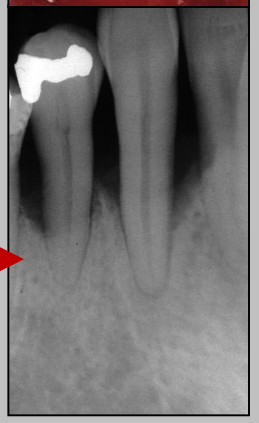
Bakterielle Kollagenase

Pro-Kollagenasen ▶ MMPs

Aktivatoren

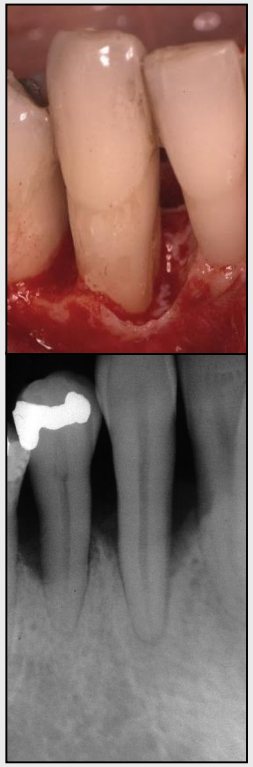
Pro-Kollagenasen ▶ MMPs





Zellinfiltrat: Polymorphkernige Leukozyten, Monozyten, Makrophagen, Lymphozyten, Plasmazellen produzieren Zytokine - Botenstoffe (TNFα, Interleukin 1ß) bzw. Chemokine und Prostaglandine (Prostaglandin E2). Diese induzieren die Produktion von Pro-Kollagenasen und der MMP -1, -8, -9.

# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau



Zytokine:

Different subgingival biofilm profiles are associated with distinct patterns of GCF cytokine expression. Aggressive periodontitis (AgP) subjects were characterized by a higher IL-1*β*/IL-10 ratio than periodontally healthy subjects, suggesting an imbalance between pro- and anti-inflammatory cytokines in AgP.

Stent-induced gingivitis is associated with marked, but reversible increases in IL-*α*a and IL-1*β* with suppression of multiple chemokines as well as selected MMPs.

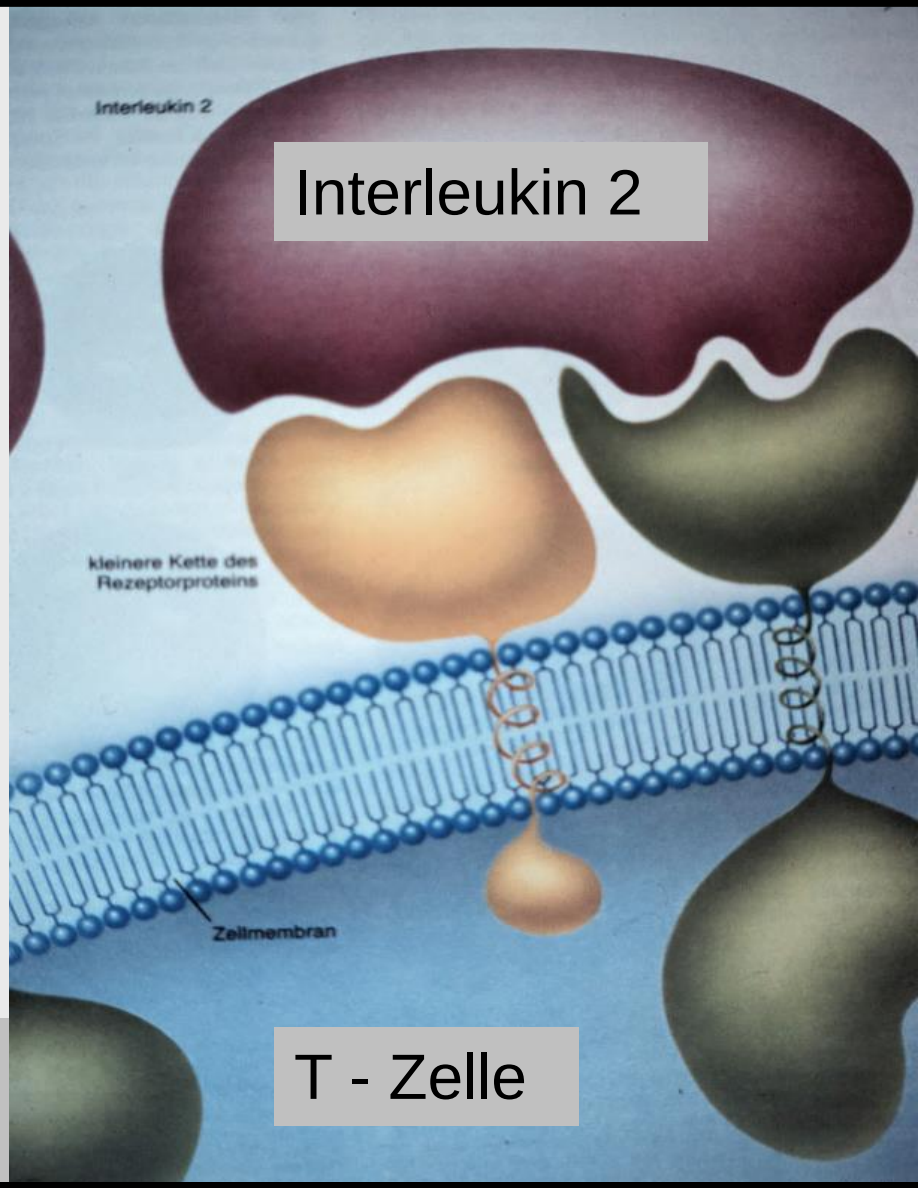

Teles RP, Gursky LC, Faveri M, Rosa EA, Teles FRF, Feres M, Socransky SS, Haffajee AD. Relationships between subgingival microbiota and GCF biomarkers in generalized aggressive periodontitis. *J Clin Periodontol 2010;37:313-323.*

Offenbacher S, Barros S, Mendoza L, Mauriello S, Preisser J, Moss K, de Jager M, Aspiras M. Changes in gingival crevicular fluid inflammatory mediator levels during the induction and resolution of experimental gingivitis in humans. *J Clin Periodontol 2010;37:324-333.*

# Zytokine

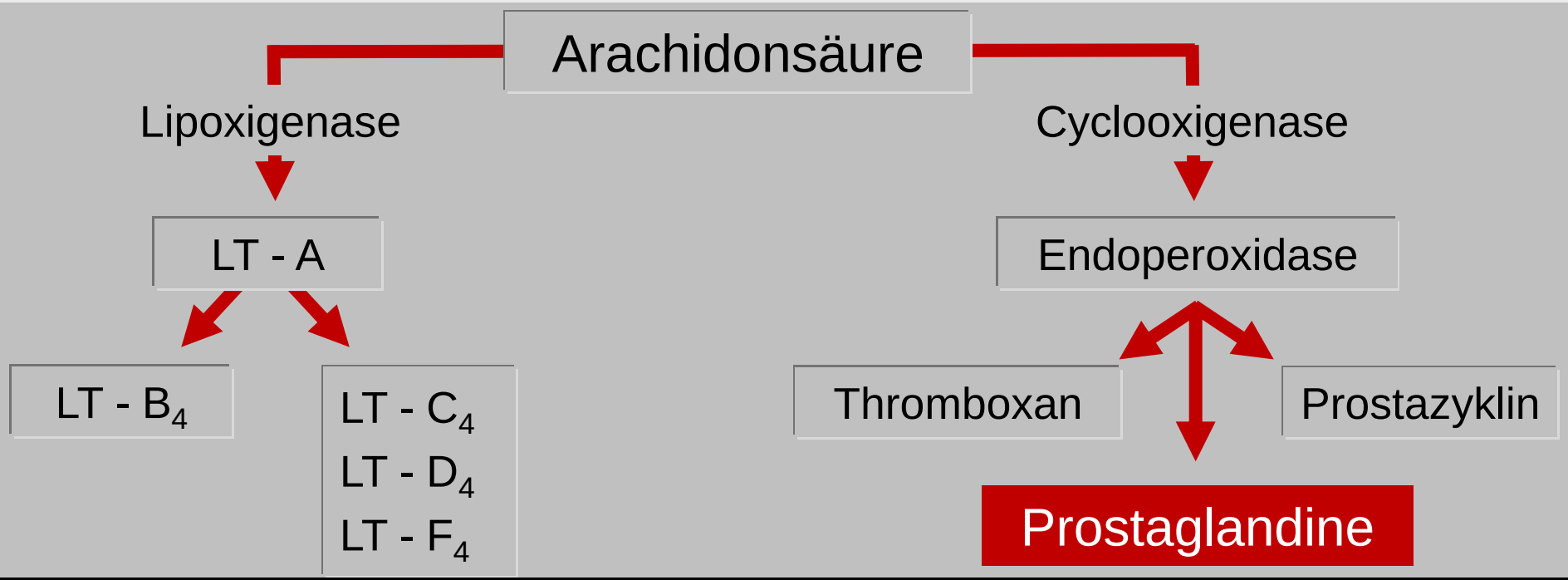
Zytokine sind Botenstoffe (Signalmoleküle), die Informationen zwischen den Zellen vermitteln:

- ⇨ Interferone (IFN)
- ⇨ hämatopoetische Wachstumsfaktoren
- ⇨ epidermale Wachstumsfaktor
- ⇨ Interleukine (IL 1-13)
- ⇨ Tumornekrosefaktor (TNF)
- ⇨ koloniestimulierenden Faktoren



# Arachidonsäuremetabolismus

AS ist eine ungesättigte Fettsäure, die als Reaktion auf spezifische Stimuli (Antigen-Antikörperkomplexe, Adrenalin, Bradykinine) oder unspezifische Stimuli (mechanische-, thermische Traumatisierung) aus Zellwänden freigesetzt wird.

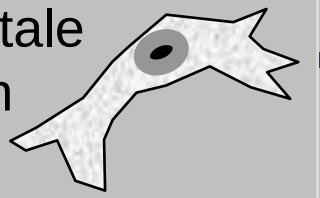


# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau


Bakterielle Antigene

LPS
(Lipopolysaccharide)

Parodontale Zellen



Mediatoren

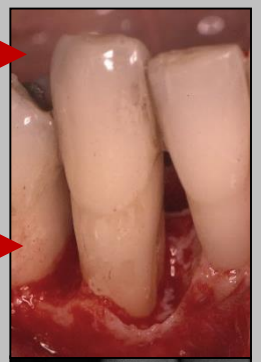
Zellinfiltrat

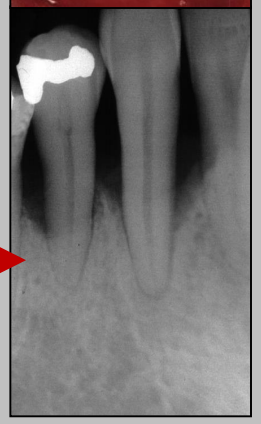
Bakterielle Kollagenase

Pro-Kollagenasen ▶ MMPs

Aktivatoren

Pro-Kollagenasen ▶ MMPs





Parodontale Zellen: Fibroblasten, Osteoblasten, Epithel- u. Endothelzellen produzieren als Wirtsantwort Pro-Kollagenasen und MMPs: MMP-1 und -8 aus Fibroblasten, MMP-2 (Gelatinase), MMP-3 (Stromelysin), MMP-13 aus Osteoblasten.

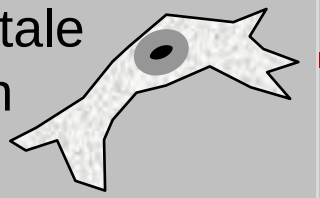
Li W, Xiao L, Hu J. Matrix metalloproteinase-1 promoter -1607 1G/2G polymorphism and chronic periodontitis susceptibility: a meta-analysis and systematic review. *J Clin Periodontol 2013;40:1095-1103.*

# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau


Bakterielle Antigene

LPS
(Lipopolysaccharide)

Parodontale Zellen



Mediatoren

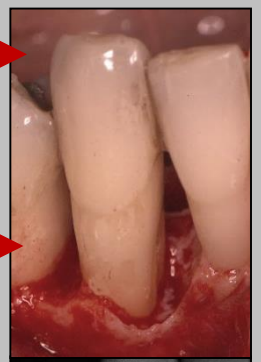
Zellinfiltrat

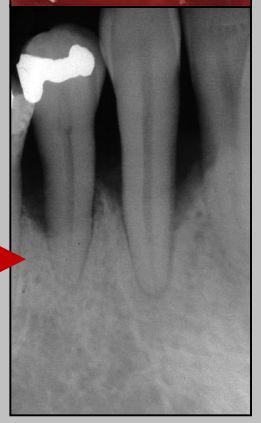
Bakterielle Kollagenase

Pro-Kollagenasen ▶ MMPs

Aktivatoren

Pro-Kollagenasen ▶ MMPs





Polymorphkernige Leukozyten sind zusätzlich für die Produktion PMN-Kollagenase und Gelatinase (MMP-8 und -9) verantwortlich.

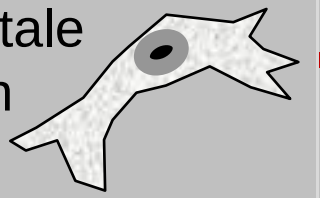
Aktivatoren: Detergentien, Oxydantien, Plasmin (Serumprotease - Wirt), Kathepsin (PMN), MMP-3 (Stromelysin), Autoaktivierung

# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau


Bakterielle Antigene

LPS
(Lipopolysaccharide)

Parodontale Zellen



Mediatoren

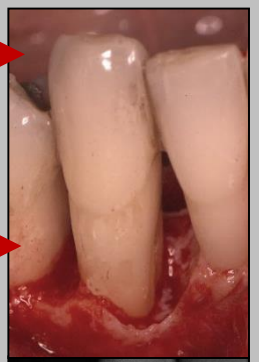
Zellinfiltrat

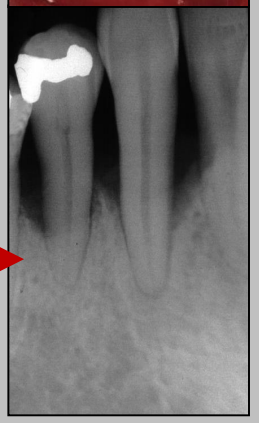
Bakterielle Kollagenase

Pro-Kollagenasen ▶ MMPs

Aktivatoren

Pro-Kollagenasen ▶ MMPs





Our results suggest that MMP-8, MMP-9, MMP-13 in GCF were independently related to coexistence of periodontitis and MetS. MMP-9 and MMP-13 could be an appropriate common indicator of periodontitis and MetS in women.

Han D-H, Shin H-S, Paek D, Kim H-D. Gingival crevicular fluid levels of matrix metalloproteinases cross-sectionally related to periodontitis and metabolic syndrome in community Koreans. *J Clin Periodontol 2012;39:1125-1131.*

# Matrix Metalloproteinasen (MMPs)

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Enzymes and end-products of type I collagen degradation have different associations with each other and with periodontal status that may reflect their roles in the cascade leading to alveolar bone loss. MMP-8 is a strong biomarker candidate for detecting alveolar bone destruction.

Gursoy UK, Ko¨no¨nen E, Huumonen S, Tervahartiala T, Pussinen PJ, Suominen AL, Sorsa T. Salivary type I collagen degradation end-products and related matrixmetalloproteinases in periodontitis. *J Clin Periodontol 2013;40:18-25.*

MMP-9-1562 C>T promoter polymorphism appears to be a risk factor for MGRs development (multiple gingival recessions) and a potential predictor of more severe clinical phenotypes.

Perunovic N, Rakic M, Jankovic S, Aleksic Z, Struillou S, Cakic S, Puletic M, Lekovic V, Milasin J. MMP-9-1562 C>T (rs3918242) promoter polymorphism as a susceptibility factor for multiple gingival recessions. *IntJ Periodontics Restorative Dent 2015;35:263-269.*

# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau

Background: The aim of this study is to explore different gingival crevicular fluid (GCF) matrix metalloproteinase-8 (MMP-8) patterns in smokers and non-smokers with chronic periodontitis (CP) and test the utility of baseline GCF MMP-8 levels in predicting categorically assessed treatment outcomes.

Results: GCF MMP-8 response patterns could be clustered into two different site profiles among both smokers and non-smokers. Smoker site profiles 1 and 2 had significantly different clinical attachment level and gingival recession changes by the end of the maintenance period. In smoker sites, baseline MMP-8 levels significantly predicted the categorical treatment outcome.

Conclusions: Baseline GCF MMP-8 levels strongly predict how MMP-8 levels behave during the maintenance period. In smoker sites, high baseline MMP-8 levels indicate weak treatment response.

Leppilahti JM, Kallio MA, Tervahartiala T, Sorsa T, Mäntylä P. Gingival crevicular fluid matrix metalloproteinase-8 levels predict treatment outcome among smokers with chronic periodontitis *J Periodontol 2014;85:250-260.*

Leppilahti JM, Sorsa T, Kallio MA, Tervahartiala T, Emingil G, Han B, Mäntylä P. The utility of gingival crevicular fluid matrix metalloproteinase-8 response patterns in prediction of site-level clinical treatment outcome. *J Periodontol. 2015;86(6):777-787.*

# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau

Frequencies of postive site-specific GCF biomarker detection

| | Healthy *n* = 20 | Gingivitis *n* = 19 | Periodontitis *n* = 19 | p |
|---|---|---|---|---|
| Azurocidin | 13 (65%) | 18 (94.7%) | 19 (100%) | **0.003** |
| CXCL5 | 18 (90%) | 17 (89.5%) | 18 (94.7%) | 0.241 |
| MPO | 6 (30%) | 17 (89.5%) | 19 (100%) | **<0.0001** |
| MMP-8 IFMA | 20 (100%) | 19 (100%) | 19 (100%) | – |
| MMP-8 ELISA | 7 (35%) | 18 (94.7%) | 19 (100%) | **<0.0001** |
| MMP-13 | 20 (100%) | 18 (94.7%) | 19 (100%) | 0.361 |
| MMP14 | 20 (100%) | 18 (94.7%) | 19 (100%) | 0.361 |
| TIMP-1 | 2 (10%) | 2 (10.5%) | 13 (68.4%) | **<0.0001** |

Conclusions: MPO and collagenolytic MMPs are highly discriminatory biomarkers for site-specific diagnosis of periodontitis. The comparison of two quantitative MMP-8 methods demonstrated IFMA to be more accurate than ELISA.

Leppilahti JM, Hernández-Ríos PA, Gamonal JA, Tervahartiala T, Brignardello-Petersen R, Mantyla P, Sorsa T, Hernández M. Matrix metalloproteinases and myeloperoxidase in gingival crevicular fluid provide site-specific diagnostic value for chronic periodontitis. *J Clin Periodontol 2014;41:348-356.*

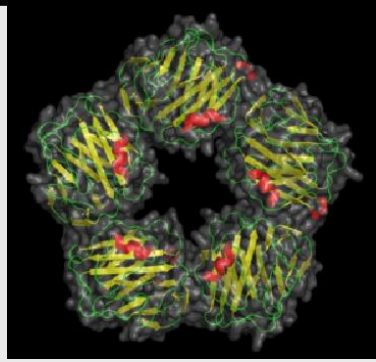
# Matrix Metalloproteinasen (MMPs) im parodontalen Abbau

Background: Matrix metalloproteinase (MMP)-8 is a major destructive collagenase involved in periodontitis and can be regarded as a periodontitis biomarker. A neutrophil collagenase 2 (active MMP-8 [aMMP-8]) oral fluid immunoassay has recently been demonstrated to be a periodontitis risk indicator among adults. The aim of this study is to investigate whether a point-of-care mouthrinse test based on an aMMP-8 immunoassay could identify patients with oral inflammatory burden (periodontitis and caries) among adolescents with early pathologic findings.

Conclusions: In 5 minutes, the aMMP-8 chairside test showed promising results, recognizing oral inflammatory burden in adolescents with early initial signs of periodontitis. Caries lesions could also be detected, but less efficiently.

Heikkinen AM, Nwhator SO, Rathnayake N, Mäntylä P, Vatanen P, Sorsa T. Pilot study on oral health status as assessed by an active matrix metalloproteinase-8 chairside mouthrinse test in adolescents. *J Periodontol 2016;87:36-40.*

# C-reaktives Protein



Patients with AgPeriodontitis have statistically significant elevations in serum hsCRP levels compared to subjects without periodontitis. Elevated hsCRP (High-Sensitivity C-Reactive Protein) in these subjects might represent a contribution of periodontal infections to systemic inflammation in young individuals. C-reactive protein blood test: low risk <1mg/l - high risk >3mg/l.


Pitiphat W, Savetsilp W, Wara-Aswapati N. C-reactive protein associated with periodontitis in a Thai population. *J Clin Periodontol 2008;35:120-125.*

Ylöstalo PV, Järvelin M-R, Laitinen J, Knuuttila MLE. Self-reported gingivitis and tooth loss poorly predict C-reactive protein levels: a study among finnish young adults. *J Clin Periodontol 2008;35:114-119.*

Salzberg TN, Overstreet BT, Rogers JD, Califano JV, Best AM, Schenkein HA. C-reactive protein levels in patients with aggressive periodontitis. *J Periodontol 2006;77(6):933-939.*

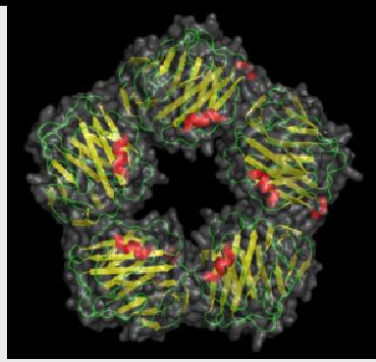
D'Aiuto F, Nibali L, Parkar M, Suvan J, Tonetti MS. Short-term effects of intensive periodontal therapy on serum inflammatory markers and cholesterol. J Dent Res 2005;84:269-273.

Seinost G, Wimmer G, Skerget M, Thaller E, Brodmann M, Gasser R, Bratschko RO, Pilger E. Periodontal treatment improves endothelial dysfunction in patients with severe periodontitis. *Am Heart J 2005;149:1050-1054.*

Offenbacher S, Beck JD. A perspective on the potential cardioprotective benefits of periodontal therapie. *Am Heart J 2005;149:950-954.*

D‘Aiuto F, Ready D, Tonetti MS. Periodontal disease and C-reactive protein-associated cardiovascular risk. *J Periodontal Res 2004;39:236-241.*

# C-reaktives Protein



Self-reported gingivitis and tooth loss have a miniscule effect on CRP levels among a general population of young adults.

There is strong evidence from cross-sectional studies that plasma hsCRP in periodontitis is elevated compared with controls.

There is modest evidence on the effect of periodontal therapy in lowering the levels of hsCRP.


Gomes-Filho IS, Coelho JMF, Seixas da Cruz S, Passos JS, Teixeira de Freitas CO, Farias NS, Amorim da Silva R, Silva Pereira MN, Lopes Lima T, Lima Barreto M. Chronic periodontitis and C-peactive protein levels. *J Periodontol 2011;82:969-978.*

Megson E, Fitzsimmons T, Dharmapatni K, Bartold PM. C-reactive protein in gingival crevicular fluid may be indicative of systemic inflammation. *J Clin Periodontol 2010;37:797-804.*

Fitzsimmons TR, Anne E. Sanders AE, Bartold PM, Slade GD. Local and systemic biomarkers in gingival crevicular fluid increase odds of periodontitis. *J Clin Periodontol 2010;37:30-36.*

Paraskevas S, Huizinga JD, Loos BG. A systematic review and meta-analyses on C-reactive protein in relation to periodontitis. *J Clin Periodontol 2008;35:277-290.*

Linden GJ, McClean K, Young I, Evans A, Kee F. Persistently raised C-reactive protein levels are associated with advanced periodontal disease. *J Clin Periodontol 2008;35:741-747.*

Slade GD, Gezzi EM, Heiss G, Beck JD, Riche E, Offenbacher S. Relationship between periodontal disease and C-reactive protein among adults in the atherosclerosis risk in communities study. *Arch Intern Med 2003;163:172-179.*

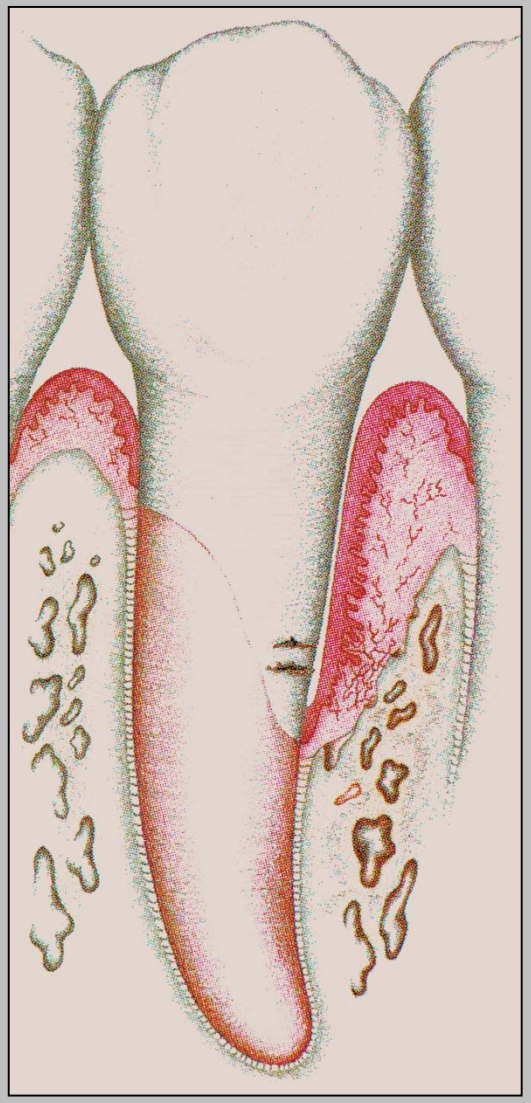
# Bakteriämie

Aim: The aim of this study was to investigate the robustness of the observations on the influence of oral hygiene, gingival and periodontal status on the development of bacteraemia from everyday oral activities (B-EOA), analysing its prevalence, duration, magnitude and bacterial diversity.

Conclusions: Meta-analysis showed that plaque accumulation and gingival inflammation scores significantly increased the prevalence of bacteraemia following toothbrushing. However, systematic review showed no relationship between oral hygiene, gingival and periodontal status and the development of B-chewing, and there is no evidence that gingival and periodontal health status affects B-flossing.

Toma´s I, Diz P, Tobı´as A, Scully C, Donos N. Periodontal health status and bacteraemia from daily oral activities: systematic review/meta-analysis. *J Clin Periodontol 2012;39:213-228.*

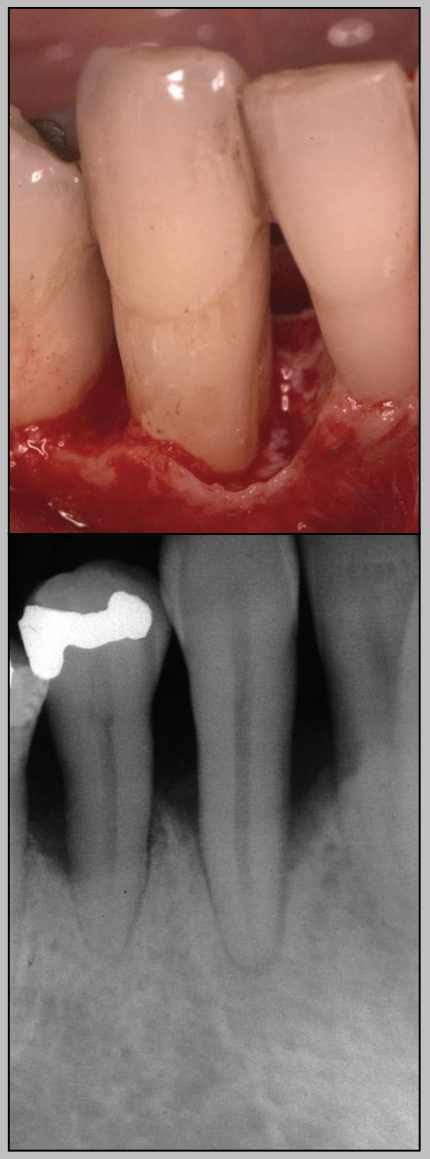
# Zusammenbruch der Kollagenmatrix



Normalerweise sind die Enzyme durch ihre natürlich vorkommenden Hemmstoffe (TIMPs: Tissue Inhibitors of Metalloproteinases) gut kontrolliert. Durch die Erkrankung verschwindet die Hemmung durch Aktivität der Lipopolysacharide aus Makrophagen und anderen Entzündungs-zellen.

Diese enzymatischen Abläufe enden mit der Zerstörung des parodontalen Bindegewebes.

# Zusammenbruch der Kollagenmatrix

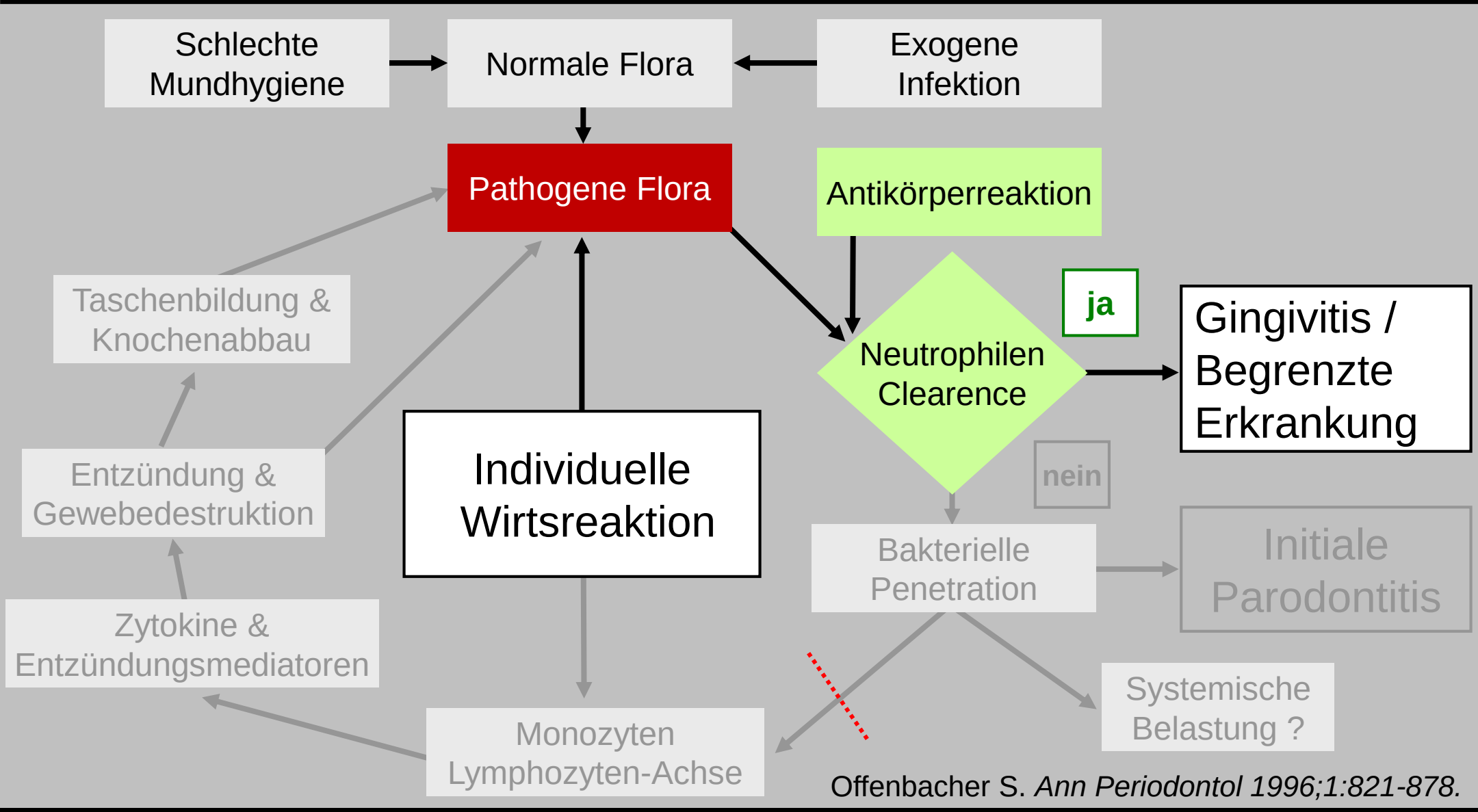


1. Stromelysine (MMP-3) entfernen den Proteoglycan- und Fibronectinanteil der Matrix. Dadurch kommt es zur proteolytischen Zerstörung der Fasern durch die Kollagenasen.

2. Die Kollagenfasern falten sich auf und werden durch den Angriff der Gelatinasen weiter zerstört.

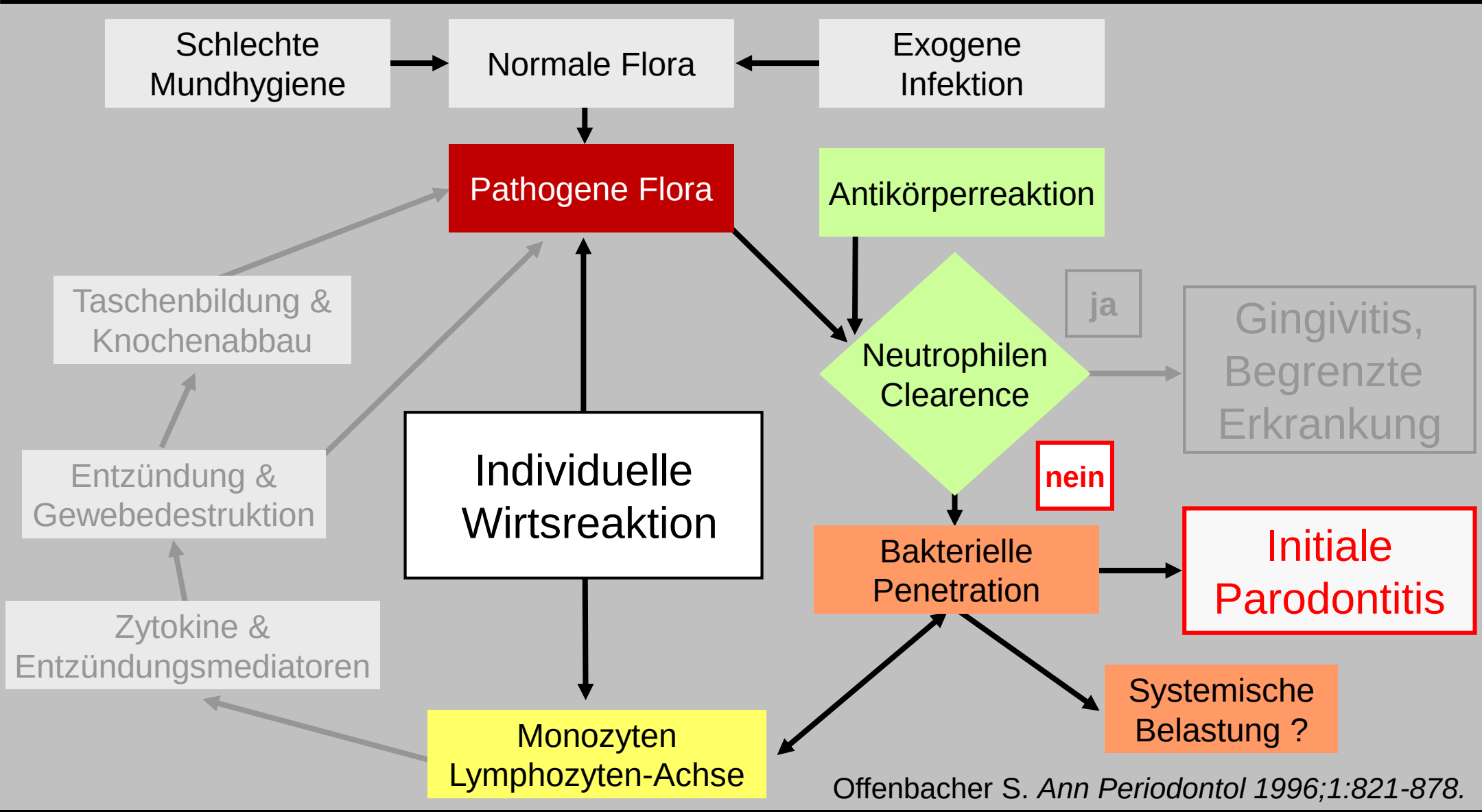
3. Bei Fortschreiten der Erkrankung kommt es im Rahmen der Parodontitis durch Osteoklasten-aktivität zum typischen Knochenverlust.

# Critical Pathway Model of Pathogenesis



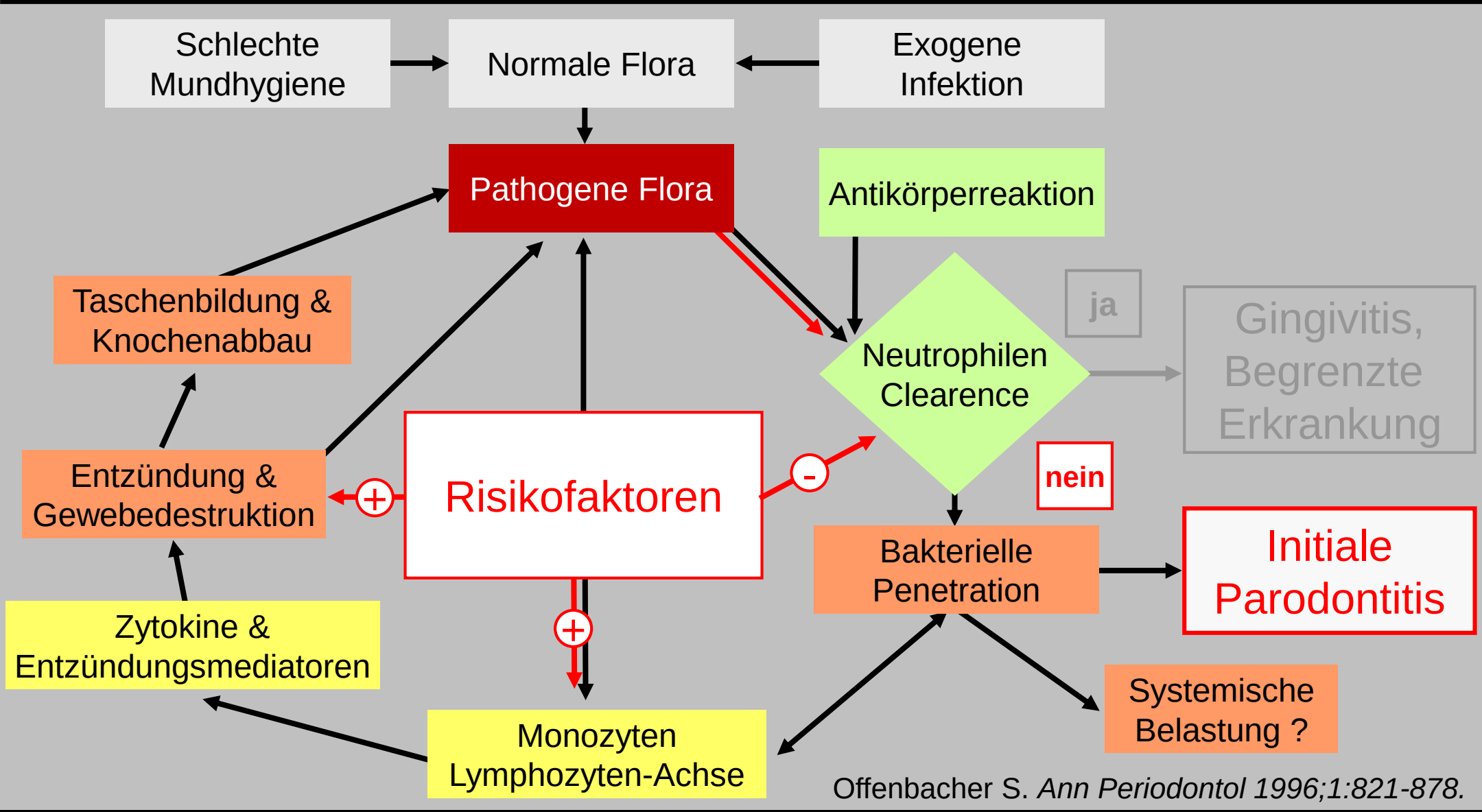

Offenbacher S. *Ann Periodontol 1996;1:821-878.*

# Critical Pathway Model of Pathogenesis



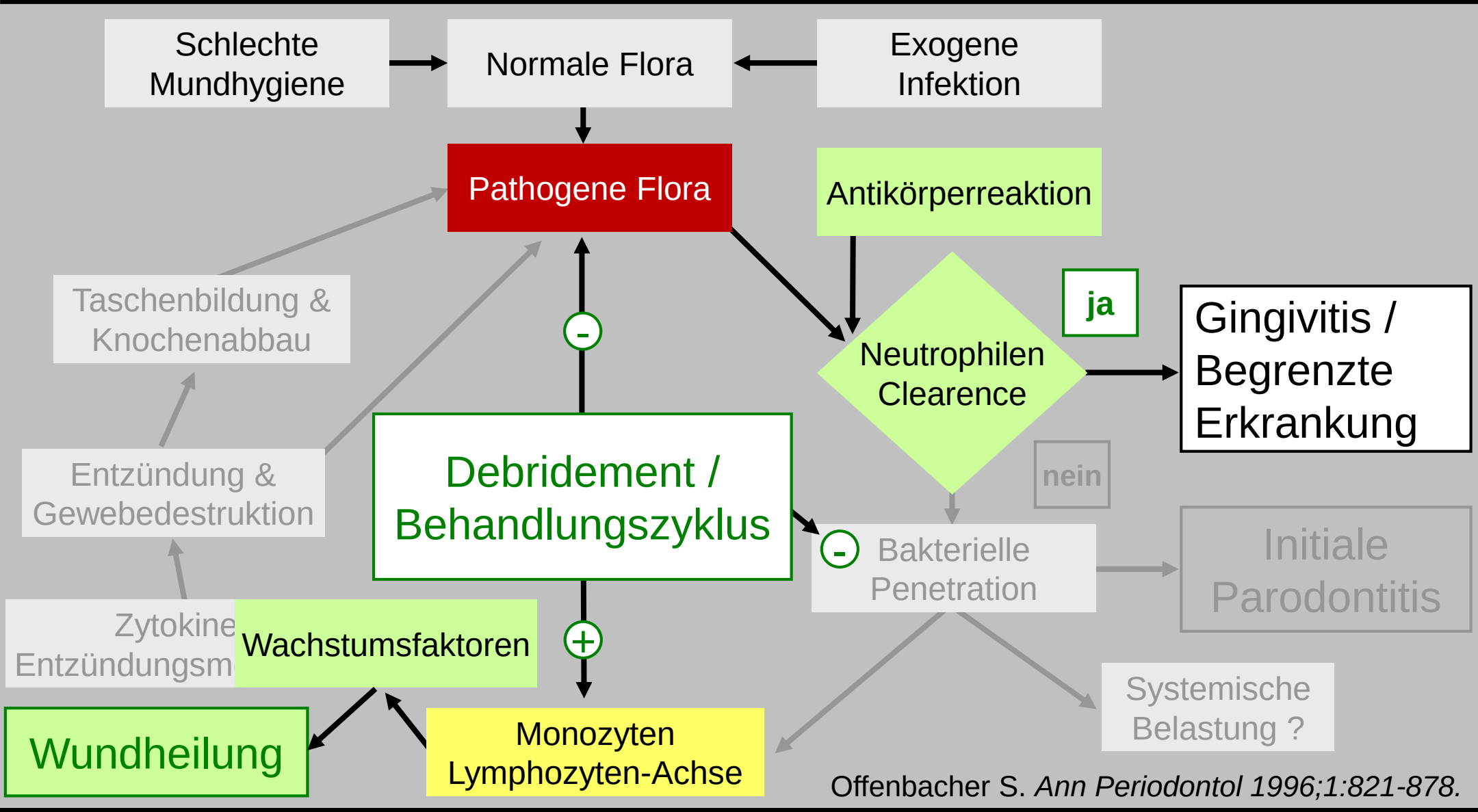

Offenbacher S. *Ann Periodontol 1996;1:821-878.*

# Critical Pathway Model of Pathogenesis



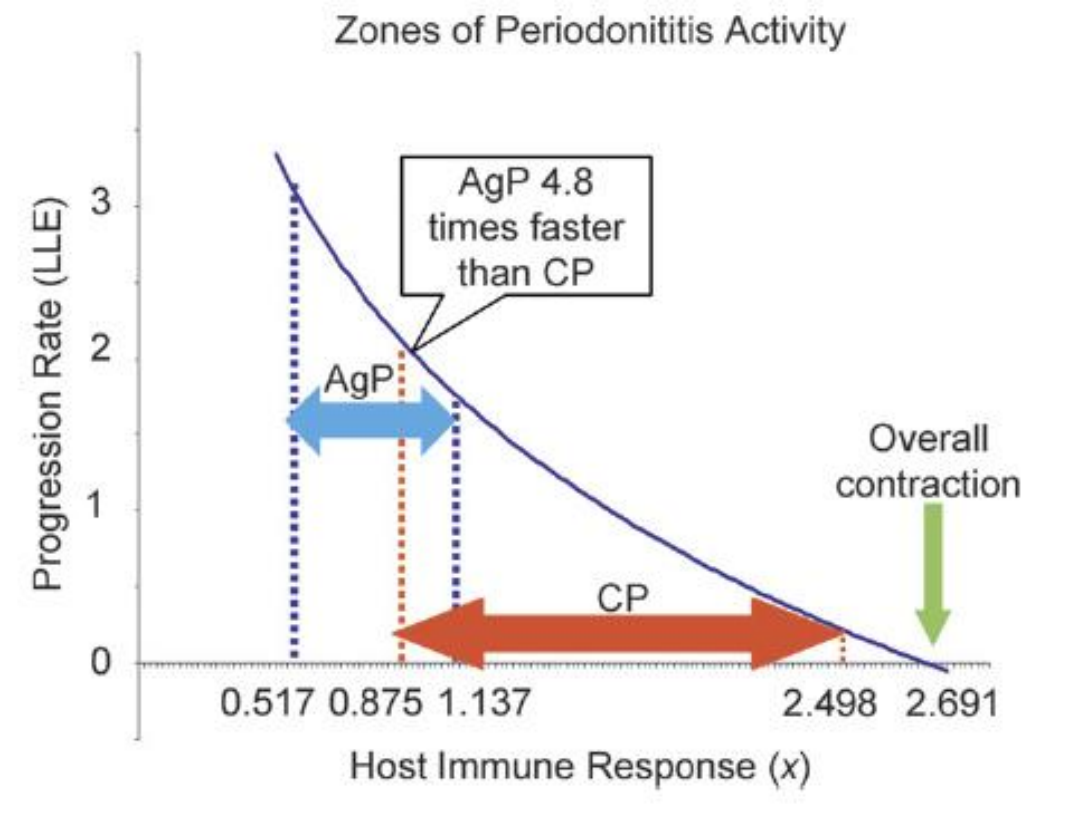

Offenbacher S. *Ann Periodontol 1996;1:821-878.*

# Critical Pathway Model of Pathogenesis




Offenbacher S. *Ann Periodontol 1996;1:821-878.*

# Pathogenese




Conclusions: This study introduces a mathematical model that identifies periodontitis as a non-linear chaotic process. It offers a quantitative assessment of the disease progression rate and identifies two zones of disease activity that correspond to the existing classification of periodontitis in the AgP and CP types.

Papantonopoulos G, Takahashi K, Bountis T, Loos BG. Mathematical modeling suggests that periodontitis behaves as a non-linear chaotic dynamical process. *J Periodontol 2013;84(10):e29-39.*

# Interleukin-1-Genotyp und Parodontitis

Der Schweregrad der Parodontitis wird durch einen komplexen Genotyp im Interleukin-1-Cluster beeinflusst. Bei IL-1-Genotyp positiven PatientInnen kommt es als Reaktion auf Bakterien zu einer Überproduktion von IL-1. Im Sulcusfluid sind Prostaglandin E2 (PGE2), IL-1 beta, IL-2 in hohen Dosen, Tumornekrosefaktor alpha (TNF alpha) und Interferon gamma (IFN-gamma) in mittlerer und IL-4, IL-6 in geringer Konzentration nachweisbar.

Kornman KS, Crane A, Wang HY, di Giovine FS, Newman MG, Pirk FW, Wilson TG Jr, Higginbottom FL, Duff GW. The interleukin-1 genotype as a severity factor in adult periodontal disease. *J Clin Periodontol 1997;24:72-77.*

Salvi GE, Brown CE, Fujihashi K, Kiyono H, Smith FW, Beck JD, Offenbacher S. Inflammatory mediators of the terminal dentition in adult and early onset periodontitis. *J Periodontal Res 1998;33:212-25.*

Verschiedene Formen der Erwachsenenparodontitis zeigen einen direkten Zusammenhang auch bei Nichtrauchern bzw. PatientInnen ohne Pg / Aa.

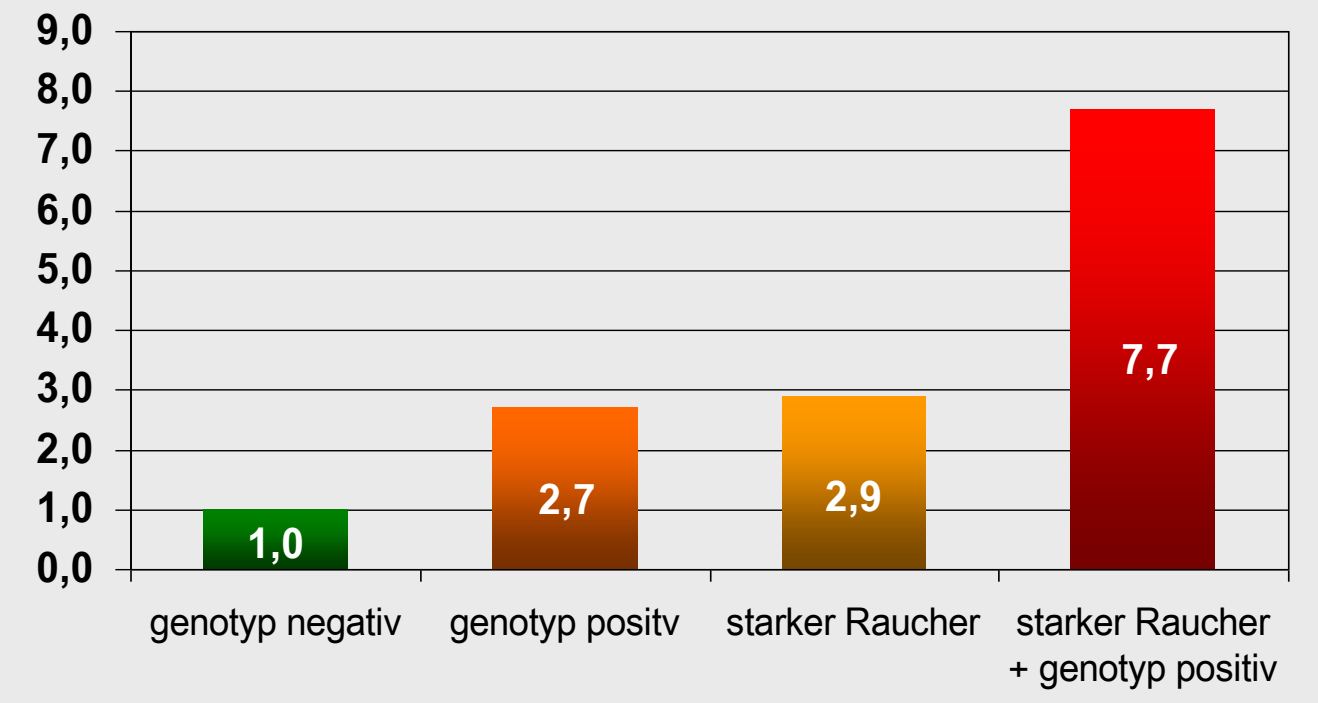
Laine ML, Farre MA, Gonzales G, van Dijk LJ, Ham AJ, Winkel EG, Crusius JB, Vandenbroucke JB, van Winkelhoff AJ, Pena AS. Polymorphism of the interleukin-1 gene family, oral microbial pathogens, and smoking in adult periodontitis. *J Dent Res 2001;80:1659.*

# Risikopotenzierung

Interleukin-1-Genotype stellt neben Pg, Rauchen, Alter einen weiteren Risikofaktor für Auftreten und Progression der Parodontitis dar.

Cullinan MP, Westermann B, Hamlet SM, Palmer JE, Faddy MJ, Lang NP, Seymour GJ. A longitudinal study of interleukin-1 gene polymorphism and periodontal disease in a general adult population. *J Clin Periodontol 2001;28:1137-1144.*

Lopez NJ, Jara L, Valenzuela NY. Association of Interleukin-1 polymorphisms with periodontal disease. *J Periodontol 2005,76:234-243.*




McGuire MK, Nunn ME. Prognosis versus actual outcome. IV. The effectiveness of clinical parameters and IL-1 genotype in accurately predicting prognoses and tooth survival. *J Periodontol 1999;70(1):49-56.*

# Rauchen

A clinically significant impact on periodontal conditions may require 30 years of smoking or more. Tooth loss, radiographic evidence of carotid calcification, current smoking status, and male gender can predictably be associated with alveolar bone loss in older subjects.

Smoking cessation may be associated with a relatively rapid improvement in the periodontium.

A large proportion of periodontal patient smokers may be considering quitting, and nearly half requested provision of smoking cessation intervention in conjunction with the periodontal treatment.


Martinelli E, Palmer RM, Wilson RF, Newton JT. Smoking behaviour and attitudes to periodontal health and quit smoking in patients with periodontal disease. *J Clin Periodontol 2008;35:944-954.*

Thomson WM, Broadbent JM, Welch D, Beck JD, Poulton R. Cigarette smoking and periodontal disease among 32-year-olds: a prospective study of a representative birth cohort. *J Clin Periodontol 2007;34:828-834.*

Persson RE, Kiyak AH, Wyatt CCI, MacEntee M, Persson GR. Smoking, a weak predictor of periodontitis in older adults. *J Clin Periodontol 2005;32:512-517.*

Bergström J. Tobacco smoking and risk for periodontal disease. *J Clin Periodontol 2003;30:107-113.*

# Rauchen

Experimentelle Parodontitis + Rauchen (Tierversuch, 1.UK-Molar, Baumwoll-Ligatur)

Conclusion: „…the effect of CSI (cigarette smoke inhalation) on MMP-2 levels and activity may account for the increased periodontitis progression rate observed in smokers“.


Kontrollgruppe

Raucher

Neto JBC, de Souza AP, Barbieri D, Moreno H, Sallum EA, Nociti FH. Matrix metalloproteinase-2 may be involved with increased bone loss associated with experimental periodontitis and smoking: a study in rats. *J Periodontol 2004;75(7):995-1000.*

# Rauchen

Aims: To determine the effect of nicotine, cotinine and cigarette smoke extract (CSE) on the neutrophil respiratory burst and their effect on activation of the nuclear factor-*κ*B (NF*κ*B) pathway in oral epithelium.

Conclusions: These data demonstrate that smoke extract reduces the ability of neutrophils to generate ROS after stimulation with *F. nucleatum* and IgG-opsonized *S. aureus* but, at high concentrations, stimulates extracellular ROS (reactive oxygen species) generation.
During periodontitis, cigarette smoking may differentially affect neutrophil function, generally preventing elimination of periodontal pathogens but, in heavy smokers, also stimulating ROS release and oxidative stress mediated tissue damage.

Matthews JB, Chen FM, Milward MR, Wright HJ, Carter K, McDonagh A, Chapple ILC. Effect of nicotine, cotinine and cigarette smoke extract on the neutrophil respiratory burst. *J Clin Periodontol 2011;38:208-218.*

# Rauchen

Aim: The aim of this study was to compare the expression of 22 chemokines and cytokines in gingival crevicular fluid (GCF) from smokers and non-smokers with periodontitis and periodontally healthy control subjects.

Conclusions: Periodontitis subjects had significantly elevated cytokine and chemokine profiles. Smokers exhibited a decrease in several pro-inflammatory cytokines and chemokines and certain regulators of T-cells and NK-cells. This reflects the immunosuppressant effects of smoking which may contribute to an enhanced susceptibility to periodontitis.

Tymkiw KD, Thunell DH, Johnson GK, Joly S, Burnell KK, Cavanaugh JE, Brogden KA, Guthmiller JM. Influence of smoking on gingival crevicular fluid cytokines in severe chronic periodontitis. *J Clin Periodontol 2011;38:219-228.*

# Rauchen

Aim: The aim of this 12-month prospective study was to assess the adjunctive effect of smoking cessation in non-surgical periodontal therapy of subjects with severe chronic periodontitis.

Materials and methods: Of the 201 subjects enrolled from a smoking cessation clinic, 93 were eligible and received non-surgical periodontal treatment and concurrent smoking cessation treatment. Periodontal maintenance was performed every 3 months. Full-mouth periodontal examination in six sites per tooth was performed by a calibrated examiner, blinded to smoking status, at baseline, 3, 6 and 12 months after non-surgical periodontal treatment.

Conclusion: Smoking cessation promoted clinical attachment gain in chronic periodontitis subjects from a smoking cessation clinic after 1 year of follow-up.

Rosa EF, Corraini P, Carvalho VF, Inoue G, Gomes EF, Lotufo JPB, De Micheli G, Pannuti CM. A prospective 12-month study of the effect of smoking cessation on periodontal clinical parameters. *J Clin Periodontol 2011;38(6):562-571.*

# Rauchen

Aim: The aim of the present study was to examine how deleterious current smoking and the use of Swedish moist snuff (snus) is for periodontal health compared with non-tobacco users.

Results: Multiple logistic regression shows, after adjusting for age, gender and sociodemographic variables, that relative to non-tobacco users, cigarette smokers had statistically significant less gingivitis, a higher frequency of PPD.

Conclusions: Cigarette smokers were found to have a statistically significant higher risk of severe periodontitis than non-tobacco users and users of snus. Using snus did not seem to be a risk factor for periodontitis.

Hugoson A, Rolandsson M. Periodontal disease in relation to smoking and the use of Swedish snus: epidemiological studies covering 20 years (1983–2003). *J Clin Peridontol 2011;38:809-816.*

# Rauchen

Aim: To relate the mean percentage of bleeding on probing (BOP) to smoking status in patients enrolled in supportive periodontal therapy (SPT).

Materials and Methods: Retrospective data on BOP from 8′741 SPT visits were related to smoking status among categories of both periodontal disease severity and progression (instability) in patients undergoing dental hygiene treatment at the Medi School of Dental Hygiene (MSDH), Bern, Switzerland 1985-2011.

Conclusions: Irrespective of the smoking status, increased mean BOP in SPT patients relates to disease severity and periodontal instability while smokers demonstrate lower mean BOP concomitantly with an increased prevalence of residual PPDs.

Ramseier CA, Mirra D, Schütz C, Sculean A, Lang NP, Walter C, Salvi GE. Bleeding on Probing as it relates to smoking status in patients enrolled in supportive periodontal therapy for at least 5 years. *J Clin Periodontol 2015;42:150-159.*

# Interleukin-1-Genotyp und Rauchen

There is a gene-environmental interaction between smoking and the IL-1 genetic polymorphism. Smokers bearing the genotype-positive IL-1 allele combination have an increased risk of periodontitis. The IL-1 genotype has no influence in non-smokers.

Under supportive periodontal therapy: gender, smoking habits, age and clinical periodontal conditions (bleeding on probing) did not differ by IL-1 gene status.

Meisel P, Siegemund A, Grimm R, Herrmann FH, John U, Schwahn C, KocherT. The interleukin-1 polymorphism, smoking, and the risk of periodontal disease in the population-based SHIP study. *J Dent Res 2003;82:189-193.*
Meisel P, Schwahn C, Gesch D, Bernhardt O, John U, KocherT. Dose-effect relation of smoking and the interleukin-1 gene polymorphism in periodontal disease. *J Periodontol 2004;75:236-242.*
Agerbaek MR, Lang NP, Person GR. Microbiological composition associated with interleukin-1 gene polymorphism in subjects undergoing supportive periodontal therapy. *J Periodontol 2006;77(8):1397-1402.*

# Interleukin-1-Genotyp und Implantat

Bei ImplantatpatientInnen steigt das Verlustrisiko bei Rauchern um das 2,5-fache. Ein direkter Zusammenhang zu Patienten mit Interleukin-1-Genotyp und Implantatverlusten konnte nicht nachgewiesen werden.


Wilson TG Jr, Higginbottom FL. Periodontal diseases and dental implants in older adults. *J Esthet Dent 1998;10(5):265-271.*

Wilson TG Jr, Nunn M. The relationship between interleukin-1 periodontal genotype and implant loss. Initial data. *J Periodontol 1999;70(7):724-729.*

McGuire MK, Nunn ME. Prognosis versus actual outcome. IV. The effectivness of clinical parameters and IL-1 genotype in accurately predicting prognoses and tooth survival. *J Periodontol 1999;70:49-56.*

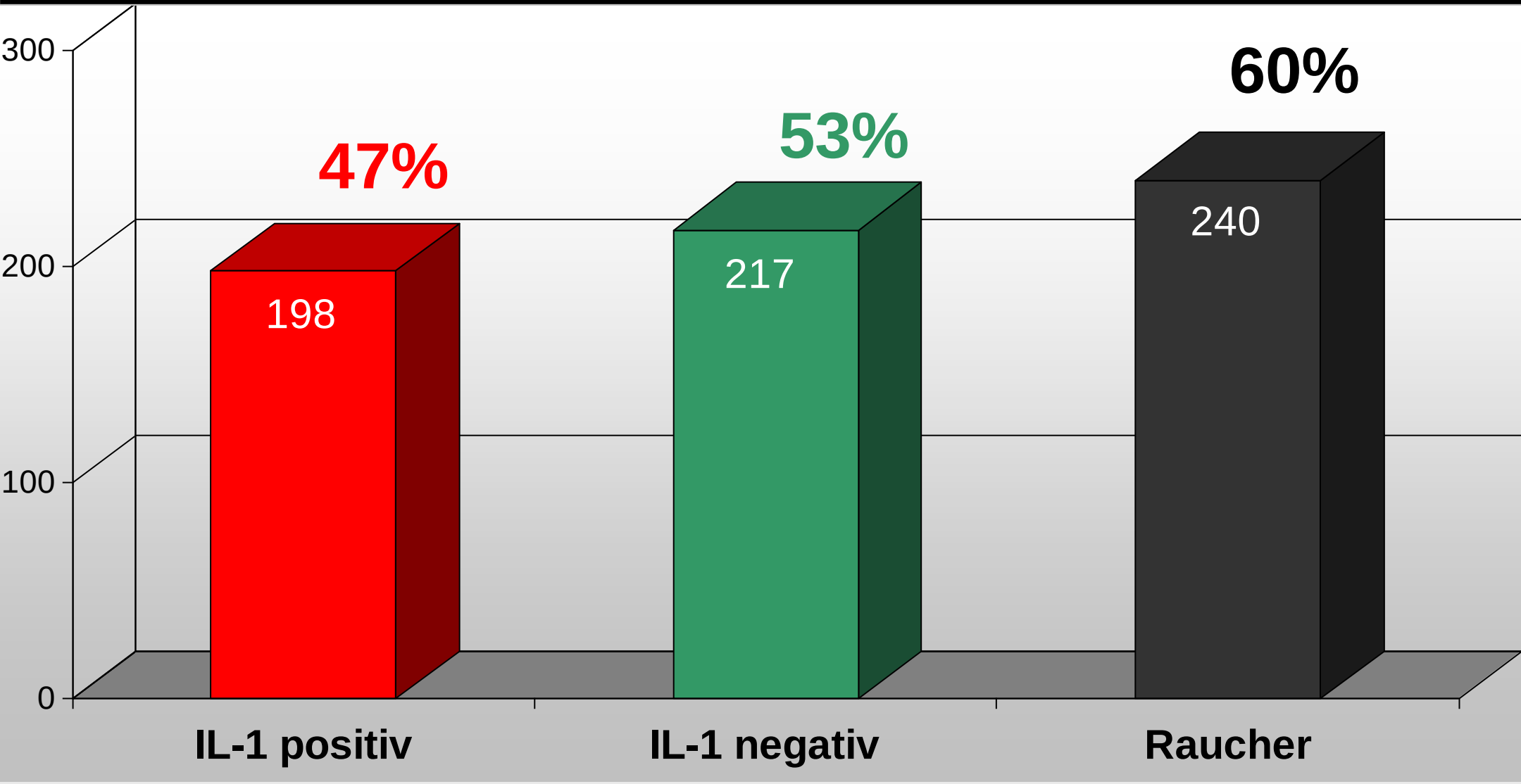
Siervo S, Wirz J, Schmidli F, Coraini C, Wang HY, Siervo P. Genetic susceptibility and biocorrosion: who plays the tune in late implant failure. *J Periodontol 2000.*


Bei rauchenden, IL-1-Genotyp positiven ImplantatpatientInnen kommt es infolge eines starken synergistischen Effektes zu einem signifikant höheren Risiko für biologische Komplikationen oder Langzeitversagen von Implantaten.


Gruica B, Wang HY, Lang NP, Buser D. Impact of IL-1 genotype and smoking status on the prognosis of osseointegrated implants. *Clin Oral Implants Res 2004;15:393-400.*

Feloutzis A, Lang NP, Tonetti MS, Burgin W, Brägger U, Buser D, Duff GW, Kornman KS. IL-1 gene polymorphism and smoking as risk factors for peri-implant bone loss in a well-maintained population. *Clin Oral Implants Res 2003;14:10-17.*

# Interleukin-1-Genotyp und Rauchen




n = 415 2000 - 2010 Parodontologie Graz

# Interleukin-1-Genotyp und Mikroorganismen

Background: Recent research is increasingly showing that host genetic variants can affect the colonization by specific microbes. The aim of this study was to systematically investigate the associations between host genetic variants and subgingival microbial detection and counts. A systematic search of the literature was conducted in Ovid Medline, Embase, LILACS and Cochrane Library for studies reporting data on host genetic variants and detection of microbes subgingivally.

Conclusions: There is no evidence yet that neither *IL1* genetic polymorphisms nor other investigated genetic polymorphisms are associated with presence and counts of subgingival bacteria. Further studies on large populations with replication samples should clarify the possible effects of other genetic variants on the subgingival microbiota.

Nibali L, Di Iorio A, Onabolu O, Lin G-H. Periodontal infectogenomics: systematic review of associations between host genetic variants and subgingival microbial detection. *J Clin Periodontol 2016;43:889-900.*

# Zytokine - Parodontitis

Aim: The aim of this analysis was to evaluate the importance of genetic variants of TNFα for the severity of periodontal disease and periodontal risk factors with respect to periodontal risk factors in a cohort of coronary patients.

Methods: After including of patients, an extensive periodontal examination also involving PCR-sampling for 11 periodontal bacteria was performed. In this subanalysis, single nucleotide polymorphisms (SNPs) c.308G>A, c.238G>A and haplotypes for TNFα were analysed by CTS-PCR-SSP Tray kit (Heidelberg, Germany).

Results: The AG+AA genotype of SNP c.238G>A of TNFα gene was associated with the amount of clinical attachment loss in patients with coronary heart disease in multivariate regression analysis. Moreover, prevotella intermedia occurred more frequently in carriers who were positive for the AG+AA genotype and A-allele of SNP c.308G>A in bivariate and multivariate analyses. Furthermore, only in bivariate analyses significant associations of genetic variants of TNFα with intensified bleeding on probing and with higher plasma level of interleukin 6 could be shown.

Conclusions: Genetic variants of TNFa gene, namely c.308G>A and c.238G>A, are associated with periodontal conditions in patients with coronary heart disease.

Schulz S, Schlitt A, Lutze A, Lischewski S, Seifert T, Dudakliewa T, Gawe R, Werdan K, Hofmann B, Gla¨ser C, Schaller H-G, Reichert S. The importance of genetic variants in TNFα for periodontal disease in a cohort of coronary patients. *J Clin Periodontol 2012;39:699-706.*

# Zytokine - Parodontitis

Aim: To examine changes in levels of gingival crevicular fluid (GCF) cytokines, after periodontal therapy of generalized aggressive periodontitis (GAgP).

Materials and Methods: Twenty-five periodontally healthy and 24 GAgP subjects had periodontal clinical parameters measured and gingival crevicular fluid (GCF) samples collected from up to 14 sites/subject. GCF samples were analysed using multiplex bead immunoassay for: GM-CSF, IFN-c, IL-10, IL-1b, IL-2, IL-6 and TNF-$\alpha$. Aggressive periodontitis subjects were randomly assigned to either scaling and root planing (SRP) alone or SRP plus systemic amoxicillin (500 mg) and metronidazole (400 mg) 3 times a day for 14 days. Clinical parameters and GCF cytokines were re-measured 6 months after treatment.

Conclusions: Periodontal therapy improved GCF cytokine profiles by lowering IL-1b and increasing IL-10 levels. The reduction in GCF GM-CSF after therapy implicates this cytokine in the pathogenesis of GAgP. There was no difference between therapies in changes of GCF cytokines.

Oliveira APL, Faveri M, Gursky LC, Mestnik MJ, Feres M, Haffajee AD, Socransky SS, Teles RP. Effects of periodontal therapy on GCF cytokines in generalized aggressive periodontitis subjects. *J Clin Periodontol 2012;39:295-302.*

# Zytokine - Parodontitis / Gingivitis / Implantatverlust

| | IL-genotype: Korrelation / kein Zusammenhang | +Rauchen | +Diabetes |
|---|---|---|---|
| IL-1 (α,ß,RN) | Kornman 1997, Salvi 1998, Gore 1998, Mc Guire 1999, Parkhill 2000, Mc Devitt 2000, De Sanctis 2000, Cullinan 2001, Papapanou 2001, Laine 2001, Lopez 2005, Scapoli 2005, Anusaksathien 2003, Havemose-Poulsen 2007, Nikolopoulos 2008, Geismar 2008, Lopez 2009, Fitzsimmons 2010, Trombelli 2010, Kaushik 2011, Karimbux 2012, Rathnayake, Araújo 2013, Sánchez 2013, Liukkonen 2016, Hodge 2001, Jepsen 2003, Meisel 2004, Shapira 2005, Loos 2005, Stein 2009 | Mc Devitt 2000, Parkhill 2000, Meisel 2004, Feloutzis 2003, Gruica 2004, Almasri 2007, Jankovic 2013, Wilson 1998, 1999, Agerbaek 2006, Huynh-Ba 2007 | |
| IL-2, -10 | Scarel-Caminaga 2002, 2004, Pinar 2007, Larsson 2011, Schaefer 2013 | | |
| IL-4 | Michel 2001, Gonzales 2004, Anovazzi 2010 | | |
| IL-6 | Galicia 2006, Raunio 2007, Nibali 2008, Saxlin 2009, Jingjin 2010, Ishida 2012, Scapoli 2007 | | Raunio 2008, Andriankaja 2009 |
| IL-6, CD14 | Tervonen 2007, Nibali 2008, 2010 | | |
| IL-11, -17 | Johnson 2004, Liukkonen 2016, Croandijk 2002 | | |
| IL-12 | Takeuchi-Hatanaka 2008, Reichert 2008 | | |
| IL-21, -23 | Dutzan 2011, Liukkonen 2016 | | |
| TNFα | Soga 2003, Schulz 2012, Craandijk 2002, Scapoli 2007 | | |

The evidence for the effect of Interleukin-1 genotype, osteoporosis, psychosocial factors is inconclusive and requires further investigation.

Heitz-Mayfield LJA. Disease progression: identification of high-risk groups and individuals for periodontitis. *J Periodontol 2005;32(6):196-192.*

# Zytokine - Parodontitis

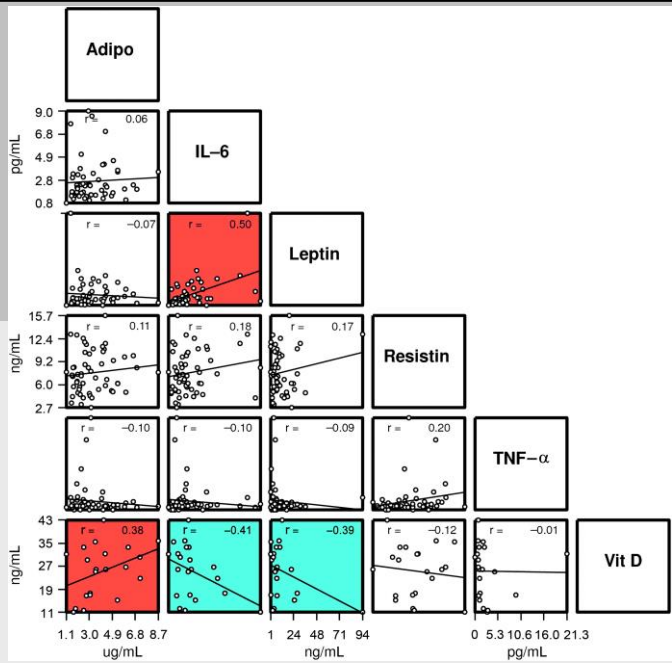
Background: The purpose of this study is to determine whether baseline salivary inflammatory biomarkers could discriminate between different clinical levels of disease and/or detect clinical changes over a 3-week stent-induced biofilm overgrowth (SIBO) period…Saliva samples were assessed for levels of 13 different biomarkers by multiplex immunoassay.

Conclusions: In summary, this investigation supports salivary levels of IL-1ra and IL-6 as potential indicators for PD changes during induced gingival inflammation. In addition, participants from the BGI-P3 group (severe periodontitis) demonstrated elevated baseline levels of IL-1β, MMP-3, MMP-8, MMP-9, and NGAL compared with the other study groups, strengthening the relevance of participants' biologic phenotype on expression of salivary biomarkers.

Morelli T, Stella M, Barros SP, Marchesan JT, Moss KL, Kim SJ, Yu N, Aspiras MB, Ward M, Offenbacher S. Salivary biomarkers in a biofilm overgrowth model. *J Periodontol. 2014 Dec;85(12):1770-1778.*

# IL-6, TNFα, Adiponectin, Leptin, Vitamin D

Red panels represent statistically significant positive correlations, and turquoise panels represent statistically significant negative correlations.




Results: There were positive correlations between adiponectin/vitaminD and between IL-6/leptin, negative correlations between IL-6/vitamin D and leptin/vitamin D, but no associations between serum analytes and clinical or microbial parameters.

Sex and body mass index were associated with levels of adipokines.

Periodontal therapy improved clinical and microbiologic parameters but did not influence the levels of serum analytes.

Teles FR, Teles RP, Martin L, Socransky SS, Haffajee AD. Relationships among interleukin-6, tumor necrosis factor-a, adipokines, vitamin D, and chronic periodontitis. *J Periodontol 2012;83:1183-1191.*

# Stress

Parodontitispatienten zeigen andere Stressbewältigungsstrategien als Kontrollpersonen. Bei der Überprüfung eines Einflusses von Coping-varianten auf den Schweregrad der parodontalen Erkrankung zeigte sich, dass Patienten mit abwehrenden Copingstilen höhere Attachmentverluste und einen negativen Einfluss auf die Therapie aufwiesen.

Die Pathomechanismen sind weitgehend unklar. Psychoneuro-immunologische und verhaltensorientierte Mechanismen (Rauchen) werden vermutet.

Wimmer G, Janda M, Wieselmann-Penkner, Jakse N, Polansky R, Pertl C. Coping with stress: ist influence on periodontal disease. *J Periodontol 2002;73:1343-1351.*
Wimmer G, Jakse N, Haas M. Der Einfluss von Stress auf parodontale Erkrankungen. *Stomatologie 2002;99:207-215.*
Wimmer G, Köhldorfer G, Mischak I, Lorenzoni M, Kallus W. Coping With Stress. Its Influence on Periodontal Therapy. *J Periodontol 2005;76:90-98.*

# Stress

Background: Scientific evidence for psychologic stress as a risk factor for periodontitis is fragmentary and relies mostly on either questionnaire-based or biomarker studies. The aim of this study is to investigate brain-derived neurotrophic factor, substance P, vasoactive intestinal peptide (VIP), neuropeptide Y (NPY), calcitonin gene-related peptide, and adrenomedullin as well as cortisol in saliva and serum in periodontal health and disease combined with different aspects of stress and possible associations with clinical parameters.

Results: VIP and NPY showed significantly higher levels in saliva but not in serum of patients with periodontitis. These neuropeptides correlated with the extent, severity, and bleeding on probing scores in patients with periodontitis. Females had significantly lower salivary VIP levels. There were no differences among participants regarding psychologic stress.

Haririan H, Andrukhov O, Böttcher M, Pablik E, Wimmer G, Moritz A, Rausch-Fan X. Salivary neuropeptides, stress, and periodontitis
*Journal of Periodontology 2018 89:1,9-18.*

# Alkohol

Objective: Investigate the association between the frequency of alcohol consumption and periodontitis…

Methods: … Associations between the occurrence of periodontitis and potential risk variables were analysed by univariate and multivariate logistic regression stratified by smoking status when appropriate.

Conclusions: Occurrence of periodontitis among alcohol users were high and the frequency of alcohol consumption increased the odds of periodontitis incrementally mainly in smokers.

A negative influence of alcohol consumption was observed on clinical and microbiologic periodontal parameters, as well as a slight influence on immunologic parameters, signaling the need for additional studies.

Lages EJP, Costa FO, Lages EMB, Cota LOM, Cortelli SC, Nobre-Franco GC, Cyrino RM, Cortelli JR. Risk variables in the association between frequency of alcohol consumption and periodontitis. *J Clin Periodontol 2012;39:115-122*.

Lages EJP, Costa FO, Cortelli SC, Cortelli JR, Cota LOM, Magalhães Cyrino R, Lages EMB, Nobre-Franco GC, Brito JAR, Gomez RS. Alcohol consumption and periodontitis: quantification of periodontal pathogens and cytokines. *Journal of Periodontology 2015,86(9):1058-1068*.

# Risikofaktoren

Objectives: Evaluation of patient-related risk factors contributing to tooth loss and recurrence of periodontitis 10.5 years after initial therapy in patients with aggressive periodontitis.

Conclusion: Age, absence of IL-1 composite genotype and low social status are detected as risk factors for tooth loss. Smoking and high mean GBI (Gingival Bleeding Index) are associated with an increased risk for recurrence of periodontitis, whereas regular SPT (supportive periodontal therapy) acts as a protective factor.

Bäumer A, El Sayed N, Kim T-S, Reitmeir P, Eickholz P, Pretzl B. Patient-related risk factors for tooth loss in aggressive periodontitis after active periodontal therapy. *J Clin Periodontol 2011;38:347-354.*

# Pathogenese der Parodontalerkrankungen

**Endogene Faktoren**
- Schwangerschaft
- Osteoporose
- Leukämie
- HIV

**Genetik**
- IL-1α,-1ß,-RN, IgG2 M.,
- Hypercholesterinämie,
- Zyklische Neutropenie,
- Down Syndrom

**Diabetes mellitus (Typ 1/2)**
**Metabolisches Syndrom**
**Hyperlipidämie**

Spezifische Mikroorganismen

Wirt - Immunantwort

B Parodontitis

Metabolische Veränderungen

Anatomische Veränderungen = Traditionelle Zahnheilkunde

**Exogene Faktoren**
- Hygiene
- Rauchen
- Alkohol
- Medikamente
- Ernährung, Mikronährstoffe
- Psychosoziale Faktoren
- Stress
- Lebenspartner
- Familie

Offenbacher S. Periodontal diseases: pathogenesis. *Ann Periodontol 1996;1:821-878.*

# Pathogenese der Parodontalerkrankungen

**Endogene Faktoren**
- Schwangerschaft
- Osteoporose
- Leukämie
- HIV

**Genetik**
- IL-1α,-1ß,-RN, IgG2 M.,
- Hypercholesterinämie,
- Zyklische Neutropenie,
- Down Syndrom

**Spezifische Mikroorganismen**

Wirt - Immunantwort

**Parodontitis**

Metabolische Veränderungen

**Exogene Faktoren**
- Hygiene
- Rauchen
- Alkohol
- Medikamente
- Ernährung, Mikronährstoffe
- Psychosoziale Faktoren
- Stress
- Lebenspartner
- Familie

**Diabetes mellitus (Typ 1/2)**
**Metabolisches Syndrom**
**Hyperlipidämie**

Kardiovaskuläre Erkrankungen

Preterm low birth weight, Arteriosklerose, Pneumonie

Erektile Dysfunktion, Chron. Nierenerkrankungen, Arthritis

Mortalität, Hirnabszess, Trigeminusneuralgie, COPD

Neonatal intensive care unit

# Pathogenese der Parodontalerkrankungen

**Endogene Faktoren**

Schwangerschaft
Osteoporose
Leukämie
HIV

**Genetik**

IL-1α,-1ß,-RN, IgG2 M.,
Hypercholesterinämie,
Zyklische Neutropenie,
Down Syndrom

**Spezifische Mikroorganismen**

Wirt - Immunantwort

B Parodontitis

Metabolische Veränderungen

**Exogene Faktoren**

Hygiene
Rauchen
Alkohol
Medikamente
Ernährung, Mikronährstoffe
Psychosoziale Faktoren
Stress
Lebenspartner
Familie

**Diabetes mellitus (Typ 1/2)**
**Metabolisches Syndrom**
**Hyperlipidämie**

Kardiovaskuläre Erkrankungen
Preterm low birth weight
Arteriosklerose
Pneumonie
Erektile Dysfunktion
Chron. Nierenerkrankungen
Arthritis
Mortalität
Hirnabszess
Trigeminusneuralgie
COPD
Neonatal intensive care unit

# Pathogenese der Parodontalerkrankungen

**Endogene Faktoren**
- Schwangerschaft
- Osteoporose
- Leukämie
- HIV

**Genetik**
- IL-1α,-1ß,-RN, IgG2 M.,
- Hypercholesterinämie,
- Zyklische Neutropenie,
- Down Syndrom

**Spezifische Mikroorganismen**

Wirt - Immunantwort


Parodontitis

Metabolische Veränderungen

**Exogene Faktoren**
- Hygiene
- Rauchen
- Alkohol
- Medikamente
- Ernährung, Mikronährstoffe
- Psychosoziale Faktoren
- Stress
- Lebenspartner
- Familie

**Diabetes mellitus (Typ 1/2)**
**Metabolisches Syndrom**
**Hyperlipidämie**

Kardiovaskuläre Erkrankungen

Preterm low birth weight · Arteriosklerose · Pneumonie

Erektile Dysfunktion · Chron. Nierenerkrankungen · Arthritis

Mortalität · Hirnabszess · Trigeminusneuralgie · COPD

Neonatal intensive care unit

# Pathogenese der Parodontalerkrankungen

**Endogene Faktoren**

Schwangerschaft
Osteoporose
Leukämie
HIV

**Genetik**

IL-1α,-1ß,-RN, IgG2 M.,
Hypercholesterinämie,
Zyklische Neutropenie,
Down Syndrom

**Spezifische Mikroorganismen**

Wirt - Immunantwort

**Parodontitis**

Metabolische Veränderungen

**Exogene Faktoren**

Hygiene
Rauchen
Alkohol
Medikamente
Ernährung, Mikronährstoffe
Psychosoziale Faktoren
Stress
Lebenspartner
Familie

**Diabetes mellitus (Typ 1/2)**
**Metabolisches Syndrom**
**Hyperlipidämie**

# Risikofaktor - Diabetes mellitus (Typ 1 und 2)

Bei Typ I- und II- Diabetikern sind signifikante Zusammenhänge zwischen Diabeteseinstellung, Parodontalbefund und Zahnverlust nachweisbar.

Hodge PJ, Robertson D, Paterson K, Smith GLF, Creanor S, Sherriff A. Periodontitis in non-smoking type 1 diabetic adults: a cross-sectional study. *J Clin Periodontol 2012;39:20-29.*
Kaur G, Holtfreter B, Rathmann WG, Schwahn C, Wallaschofski H, Schipf S, Nauck M, Kocher T. Association between type 1 and type 2 diabetes with periodontal disease and tooth loss. *J Clin Periodontol 2009;36(9):765-774.*
Salvi GE, Beck JD, Offenbacher S. PGE2, IL-1 beta, and TNF-alpha responses in diabetics as modifiers of periodontal disease expression. *Ann Periodontol 1998;3(1):40-50.*
Willerhausen-Zönnchen B, Lemmen C, Hamm G. Beziehung zwischen Speichel -komponenten und Parodontitis bei insulinabhängigen Diabetikern. *Dtsch Zahnärztl Z 1991;46,281-284.*

Eine nicht behandelte, fortgeschrittene marginale Parodontitis stellt einen Risikofaktor für erhöhte glykosylierte Hämoglobinwerte (HbA1c) dar. Patienten mit NIDDM und Parodontitis zeigen einen signifikant höheren Verlust von Alveolarknochen. Prädiabetische und diabetische Ratten zeigen Zusammenhänge von Parodontitis und Nierenveränderungen.

Taylor GW, Burt B A, Becker MP, Genco RJ, Shlossman M, Knowler WC, Petit DJ. Severe periodontitis and risk for poor glycemic control in patients with non-insulin-dependent diabetes mellitus. *J Periodontol 1996;67,10(Supplement):1085-1093.*
Taylor GW, Burt B A, Becker MP, Genco RJ, Shlossman M, Knowler WC, Petit DJ. Non-insulin dependent diabetes mellitus and alveolar bone los progression over 2 years. *J Periodontol 1998;69(1):76-83.*
Pontes Andersen CC, Holmstrup P, Buschard K, Flyfbjerg A. Renal alterations in prediabetic rats with periodontitis. *J Periodontol 2008;79(4):684-690.*

# Risikofaktor - Diabetes mellitus (Typ 2)

Aim: To determine the impact of periodontitis on oxidative/inflammatory status and diabetes control in Type 2 diabetes.

Materials and Methods: A comparative study of 20 Type 2 diabetes patients with periodontitis [body mass index (BMI) 31+5], 20-age/gender-matched, non-periodontitis Type 2 diabetes controls (BMI 29+6) and 20 non-diabetes periodontitis controls (BMI 25+4) had periodontal examinations and fasting blood samples collected. Oxidative stress was determined by plasma small molecule antioxidant capacity (pSMAC) and protein carbonyl levels; inflammatory status by total/differential leucocytes, fibrinogen and high sensitivity C-reactive protein (hsCRP); diabetes status by fasting glucose, HbA1c, lipid profile, insulin resistance and secretion.

Conclusion: Periodontitis is associated with increased oxidative stress and compromised glycaemic control in Type 2 diabetes patients.

Allen EM, Matthews JB, O' Halloran DJ, Griffiths HR, Chapple IL: Oxidative and inflammatory status in Type 2 diabetes patients with periodontitis. *J Clin Periodontol 2011;38:894-901.*

# Risikofaktor - Diabetes mellitus (Typ 2)

Background: It is well accepted that glycemic control in patients with diabetes mellitus (DM) is affected by systemic inflammation and oxidative stress. The aim of the present study is to assess over a period of 6 months the effect of non-surgical periodontal therapy on serum levels of high-sensitivity C-reactive protein (hsCRP), *d*-8-iso prostaglandin F2a (*d*-8-iso) as a marker of oxidative stress, and matrix metalloproteinase (MMP)-2 and MMP-9 on patients with type 2 DM. Results: Although there was a trend to a reduction in hsCRP, *d*-8-iso and MMP-9 it did not reach statistical significance. MMP-2 levels remained unchanged after periodontal treatment.

Conclusion: Effective non-surgical periodontal treatment of participants with type 2 DM and moderate to severe periodontal disease improved significantly A1c (serum glycated hemoglobin) levels but did not result in a statistically significant improvement in hsCRP, *d*-8-iso, MMP-2, and MMP-9 levels.

Koromantzos PA, Makrilakis K, Dereka X, Offenbacher S, Katsilambros N, Vrotsos IA, Madianos PN. Effect of non-surgical periodontal therapy on C-reactive protein, oxidative stress, and matrix metalloproteinase (MMP)-9 and MMP-2 levels in patients With type 2 diabetes: A randomized controlled study. *J Periodontol 2012;83:3-10.*

# Risikofaktor - Diabetes mellitus (Typ 2)

Aim: To assess the periodontal status and number of missing teeth in patients with newly identified pre-diabetes or diabetes mellitus.

Methods: A total of 1097 subjects with previously undiagnosed diabetes were available for study, and were categorized into normoglycaemic, potentially pre-diabetes or potentially diabetes groups based on a point-of-care (POC) HbA1c test.

Conclusions: Individuals with previously unidentified pre-diabetes demonstrate a level of periodontal destruction between that observed for normoglycaemic individuals and persons with diabetes. These data emphasize the association of oral findings to dysglycaemia, and suggest that periodontal disease and tooth loss can be early complications of diabetes mellitus.

Lamster IB, Cheng B, Burkett S, Lalla E. Periodontal findings in individuals with newly identified pre-diabetes or diabetes mellitus. *J Clin Periodontol 2014;41:1055-1060.*

# Risikofaktor - Diabetes mellitus (Typ 2)

Objective: This study examined the association between periodontitis, diabetes and glycemic control.

Methods: The National Health and Nutrition Examination Survey data for 2009-2012 were analyzed. Periodontitis status of each participant was assessed using the full mouth periodontal examination protocol, classified using the Centers for Disease Control and Prevention and the American Academy of Periodontology (AAP) surveillance case definition for total periodontitis. Self-reported diabetes status was defined as yes or no….

In the bivariate analysis, several demographic factors were significantly associated with having periodontitis including self-reported diabetes status and glycemic control. In the multivariate analysis, the demographic factors, glycohemoglobin cut-off values of 8.0%, 8.5%, 9.0% and mean glycohemoglobin level remained significant, but self-reported diabetes status was not.

Conclusion: This study demonstrates that glycohemoglobin and demographic factors were significantly associated with periodontitis, but not self-reported status.

Lamster IB, Cheng B, Burkett S, Lalla E. Periodontal findings in individuals with newly identified pre-diabetes or diabetes mellitus. *J Clin Periodontol 2014;41:1055-1060.*

# Risikofaktor - Diabetes mellitus (Typ 2)

Aim: To assess an approach to improving behavioural and glycaemic outcomes in dental patients who present with diabetes risk factors and previously unrecognized hyperglycaemia.

Results: Seventy-three subjects returned for the 6-month visit. The two intervention groups did not significantly differ in any of the outcome variables. Eighty-four percent of subjects reported having visited a physician post-randomization, and 49% reported at least one positive lifestyle change as a result of our intervention. In subjects identified with potential diabetes (baseline HbA1c ≥ 6.5%), HbA1c was reduced 1.46 ± 0.28% compared to baseline ($p < 0.01$).

Conclusion: Diabetes risk assessment and education by dental professionals of affected individuals unaware of their status may contribute to improved patient outcomes.

Lalla E, Cheng B, Kunzel C, Burkett S, Ferraro A, Lamster IB. Six-month outcomes in dental patients identified with hyperglycaemia: a randomized clinical trial. *J Clin Periodontol 2015; 2:228–235.*

# Risikofaktor - Diabetes mellitus (Typ 2)

Background: This study examines the association between periodontitis, diabetes (DM), and glycemic control.

Methods: National Health and Nutrition Examination Survey data for 2009 to 2012 were analyzed. Periodontitis status of each participant was assessed using the full-mouth periodontal examination protocol, classified using the Centers for Disease Control and Prevention and the American Academy of Periodontology surveillance case definition for total periodontitis. Self-reported DM status was defined as yes or no. Glycemic control was assessed using glycohemoglobin data at cutoff points of 7.0%, 7.5%, 8.0%, 8.5%, and 9.0%. Descriptive statistics and logistic regression analyses were performed, and all analyses were adjusted for the survey design.

Conclusion: This study demonstrates that glycohemoglobin and demographic factors are significantly associated with periodontitis, but not self-reported status.

Garcia D, Tarima S, Okunseri C. Periodontitis and Glycemic Control in Diabetes: NHANES 2009 to 2012. *J Periodontol. 2015;86(4):499-506.*

# Risikofaktor - Diabetes mellitus (Typ 2)

Aim: To examine associations of pre-diabetes and well-controlled diabetes with periodontitis.

Results: Pre-diabetes was neither associated with mean CAL and PPD in multivariable adjusted linear regression models nor with edentulism (OR = 1.09 (95%-CI: 0.69-1.71)) and number of teeth (OR = 0.96 (95%-CI: 0.75–1.22), lowest quartile *versus* higher quartiles) in logistic regression models. Associations with mean CAL and edentulism were stronger in poorly controlled previously known diabetes than in well-controlled previously known diabetes (for edentulism: OR = 2.19 (95%-CI: 1.18–4.05), and OR = 1.40 (95%-CI: 0.82–2.38), respectively, for comparison with NGT).

Conclusions: Periodontitis and edentulism were associated with poorly controlled T2DM, but not with pre-diabetes and well-controlled diabetes.

Kowall B, Holtfreter B, Völzke H, Schipf S, Mundt T, Rathmann W, Kocher T. Pre-diabetes and well-controlled diabetes are not associated with periodontal disease: the SHIP Trend Study. *J Clin Periodontol 2015;42:422-430.*

# Risikofaktor - Diabetes mellitus

Results: Healthy individuals with periodontitis exhibit a poor glycaemic control and a higher risk of developing diabetes. Individuals affected by diabetes show a deterioration of glycaemic control if also affected by periodontitis and significantly higher prevalence of diabetes-related complications. Limited evidence is available on gestational diabetes and type 1 diabetes.

Conclusions: Periodontitis has a significant impact on diabetes control, incidence and complications. Nevertheless, the heterogeneity and quality of the included publications suggest that caution should be exercised when interpreting the data and that there remains an important need for additional evidence.

Graziani F, Gennai S, Solini A, Petrini M. A systematic review and meta-analysis of epidemiologic observational evidence on the effect of periodontitis on diabetes. *J Clin Periodontol. 2018;45:167-187.*

# Risikofaktor - Metabolisches Syndrom[1)]

The presence of periodontal pockets was associated with a positive conversion of metabolic-syndrome components, suggesting that preventing periodontal disease may prevent metabolic syndrome.

Morita T, Yamazaki Y, Mita A, Takada K, Seto M, Nishinoue N, Sasaki Y, Motohashi M, Maeno M. A cohort study on the association between periodontal disease and the development of metabolic syndrome. *J Periodontol 2010;81(4):512-519.*

Our data support the relationships between metabolic disturbances and periodontitis, with a central role of insulin resistance.

Benguigui C, Bongard V, Ruidavets JB, Chamontin B, Sixou M, Ferrières J, Amar J. Metabolic syndrome, insulin resistance, and periodontitis: a cross-sectional study in a middle-aged French population. *J Clin Periodontol 2010;37(7):601-608.*

A consistent association between MetS and measures of periodontitis was not seen in this cohort of postmenopausal women.

LaMonte MJ, Williams AM, Genco RJ, Andrews CA, Hovey KM, Millen AE, Browne RW, Trevisan M, Wactawski-Wende J. Association between metabolic syndrome and periodontal disease measures in postmenopausal women: The Buffalo OsteoPerio Study .*J Periodontol 2014;85:1489-1501.*

1) MetS: Abdominelle Fettleibigkeit, Bluthochdruck, Hyperlipidämie, Diabetes Typ II durch Insulinresistenz

# Risikofaktor - Metabolisches Syndrom

Reduction of periodontal inflammation either with root planing and systemic antibiotics or with plaque control and subgingival scaling significantly reduces CRP levels after 9 months in patients with MetS.

López NJ, Quintero A, Casanova PA, Ibieta CI, Baelum V, López R. Effects of periodontal therapy on systemic markers of Inflammation in patients with metabolic syndrome: a controlled clinical trial. *J Periodontol 2012;83:267-278.*

Periodontal infection measured by means of the number of teeth with deepened periodontal pockets appears to be associated with obesity.

Zhu Y, Hollis JH. Associations between the number of natural teeth and metabolic syndrome in adults. J Clin Periodontol 2015;42:113-120.
Rangé H, Léger T, Huchon C, Ciangura C, Diallo D, Poitou C, Meilhac O, Bouchard P, Chaussain C. Salivary proteome modifications associated with periodontitis in obese patients. *J Clin Periodontol 2012;39:799-806.*
Haro A, Saxlin T, Suominen A-L, Ylo stalo P, Leiviska J, Tervonen T, Knuuttila M. Serum lipids modify periodontal infection – C-reactive protein association. J Clin Periodontol 2012;39:817-823.
Gorman A, Kaye EK, Apovian C, Fung TT, Nunn M, Garcia RI. Overweight and obesity predict time to periodontal disease progression in men. *J Clin Periodontol 2012;39:107-114.*
Han D-H, Lim S, Paek D, Kim H-D. Periodontitis could be related factors on metabolic syndrome among Koreans: a case-control study. *J Clin Periodontol 2012;39:30–37.*
Saxlin T, Ylöstalo P, Suominen-Taipale L, Mnnistö S, Knuuttila M. Association between periodontal infection and obesity: results of the Health 2000 Survey. *J Clin Periodontol 2011;38:236-242.*

# Risikofaktor - Metabolisches Syndrom

Background: There has been little evaluation in longitudinal epidemiologic studies of the effect of metabolic syndrome (MetS) on periodontal status. The specific aim of this longitudinal study is to investigate whether MetS in the Japanese population could be a risk factor for periodontal disease.

Results: The prevalence of MetS was 21.6% (27/125). Study participants with MetS were approximately 2.6 times more likely to develop periodontal disease (adjusted relative risk 2.58, 95% confidence interval 1.17 to 5.67) after simultaneous adjustment for other covariates.

Conclusions: These findings support the hypothesis that MetS may be a risk factor for periodontal disease in older Japanese individuals. Additional studies with larger, more diverse populations and more complete information are needed to substantiate the findings.

Iwasaki M, Sato M, Minagawa K, Manz MC, Yoshihara A, Miyazaki H. Longitudinal relationship between metabolic syndrome and periodontal disease among Japanese adults aged ≥70 years: the niigata study. *J Periodontol. 2015;86(4):491-849*

# Risikofaktor - Hyperlipidämie

This study does not provide evidence that unfavourable lipid composition can be considered as an important risk for periodontal infection in a general adult population.

Korhonen S, Saxlin T, Suominen L, Jula A, Knuuttila M, Ylöstalo P. Serum cholesterol ratios and periodontal infection: results of the Health 2000 Survey. *J Clin Periodontol 2011;38:787-794.*

In overweight students, the frequent consumption of fatty foods and infrequent consumption of vegetables were associated with an increased risk of periodontitis.

In underweight and normal-weight students, eating habits had little effect on the periodontal condition.

Tomofuji T, Furuta M, Ekuni D, Irie K, Azuma T, Iwasaki Y, Morita M. Relationships between eating habits and periodontal condition in university students. *J Periodontol 2011;82:1642-1649.*

# Risikofaktor - Hyperlipidämie

Background: The objective of this study is to determine whether simvastatin consumption and hyperlipidemia are associated with a worse periodontal condition and specific bone activity biomarkers.

Results: …Multivariable linear regression analysis adjusted for age, sex, tobacco, and alcohol revealed that, compared with the normolipidemic patients, the simvastatin-treated patients with hyperlipidemia showed a mean reduction of 0.8 mm in CAL.

Conclusions: Within the limits of this study, the findings suggest that the intake of simvastatin is associated with increasing serum OPG concen-trations (bone metabolism marker osteoprotegerin), and this could have a protective effect against bone breakdown and periodontal attachment loss. The baseline systemic inflammatory state of patients with hyperlipidemia is indicated by their increased ESR (erythrocyte sedimentation rate).

Magan-Fernandez A, Papay-Ramırez L, Tomas J, Marfil-Álvarez R, Rizzo M, Bravo M, Mesa F. Relationships between eating habits and periodontal condition in university students. *J Periodontol 2014;85:1408-1415.*

# Risikofaktor - Hyperlipidämie

Background: The purpose of this study is to determine the serum levels of malondialdehyde (MDA), as a lipid peroxidation marker, and 8-hydroxydeoxyguanosine (8-OHdG), as an oxidative DNA damage marker, in patients with chronic periodontitis (CP) and hyperlipidemia.

Methods: A total of 74 individuals were divided into four age- and sex-matched groups: 18 patients with hyperlipidemia and CP (HLp), 18 periodontally healthy patients with hyperlipidemia (HLh), 19 systemically healthy individuals with CP (Cp), and 19 systemically and periodontally healthy controls (Ch). Clinical periodontal parameters were measured, and serum lipids, MDA, and 8-OHdG levels were assessed in blood samples.

Conclusions: In this study, serum MDA and 8-OHdG were found to be highest in the HLp group. The increased levels of MDA and 8-OHdG in HLp patients may be a result of a harmful oxidative status in association with hyperlipidemia and periodontitis.

Fentoğlu Ö, Kırzıoğlu FY, Bulut MT, Kumbul Doğuç D, Kulaç E, Önder C, Günhan M. Evaluation of lipid peroxidation and oxidative DNA damage in patients with periodontitis and hyperlipidemia. *J Periodontol. 2015;86(5):682-688.*

# Risikofaktor - Übergewicht/Fettleibigkeit

Aim: The objective of this study was to investigate whether the response to periodontal treatment differs among obese, overweight or normal-weight patients.

Results: A total of 15 studies including 867 patients were included. No significant difference was found for any clinical periodontal parameter between overweight/obese and normal-weight patients. Periodontal treatment in systemically healthy overweight/ obese patients was associated with higher decrease in TNFα levels (1 study) and higher decrease in HbA1c levels (1 study) compared to systemically healthy normal-weight patients….

Conclusions: Whereas no difference was found in clinical periodontal parameters, significant differences in inflammatory or metabolic parameters were found between overweight/obese and normal-weight patients, but existing evidence is weak.

Papageorgiou SN, Reichert C, Jäger A, Deschner J. Effect of overweight/obesity on response to periodontal treatment: systematic review and a meta-analysis. *J Clin Periodontol 2015;42:247–261.*

Keller A, Rohde JF, Raymond K, Heitmann BL. Association between periodontal disease and overweight and obesity: a systematic review. *J Periodontol.2015;86(6):766-776.*

# Mikronährstoffe - Ernährung

Aim: Nutritional factors have been implicated in several chronic inflammatory diseases that are associated with periodontitis. This manuscript reviews the evidence for nutritional exposures in the etiology and therapeutic management of periodontitis, and makes recommendations for daily nutritional intake for vitamin C (ascorbic acid), vitamin D, calcium, and antioxidants.

Conclusion: Periodontitis is associated with low serum/plasma micronutrient levels… Inadequate antioxidant levels may be managed by higher intake of vegetables, berries, and fruits (e.g. kiwi fruit), or by phytonutrient supplementation. Current evidence is insufficient to support recommendations of mono-antioxidant vitamin supplements and randomised controlled double-blind intervention studies are needed to provide evidence to underpin future recommendations.

Van der Velden U, Kuzmanova D, Chapple ILC. Micronutritional approaches to periodontal therapy. *J Clin Periodontol 2011;38(Suppl.11):142-158.*

# Mikronährstoffe - Ernährung

Aim: A double-blind randomized controlled trial to determine whether dietary supplementation with fruit/vegetable/berry juice powder concentrates, simultaneously with non-surgical periodontal therapy, improved 2-month treatment outcomes.

Methods: Volunteers with chronic periodontitis were randomly assigned to one of three groups: fruit/vegetable (FV), fruit/vegetable/berry (FVB) or placebo. Supplements were taken daily during non-surgical debridement and maintenance and outcomes assessed at 2, 5 and 8 months after completion. Primary outcomes were mean probing pocket depth (PPD), clinical attachment gain, %sites bleeding on probing (% BOP) at 2 months. Adherence and plasma b-carotene were determined.

Conclusions: Adjunctive juice powder concentrates appear to improve initial pocket depth reductions in nutritionally replete patients, where plasma micronutrient bioavailability is attainable.

Chapple ILC, Milward MR, Ling-Mountford N, Weston P, Carter K, Askey K, Dallal GE, De Spirt S, Sies H, Patel D, Matthews JB. Adjunctive daily supplementation with encapsulated fruit, vegetable and berry juice powder concentrates and clinical periodontal outcomes: a double-blind RCT. *J Clin Periodontol 2012;39:62-72.*

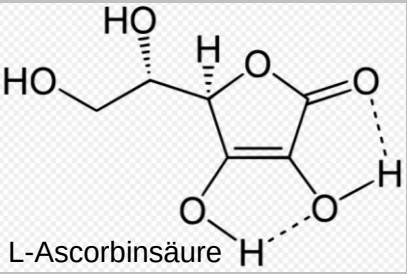
# Mikronährstoffe - Ernährung

Material & Methods: Participants (98 subjects: periodontitis/poor dietary conditions) were instructed to consume one tablet/day containing 200 mg Ester C® calcium ascorbate, 25 mg calcium threonate and 100 mg citrus flavonoids for 90 days. Following parameters were evaluated: prevalence/amount of seven traditional period. pathogens, cytomegalovirus, Epstein-Barr virus (EBV); and plasma levels of vitamin C, HbA1c and hsCRP.

Results: After VitC/Ca/CF supplementation, 100% of subjects showed normal plasma vitamin C values compared to 55% before. At baseline, 48% of subjects harboured *A.actinomycetemcomitans*, >97% the other periodontal pathogens and 73% EBV. Supplementation with VitC/Ca/CF reduced the subgingival load of all studied bacteria ($p$-values: 0.014–0.0001) and EBV ($p < 0.0001$) substantially in all initially positive subjects. Plasma levels of HbA1c and hsCRP dropped in all subjects ($p < 0.0001$).

Amaliya A, Laine ML, Loos BG, Van der Velden U. Java project on periodontal diseases: effect of vitamin C/calcium threonate/citrus flavonoids supplementation on periodontal pathogens, CRP and HbA1c. *J Clin Periodontol 2015;42:1097-1104.*

# Mikronährstoffe - Vitamin C

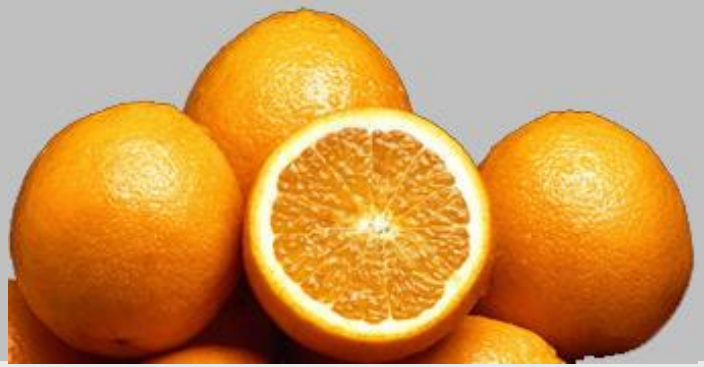



Results: Plasma vitamin C was lower in periodontitis patients compared with controls (8.3 and 11.3 mg/l, respectively, p = 0.03).
Only in the control group a positive correlation was present between vitamin C intake and plasma values. No differences could be assessed between patients and controls regarding vitamin C dietary intake and levels in PMNs and PBMCs. In the patient group, pocket depth appeared to be negatively associated with the vitamin C concentration in PMNs.

Conclusion: Although the relationship between low plasma vitamin C levels and periodontitis is clear, the disease cannot be explained by insufficient vitamin C storage capacity of leucocytes; the question remains through which mechanism low plasma vitamin C levels are related to periodontitis.

Kuzmanova D, Jansen IDC, Schoenmaker T, Nazmi K, Teeuw WJ, Bizzarro S, Loos BG, Velden van der U. Vitamin C in plasma and leucocytes in relation to periodontitis. *J Clin Periodontol 2012;39:905-912.*
Staudte H, Kranz S, Völpel A, Schütze J, Sigusch BW. Comparison of nutrient intake between patients with periodontitis and healthy subjects. *Quint Int 2012;43:907-916.*
Amaliya-Timmermann MF, Abbas F, Loos BG, Van der Weijden GA, Van Winkelhoff AJ, Winkel EG, Van der Velden U. Java project on periodontal diseases: the relationship between vitamin C and the severity of periodontitis. *J Clin Periodontol 2007;34:299-304.*

# Mikronährstoffe - Vitamin C



- Unterstützung der Abwehrmechanismen

| | |
|---|---|
| PMN, Lymphozyten | Speicherung und antioxidative Wirkung |
| Kollagensynthese | Koenzym für die Bildung von Lysin und Prolin |
| Fibroblasten | Steigerung der Vitalitätsrate (Pg) |


Kuzmanova D, Jansen IDC, Schoenmaker T, Nazmi K, Teeuw WJ, Bizzarro S, Loos BG, Velden van der U. Vitamin C in plasma and leucocytes in relation to periodontitis. *J Clin Periodontol 2012;39:905-912.*

Staudte H, Kranz S, Völpel A, Schütze J, Sigusch BW. Comparison of nutrient intake between patients with periodontitis and healthy subjects. *Quint Int 2012;43:907-916.*

Staudte H, Voelpel A, Guentsch A, Sigusch BW. Vitamin C attenuates the cytotoxic effects of Porphyromonas gingivalis on human gingival fibroblasts. *Arch Oral Biol 2010;55:40-45.*

Amaliya-Timmermann MF, Abbas F, Loos BG, Van der Weijden GA, Van Winkelhoff AJ, Winkel EG, Van der Velden U. Java project on periodontal diseases: the relationship between vitamin C and the severity of periodontitis. *J Clin Periodontol 2007;34:299-304.*

Staudte H, Sigusch BW, Glockmann E. Grapefruit consumption improves vitamin C status in periodontitis patients. *Br Dent J 2005;199:213-217.*

Phillips CL, Combs SB, Pinnell SR. Effects of ascorbic acid on proliferation and collagen synthesis in relation to the donor age of human dermal fibroblasts. *J Invest Dermatol 1994;103:228-232.*

# Mikronährstoffe - Vitamin C

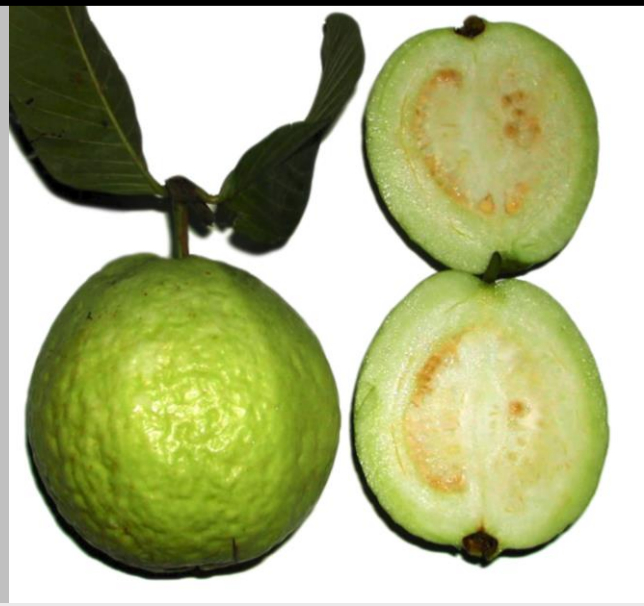
Abstract: To review the new role of an age-old micronutrient - ascorbic acid - in the management of periodontal disease. Articles pertaining to the topic were searched in PubMed and other search engines from year 1974 to April 2014 with the following key words: "ascorbic acid," "ascorbate," "vitamin C," "periodontal disease," "gingivitis," "periodontitis," "anti-oxidants" and "elderly." …

Conclusion: In the era of "periodontal medicine," the impact of remote tissue changes on systemic disease has to be taken into serious consideration. Deficiency of nutritional impact on the host, with micronutrient vitamin C detailed in this review with sources, absorption, interaction and its relationship with systemic disease, and thereby the impact on periodontal disease. Ascorbic acid plays an important role in the aging process, and in the maintenance of periodontal health in the elderly.

Alagl AS, Bhat SG. Ascorbic acid: New role of an age-old micronutrient in the management of periodontal disease in older adults. *Geriatr Gerontol Int. 2014;11:19.*

# Mikronährstoffe - Vitamin C

Objectiv: To study the effect of guava and synthetic vitamin C on the development of gingival inflammation during experimental gingivitis.



Conclusion: In a population of young nonsmoking adults, consumption of either 200 g guava/day or 200 mg synthetic vitamin C/day, prior to and during the oral hygiene abstention period, has a preventive effect on the development of experimental gingivitis as compared to the control group that developed the usual amount of experimental gingivitis.

Amaliya A, Risdiana AS, Van der Velden U. Effect of guava and vitamin C supplementation on experimental gingivitis: A randomized clinical trial. *J Clin Periodontol 2018;45:959-967.*

# Risikofaktor - Osteoporose

Results: Subjects with osteoporosis exhibited a significantly higher percentage of sites with clinical attachment loss (AL) ≥6 mm compared to subjects with osteopenia ($P$ <0.05); subjects with osteoporosis also showed a greater percentage of sites with interproximal gingival recession (GR) ≥5 mm than did control subjects ($P$ <0.05) after excluding smokers. Subjects with osteoporosis were more likely (odds ratio = 3.3; $P$ <0.05) to exhibit interproximal GR ≥5 mm than were control subjects. Osteoporosis remained significantly associated with severe clinical AL and interproximal GR after adjusting for age, supragingival plaque, and number of teeth lost.

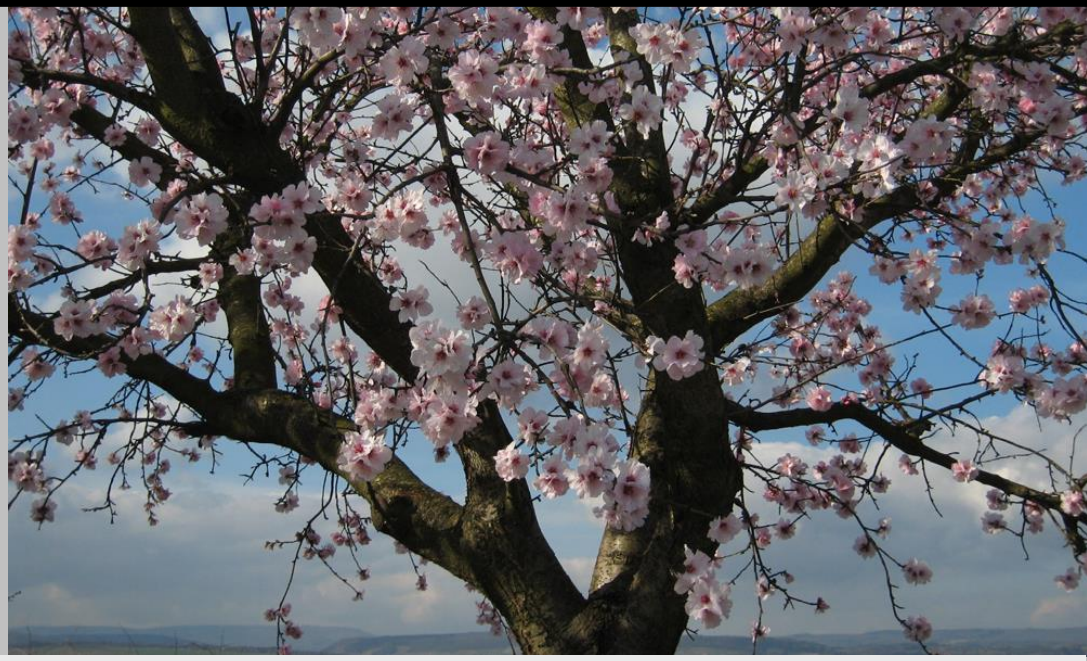
Conclusion: This study suggests that osteoporosis is associated with severe clinical AL and interproximal GR in elderly Chinese men.

Shum I, Leung P, Kwok A, Corbet EF, Orwoll ES, Phipps KR, Jin L. Periodontal conditions in elderly men with and without osteoporosis or osteopenia.. *J Periodontol 2010;81:1396-1402.*

# Risikofaktor - Osteoporose

Calcium und Vitamin D

- ⇨ Immunsystem
- ⇨ Muskulatur
- ⇨ Nervenfunktion
- ⇨ Knochenstoffwechsel



Calcium < 500 mg pro Tag erhöht das parodontale Erkrankungsrisiko.

Osteoporoseprophylaxe: Calcium und Vitamin D aus Nahrungsmitteln - Milchprodukte, grünes Gemüse und Nüsse

Al-Zahrani MS. Increased intake of dairy products is related to lower periodontitis prevalence. *J Periodontol 2006;77:289-294.*
Nishida M, Grossi SG, Dunford RG, Ho AW, Trevison M, Genco RJ. Calcium and the risk for periodontal disease. *J Periodontol 2000;71:1057-1066.*

# Vitamin D

Background: Possible synergism between female sex hormones and vitamin D on periodontitis pathology has not been assessed. Here, the authors investigate effects of estrogen, progesterone, and vitamin D on periodontitis in a population-based sample and use cell studies to explore mechanistic explanations of the population-based findings.

Conclusions: The association between HRT (hormone replacement therapy) and clinical periodontal measures was strongest among women with high vitamin D levels. This association is plausibly mediated via an anti-inflammatory transcriptional mechanism.

Jönsson D, Aggarwal P, Nilsson BO, Demmer RT. Beneficial effects of hormone replacement therapy on periodontitis are vitamin d associated. *J Periodontol 2013;84:1048-1057.*

# Vitamin D

Background: Vitamin D is hypothesized to prevent periodontal disease progression through its immune-modulating properties and its role in maintaining systemic calcium concentrations. The authors investigated associations between plasma 25-hydroxyvitamin D [25(OH)D] (collected 1997 to 2000) and the 5-year change in periodontal disease measures from baseline (1997 to 2000) to follow-up (2002 to 2005) among 655 post-menopausal women in a Women's Health Initiative Observational Study ancillary study.

Conclusions: No association between baseline 25(OH)D and the subsequent 5-year change in periodontal disease measures was observed. Vitamin D status may not influence periodontal disease progression. Thus, supplementation of vitamin D for prevention of periodontal disease progression is not warranted at this time. More studies are needed to confirm these results.

Millen AE, Andrews CA, LaMonte MJ, Hovey KM, Swanson M, Genco RJ, Wactawski-Wende J. Vitamin D status and 5-year changes in periodontal disease measures among postmenopausal women: The Buffalo OsteoPerio Study. *J Periodontol 2014;85:1321-1332.*

# Vitamin D Receptor-Polymorphismus

## Conclusions:

The results of the present meta-analysis indicate the following:

- The mutant allele t of the Taq-I locus may be a protective factor for CP but not for AP in Asians, although this was not true in whites.
- The mutant allele F of the Fok-I locus appeared to be a risk factor for AP rather than CP in Asians.
- Bsm-I and Apa-I polymorphisms were found to have no significant associations with susceptibility to periodontitis (CP/AP).

Chen L, Li H, Zhang P, Wang S. Association between vitamin D receptor polymorphisms and periodontitis: a meta-analysis. *J Periodontol 2012;83:1095-1103.*

# Vitamin D

Background: Apart from the effects of vitamin D on bone metabolism, it is also known for its immunomodulatory properties. However, so far, it is not clear whether serum 25-hydroxyvitamin D [25(OH)D] exerts any beneficial effect on the periodontium. The aim of the present study is to investigate whether the serum level of 25(OH)D is related to periodontal condition, measured by means of pocketing and gingival bleeding.

Results: There were practically no associations between serum 25(OH)D level and teeth with deep (≥4 mm) periodontal pockets or bleeding sextants.

A somewhat lower proportion of teeth with deep periodontal pockets was found in higher serum 25(OH)D quintiles among individuals with a good oral hygiene level.

Conclusions: Serum 25(OH)D did not seem to be related to periodontal condition, measured as periodontal pocketing and gingival bleeding in this low-risk, low-25(OH)D status population.

Antonoglou GN, Suominen AL, Knuuttila M, Ylöstalo P, Ojala M, Männistö S, Marniemi J, Lundqvist A, Tervonen T. Associations between serum 25-hydroxyvitamin d and periodontal pocketing and gingival bleeding: results of a study in a non-smoking population in Finland. *J Periodontol 2015;86(6):755-765.*

# Vitamin D

Background: Vitamin D is hypothesized to reduce risk for tooth loss via its influence on bone health, inflammation, and the immune response. The association between plasma 25-hydroxyvitamin D [25(OH)D] concentrations and prevalence and 5-year incidence of tooth loss in a cohort of postmenopausal females was examined.

Conclusions: In this cohort of postmenopausal females, the data do not support an association between vitamin D status and tooth loss.

Pavlesen S, Mai X, Wactawski-Wende J, LaMonte MJ, Hovey KM, Genco RJ, Millen AE. Vitamin D status and tooth loss in postmenopausal females: The Buffalo Osteoporosis and Periodontal Disease (OsteoPerio) Study. *J Periodontol 2016;87(8):852-863.*

# Vitamin D - Vitamin K

Background: The synergistic effects of vitamin D3 and vitamin K2 on bone loss prevention have been reported. This study evaluates the effects of vitamin D3 and vitamin K2 supplementation in conjunction with conventional periodontal therapy (scaling and root planing [SRP]) on gingival interleukin (IL)-1β and IL-10, serum bone alkaline phosphatase (B-ALP) and tartrate-resistant acid phosphatase 5b (TRAP-5b), and calcium and alveolar bone levels in rats with experimentally induced periodontitis.

Conclusion: Within the limitations of this study, vitamin D3 and K2 alone or in combination did not affect gingival IL-1β and IL-10, serum B-ALP and TRAP-5b levels, or alveolar bone compared with conventional periodontal therapy alone.

Aral K, Alkan BA, Saraymen R, Yay A, Şen A, Önder GÖ. Therapeutic effects of systemic vitamin k2 and vitamin d3 on gingival inflammation and alveolar bone in rats with experimentally induced periodontitis. *J Periodontol. 2015;86(5):666-673.*

# Vitamin B-Komplex

## Folsäure

- ⇨ Mangel bei Parodontitispatienten
- ⇨ Erhöhter Bedarf in der Schwangerschaft
- ⇨ Supplementierung reduziert Schwangerschaftsgingivitis
- ⇨ Kofaktor in der DNA-Synthese
- ⇨ Supplementierung mit B-Vitaminen verbessert nach PA-Chirurgie die Wundheilung

Grünes Gemüse, Hülsenfrüchte, Sprossen, Obst, Rote Beete, Karotten, Sonnenblumenkerne, Nüsse, Spargel, Tomaten, Avocado, Radieschen, Rucola, Spinat, Vollkornprodukte, Eier, Leber, Fisch.


Staudte H, Kranz S, Völpel A, Schütze J, Sigusch BW, Comparison of nutient intake between patients with periodontitis and healthy subjects. *Quint Int 2012;43:907-916.*

Esaki M, Morita M, Akhter R, Akino K, Honda O. Relationship between folic acid intake and gingival health in non-smoking adults in Japan. *Oral Dis 2010;16:96-101.*

Neiva RF, Shammari K, Nociti FH, Soehren S, Wang HL. Effects of vitamin B complex supplementation on periodontal wound healing. *J Periodontol 2005;76:1084-1091*.

Thomson ME, Pack AR. Effects of extended systemic and topical folate supplementation on gingivitis of pregnacy. *J Clin Periodontol 1982;9:275-280.*

# Vitamin B12

Aim: The aim of this study was to investigate the association of serum vitamin B12 with the progression of periodontitis and risk of tooth loss in a prospective cohort study.

Materials and Methods: In the Study of Health in Pomerania, 1648 participants were followed from 2002–2006 to 2008–2012 (mean duration 5.9 years)... PD and CAL were measured to reflect periodontal status on a half-mouth basis at each survey cycle…

Results and Conclusions: In multivariate regression models, baseline vitamin B12 was *inversely associated* with changes in mean PD mean CAL, and risk ratios of tooth loss. Stratified analyses showed stronger associations between vitamin B12 and changes in mean CAL among never smokers.

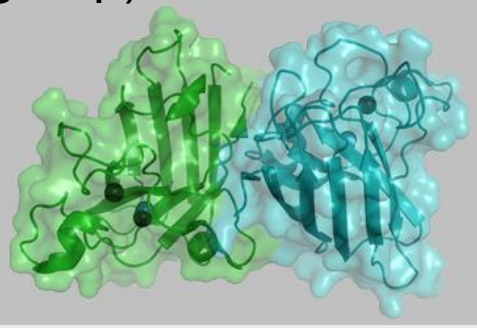
Zong G, Holtfreter B, Scott AE, Völzke H, Petersmann A, Dietrich T, Newson RS, Kocher T. Serum vitamin B12 is inversely associated with periodontal progression and risk of tooth loss: a prospective cohort study. *J Clin Periodontol 2016;43:2-9*.

# Vitamin E / SOD[1)]

Background: This study investigates the levels of superoxide dismutase (SOD) activity in serum and saliva of patients with chronic periodontitis (CP). In addition, the outcome of scaling and root planing (SRP) with and without vitamin E supplementation is evaluated in terms of changes in periodontal parameters and SOD activity in patients with CP.

Methods: Serum and salivary SOD activity in 38 patients with CP were compared with those of 22 systemically and periodontally healthy individuals (control group)…

1) Superoxid-Dismutase (SOD) ist der Sammelbergriff für Enzyme, die Superoxid-Anionen (oxydativer Stress) zu Wasserstoffperoxid umwandeln.



Conclusions: Systemic and local SOD levels are lowered in CP. Adjunctive vitamin E supplementation improves periodontal healing as well as antioxidant defense.

Singh N, Chander Narula S, Kumar Sharma R, Tewari S, Kumar Sehgal P. Vitamin e supplementation, superoxide dismutase status, and outcome of scaling and root planing in patients with chronic periodontitis: a randomized clinical trial. *J Periodontol 2014;85:242-249.*

# SOD[1)]

This study assessed the activities of antioxidant enzymes superoxide dismutase (SOD), glutathione reductase (GR), and catalase (CAT) and free radical damage marker malondialdehyde (MDA) levels in saliva of 30 patients with chronic periodontitis (CP) compared to 30 healthy controls by spectrophotometry. MDA levels were significantly elevated in the CP group, whereas the SOD, CAT, and GR activities were significantly reduced compared to healthy controls. MDA levels demonstrated a significant direct correlation with all periodontal parameters, whereas all antioxidant enzymes studied (SOD, CAT, and GR) showed an inverse correlation.

1) Superoxid-Dismutase (SOD) ist der Sammelbergriff für Enzyme, die Superoxid-Anionen (oxydativer Stress) zu Wasserstoffperoxid umwandeln.

Conclusions: These findings support the idea that oxidative stress has a role in periodontal disease pathogenesis.

Trivedi S, Lal N, Mahdi AA, Singh B, Pandey A. Association of salivary lipid peroxidation levels, antioxidant enzymes, and chronic periodontitis. *Int J Periodontics Restorative Dent 2015;35:e14-e19.*

# Antioxidantien

Patienten mit Parodontitis, Diabetes und Lungenerkrankungen zeigen eine verminderte antioxidative Kapazität.

Der Glutathion-Spiegel im Sulkus (antioxidativ wirkendes körpereigenes Tripeptid) ist herabgesetzt. Beim Gesunden ist die Glutathionkonzentration der Lunge (extrazellulär) vergleichbar. Dies könnte Ausdruck einer entzündungshemmenden Abwehrstrategie exponierter Epithelien sein.

Die Bestimmung dieses Antioxidantiums könnte als Vorhersagetool für den Schweregrad der Erkrankung herangezogen werden.

Grant MM, Brock GR, Matthews JB, Chapple LC. Crevicular fluid glutathione levels in periodontitis and the effect of non-surgical therapy. *J Clin Periodontol 2010;37:17-23.*

Chapple IL, Brock G, Eftimaldi C, Matthews JB. Glutathione in gingival crevicular fluid and ist relation to local antioxidant capacity in periodontal health and disease. *Arterioscler Mol Pathol 2002;55(6):367-373.*

# Antioxidantien - Polyphenole

Abstract: The objective of this study was to test the antibacterial effects of selected PPs on periodontal pathogens… Selected PPs (n = 48) were screened against Streptococcus mitis , Aa, Fn and Pg….

Conclusions: At this concentration, adhesion of curcumin and quercetin to the substrate also inhibited adhesion of S. mitis, and biofilm formation and maturation. Only curcumin-treated biofilms displayed a significantly reduced metabolic activity. …

Further cellular and in vivo studies are necessary to confirm their beneficial activities and potential use in the prevention and or treatment of periodontal diseases.

Shahzad M, Millhouse E, Culshaw S, Edwards CA, Ramage G, Combet E. Selected dietary (poly)phenols inhibit periodontal pathogen growth and biofilm formation. *Food Funct 2015 ;1:13.*

# Antioxidantien - Polyphenole

Background: Curcumin is a polyphenol extracted from root of turmeric and known to possess multifunctional properties…
In this study, the antibacterial effect of curcumin on periodontopathic bacteria is investigated, particularly *Pg*.
Results: Curcumin inhibited the growth of *P. gingivalis*, *Prevotella intermedia*, *Fusobacterium nucleatum*, and *Treponema denticola* in a dose-dependent manner. A concentration of 20 µg/mL curcumin inhibited these *P. gingivalis* biofilm formations by >80%. Conversely, 100 µg/mL curcumin did not suppress the growth of *Aggregatibacter actinomycetemcomitans*.

Conclusion: Curcumin possesses antibacterial activity against periodontopathic bacteria and may be a potent agent for preventing periodontal diseases.

Izui S, Sekine S, Maeda K, Kuboniwa M, Takada A, Amano A, Nagata H. Antibacterial activity of curcumin against periodontopathic bacteria. *J Periodontol 2016;87:83-90.*

# Omega-3-Fettsäuren

EPA - Eicosapentaensäure

DHA - Docosahexaensäure

DPA - Docosapentaensäure

LNA - α-Linolensäure

⇨ Aktivierung von Lipidmediatoren

## Tierversuch bei experimenteller Parodontitis

⇨ Hemmung der Osteoklasten bzw. Knochendestruktion (Infektion mit Pg).

⇨ Hemmung der Freisetzung proinflammatorischer Zytokine

⇨ Immunmodulierend - Zunahme der IgG-Antikörper

Bendyk A, Marino V, Zilm PS, Howe P, Bartold PM. Effect of dietary omega-3 polyunsaturated fatty acids on experimental periodontitis in the mouse. *J Periodontal Res 2009;44(2):211-216.*

Kesavalu L, Vasudevan B, Raghu B, Browning E, Dawson D, Novak JM, Correll MC, Steffen MJ, Bhattacharya A, Fernandes G, Ebersole JL. Omega-3 fatty acid effect on alveolar bone loss in rats. *J Dent Res 2006;85(7):648-652.*

# Omega-3-Fettsäuren

Abstract: The aim of this double-blind, randomized pilot study versus placebo is to evaluate this action in human experimentally-induced gingivitis. The clinical results of the trial demonstrated, in particular, a significant reduction of GI in the treated group ($p < 0.05$, Student t-test), but no significant difference between the groups. The biochemical results showed that EPA, DHA and DPA were found in the cells sampled, at higher levels in the subjects taking the drug. The levels of AA, PGE2 and LTB4 (Leukotriene B4) are reduced in the experimental group and increased in the control group, with no significant difference.

Conclusions: This human experimental gingivitis studies demonstrated that n-3 PUFA induced a tendency towards reduced inflammation but it was not possible to conclude significant efficacy.

Rosenstein ED, Kushner LJ, Kramer N, Kazandjian G. Pilot study of dietary fatty acid supplementation in the treatment of adult periodontitis. *Prostaglandins Leukot Essent Fatty Acids 2003;68(3):213-218.*

Campan P, Planchand PO, Duran D. Pilot study on n-3 polyunsaturated fatty acids in the treatment of human experimental gingivitis. *J Clin Periodontol 1997;24(12):907-913.*

# Omega-3-Fettsäuren

Aim: The impact of nonsurgical periodontal treatment combined with supplementation with omega (ω)-3 on the serum levels of EPA , DHA , DPA and AA (arachidonic acid).
Methods: Fifteen patients with CP were treated with SRP. The test group consisted of seven patients supplemented with ω-3 (EPA plus DHA 3x300mg) for 12 months….
The periodontal examination and the serum levels were performed at baseline, and 4, and 12 months after therapy.

Conclusions: Nonsurgical periodontal treatment combined with ω-3 supplementation significantly increased the EPA levels and decreased the AA and DPA levels resp. the AA/EPA ratio in serum after one year follow-up. However, no effect on the clinical outcome of periodontal therapy was observed.

Martinez GL, Koury JC, Martins MA, Nogueira F, Fischer RG, Gustafsson A, Figueredo CM. Serum level changes of long chain-polyunsaturated fatty acids in patients undergoing periodontal therapy combined with one year of omega-3 supplementation: a pilot randomized clinical trial. *J Periodontal Implant Sci. 2014;44(4):169-177.*

# Omega-3-Fettsäuren - Topische Anwendung

Aim: The aim of this clinical study was to evaluate the effects of topical application of n-6 or n-6 polyunsaturated fatty acids in patients with experimental gingivitis.

Methods: In each subject, similar teeth served as experimental and control over a 21-day non-hygiene phase and a 9-day resolving phase. Efficacy assessment was based on the bleeding on probing frequency (BOP) and the gingivocrevicular fluid volume (GCF).

Results: After 21 days of plaque growth, the BOP, GCF and LTB4 levels were significantly increased in all groups, with no differences between the control and experimental side.

Conclusions: The topical application of n-6 or n-6 fatty acids failed to inhibit the development of experimental gingivitis. Rinsing with n-6 fatty acids could reduce the level of GCF in established experimental gingivitis.

Eberhard J, Heilmann F, Açil Y, Albers HK, Jepsen S. Local application of n-3 or n-6 polyunsaturated fatty acids in the treatment of human experimental gingivitis. *J Clin Periodontol 2002;29(4):364-369.*

# Omega-3-Fettsäuren + Aspirin

Results: Statistical analyses demonstrated a significant reduction in probing depths and a significant attachment gain after 3 and 6 months in the ω-3 group compared to baseline and the control group ($P < 0.05$). Salivary RANKL and MMP-8 levels showed significant reductions in the ω-3 group in response to treatment at 3 and 6 months and compared to the control group at 6 months ($P < 0.01$). Supplementation with ω-3 + aspirin resulted in a significant shift in the frequency of pockets with probing depths <4 mm ($P < 0.05$).

Conclusions: The results of this preliminary clinical study suggest that dietary supplementation with ω-3 PUFAs and 81 mg aspirin may provide a sustainable, low-cost intervention to augment periodontal therapy.

El-Sharkawy H, Aboelsaad N, Eliwa M, Darweesh M, Alshahat M, Kantarci A, Hasturk H, Van Dyke TE. Adjunctive treatment of chronic periodontitis with daily dietary supplementation with omega-3 Fatty acids and low-dose aspirin. *J Periodontol 2010;81(11):1635-1643.*

# Omega-3-Fettsäuren

Background: The aim of the authors is to analyze the serum levels of DHA, EPA, DPA, and AA in patients with generalized chronic periodontitis (GCP) and compare these results with serum levels of patients with gingivitis only.

Methods: Twenty-one patients with untreated GCP (mean age: 46.0 ± 8.8 years) and 16 patients with gingivitis only (mean age: 31.5 ± 7.5 years) were investigated.

Results: Significantly higher levels of DHA, DPA, EPA, and AA were observed in patients with GCP when compared with patients with gingivitis ($P = 0.007$, $P = 0.004$, $P = 0.033$, and $P = 0.001$, respectively). The differences were still significant even after the adjustments for age and sex. The PD showed a significant positive correlation with DHA ($r = 0.5$; $P = 0.003$), DPA ($r = 0.6$; $P < 0.001$), and AA ($r = 0.6$; $P < 0.001$).

Conclusions: The present findings suggest that serum levels of LC-PUFA n-3 and n-6 may be affected by the severity of periodontal disease.

Figueredo CM, Martinez GL, Koury JC, Fischer RG, Gustafsson A. Serum levels of long-chain polyunsaturated fatty acids in patients with periodontal disease. *J Periodontol 2013;84(5):675-682.*

# Omega-3-Fettsäuren

Method: We studied 9.182 adults aged 20 years and older who participated in the National Health and Nutrition Examination Survey between 1999 and 2004. Periodontitis was assessed by dental exam and was defined as >4 mm pocket depth and >3 mm attachment loss in any one tooth. Intake of n-3 fatty acids was assessed by 24-hour dietary recall. We used multivariable logistic regression to estimate the associations between periodontitis and intakes of DHA, EPA, and LNA.

Conclusions: In this nationally representative sample, higher dietary intakes of DHA and, to a lesser degree, EPA, were associated with lower prevalence of periodontitis. Interventional studies are needed to confirm the potential protective effects of n-3 fatty acids on periodontitis.

Naqvi AZ, Buettner C, Phillips RS, Davis RB, Mukamal KJ. N-3 fatty acids and periodontitis in US adults. *J Am Diet Assoc 2010;110(11):1669-7165.*

# Omega-3-Fettsäuren

Aim: To examine whether the intake of omega-3 and omega-6 polyunsaturated fatty acids (PUFAs) is associated with periodontal condition.

Results: In this population, there were no statistically significant associations between the examined omega-3 or omega-6 fatty acids or their ratios and the periodontal outcome variables.

Conclusions: This cross-sectional study provided evidence that individual omega-3 or omega-6 fatty acids, their subclasses or ratios are not associated with periodontal health among a non-diabetic, non-rheumatoid and non-smoking population.

Jauhiainen L, Ylöstalo P, Männistö S, Kanerva N, Knuuttila M, Suominen AL. Periodontal condition in relation to intake of omega-3 and omega-6 polyunsaturated fatty acids. *J Clin Periodontol 2016;43:901-908.*

# Nitrat-Nitrit-Metabolismus

Aim: This prospective, parallel group, two-armed, double-blind, placebo-controlled randomized trial evaluated the impact of dietary nitrate consumption on gingival inflammation in recall patients.

Material and Methods: Forty-four (23 test/21 placebo) periodontal recall patients with chronic gingivitis were enrolled. At baseline, gingival index (GI), plaque control record (PCR) and salivary nitrate level (SNL) were recorded, followed by sub- and supragingival debridement. Subsequently, participants were randomly provided with 100 ml bottles of a lettuce juice beverage to be consumed 3× daily over 14 days, containing either a standardized amount of nitrate resulting in an intake of approximately 200 mg nitrate per day (test) or being devoid of nitrate (placebo).

Results: ... At day 14, mean GI of the test group was significantly reduced compared to baseline and significantly lower ($p$ = 0.002) than in the placebo group. Also, mean SNL in the test group was significantly higher than in the placebo group. Mean PCR did not change significantly in both groups.

Conclusions: Dietary nitrate consumption may be a useful adjunct in the control of chronic gingivitis.

Jockel-Schneider Y, Goßner SK, Petersen N, Stölzel P, Hägele F, Schweiggert RM, Haubitz I,Eigenthaler M, Carle R, Schlagenhauf U. Stimulation of the nitrate-nitrite-NO-metabolism by repeated lettuce juice consumption decreases gingival inflammation in periodontal recall patients: a randomized, double-blinded, placebo-controlled clinical trial. *J Clin Periodontol 2016;43:603-608*

# Feldstudie: Steinzeit-Ernährung

Background: The objective of this study was to assess the oral microbiota and clinical data in subjects without access to traditional oral hygiene methods and who ate a diet available in the Stone Age.

Methods: Ten subjects living in an environment replicating the Stone Age for 4 weeks were enrolled in this study. BOP, gingival and plaque indices, PD were assessed at baseline and at 4 weeks. Microbiologic samples were collected at the subgingival aspects of all teeth and from the dorsum of the tongue and were processed by checkerboard DNA-DNA hybridization methods.

Conclusions: … Although plaque levels increased, BOP and PD decreased. Subgingival bacterial counts increased for several species not linked to periodontitis, whereas tongue bacterial samples decreased during the study period.

Baumgartner S, Imfeld T, Schicht O, Rath C, Persson RE, Persson GR. The impact of the stone age diet on gingival conditions in the absence of oral hygiene. *J Periodontol 2009;80:759-768.*

# Feldstudie: Mochica-Kultur Peru (Mórrope-Studie)

Background: This work explores the effects of European contact on Andean foodways in the Lambayeque Valley Complex, north coast Peru. We test the hypothesis that Spanish colonization negatively impacted indigenous diet.

Methods: Diachronic relationships of oral health were examined from the dentitions of 203 late-pre-Hispanic and 175 colonial-period Mochica individuals from Mórrope, Lambayeque, to include observations of dental caries, antemortem tooth loss, alveolar inflammation, dental calculus, periodontitis, and dental wear.

Results: G-tests and odds ratio analyses across six age classes indicate a range of statistically significant postcontact increases in dental caries, antemortem tooth loss, and dental calculus prevalence (consumption of a greater proportion of dietary carbohydrates).

Klaus HD, Tam ME. Oral health and the postcontact adaptive transition: A contextual reconstruction of diet in Mórrope, Peru. *Am J Phys Anthropol. 2010;141(4):594-609.*

# Mikronährstoffe - Ernährung

Abstract: The link between nutrients and periodontal disease has not been clearly established. A PubMed and Cochrane database literature search was conducted. The published research reveals only a possible relationship between vitamins and minerals and periodontal disease.

Vitamin E, zinc, lycopene (carotenoid) and vitamin B complex may have useful adjunct benefits. However, there is inadequate evidence to link the nutritional status of the host to periodontal inflammation. More randomized controlled trials are needed to explore this association.

Kulkarni V, Bhatavadekar NB, Uttamani JR. The effect of nutrition on periodontal disease: a systematic review. *J Calif Dent Assoc.2014;42(5):302-11.*

# Risikofaktor - PLBW (preterm low birth weight)

Das Risiko einer Frühgeburt bzw. ein untergewichtiges Kind zu gebären, ist für Frauen mit marginaler Parodontitis bis zu siebenfach erhöht.

Offenbacher S, Katz V, Fertik G, Collins J, Boyd D, Maymor G, McKaig R, Beck S. Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol 1996;67,10 (Supplement):1103-1113.*

Neben Faktoren wie vorangegangene Frühgeburt, < 6 prenatale Untersuchungen hatte die Parodontitis den stärksten Einfluss auf PLBW. Von 400 Patientinnen zeigten die Unbehandelten eine PLBW-Rate von 10,11% gegenüber 1,84% in der Behandlungsgruppe. Es zeigte sich kein Unterschied zwischen lokalisierten und generalisierten Formen.

López NJ, Smith PC, Gutierrez J. Periodontal therapy may reduce the risk of preterm low birth weight in women with periodontal disease: a randomized controlled trial. *J Periodontol 2002;73:911-924.*

Maternal periodontitis was associated with a decrease in mean birth weight, as well as with LBW and VLBW.

Guimara˜es AN, Silva-Mato A, Siqueira FM, Cyrino RM, Cota LOM, Costa FO. Very low and low birth weight associated with maternal periodontitis. *J Clin Periodontol 2012;39:1024-1031.*

# Risikofaktor - PLBW (preterm low birth weight)

Conclusion: The factors involved in many cases of adverse pregnancy outcomes have still not being identified, although systemic infections may play a role. This study found a modest association between periodontitis and PB. Further research is required to establish whether periodontitis is a risk factor for PB and/or LBW.

Agueda A, Ramon JM, Manau C, Guerrero A, Echeverria JJ. Periodontal disease as a risk factor for adverse pregnancy outcomes: a prospective cohort study. *J Clin Periodontol 2008;35:16-22 .*

Conclusion: The results suggest that successful periodontal therapy in pregnant women suffering from periodontitis is a protective factor promoting the birth of children with normal weight.

Gomes-Filho IS, Cruz SS, Costa MN, Passos JS, Cerqueira EMM, Sampaio FP, Pereira EC, Miranda LF. Periodontal therapy and low birth weight: preliminary results from an alternative methodologic strategy. *J Periodontol 2010;81: 1725-1733.*

# Risikofaktor - PLBW (preterm low birth weight)

Variability among studies in definitions of periodontal disease and adverse pregnancy outcomes as well as widespread inadequate control for confounding factors and possible effect modification make it difficult to base meaningful conclusions on published data.

There is no conclusive evidence that treating periodontal disease improves birth outcome. Based on a critical qualitative review, available evidence from clinical trials indicates that, although non-surgical mechanical periodontal treatment in the second trimester of pregnancy is safe and effective in reducing signs of maternal periodontal disease, it does not reduce the rate of pre-term birth.

Wimmer G, Pihlstrom BL. A critical assessment of adverse pregnancy outcome and periodontal disease. *J Clin Periodontol 2008;35(Suppl.8):380-397.*

# Risikofaktor - PLBW (preterm low birth weight)

The results of this review show that MPDT did not decrease the risk of PB and/or LBW; however, the influence of specific aspects that were not investigated (disease diagnosis, extension and severity and the success of MPDT) should be evaluated by future RCTs.

Chambrone L, Pannuti CM, Guglielmetti MR, Chambrone LA. Evidence grade associating periodontitis with preterm birth and/or low birth weight. II. A systematic review of randomized trials evaluating the effects of periodontal treatment. *J Clin Periodontol 2011;38:902-914.*

Our results, within the limitations of this approach, indicate no evidence that AgP in the mother predisposes low birth weights. AgP has many unique biologic characteristics that differentiate it from chronic forms of periodontal disease, and the possible lack of its association with birth weight may be another such characteristic.

Schenkein HA, Koertge TE, Sabatini R, Brooks CN, Gunsolley JC. Birth weight of infants of mothers with aggressive periodontitis. *J Periodontol 2012;83:279-286.*

# Risikofaktor - PLBW (preterm low birth weight)

Conclusion: This systematic review and meta-analysis indicates statistically significant effect in reducing risk of preterm birth for SRP in pregnant women with periodontitis for groups with high risks of preterm birth only. Future research should attempt to confirm these findings and further define groups in which risk reduction may be effective.

Kim AJ, Lo AJ,* Deborah A. Pullin DA, Thornton-Johnson DS, Karimbux NY. Scaling and root planing treatment for periodontitis to reduce preterm birth and low birth weight: a systematic review and meta-analysis of randomized controlled tials. *J Periodontol 2012;83:1508-1519.*

# Risikofaktor - NICU (Neonatal intensive care unit)

Aim: The objective of this study was to determine the relationship between fetal exposure to oral pathogens and neonatal intensive care unit (NICU) admission.

Methods: Fetal immunoglobulin M against oral pathogens was detected in umbilical cord serum by immunoblot. The presence of at least one oral pathogen–specific antibody was considered seropositivity. The cord level of C-reactive protein was determined by enzyme-linked immunosorbent assay and categorized as detectable versus undetectable.

Conclusion: In utero fetal exposure to oral pathogens increases the risk for NICU admission and the length of stay. Interventions that interrupt fetal exposure to oral pathogens may reduce these risks.

Jared H, Boggess KA, Moss K, Bose C, Auten R, Beck J, Offenbacher S. Fetal exposure to oral pathogens and subsequent risk for neonatalintensive care admission. *J Periodontol 2009;13(3):878-883.*

# Risikofaktor für kardiovaskuläre Erkrankungen

The results of our study confirm an association between periodontitis and AMI in which periodontal destruction was correlated with the presence of periodontal pathogens. In particular, Pg might be considered a potential risk indicator for AMI.

Stein JM, Kuch B, Conrads G, Fickl S, Chrobot J, Schulz S, Ocklenburg C, SmeetsR. Clinical periodontal and microbiologic parameters in patients with acute myocardial infarction. *J Periodontol 2009;80(10):1581-1589.*

Nachweis der parodontopathogenen Bakterien A. actinomycetemcomitans und Porphyromonas gingivalis in Atheromen der Koronararterien.

Figuero E, Sánchez-Beltrán M, Cuesta-Frechoso S, Tejerina JM, del Castro JA, Gutiérrez JM, Herrera D, Sanz M. Detection of periodontal bacteria in atheromatous plaque by nested polymerase chain reaction. *J Periodontol 2011;82:1469-1477.*
Zambon JJ, Maraszthy VI, Grossi S, Genco RJ. Identification of periodontal pathogens in atheromas plaque*. J Dent Res1997;76:408.*

Streptococcus sanguis induziert in vitro bei Menschen und Kaninchen Thrombozytenaggregationen.

Herzberg MC, Meyer MW. Effects of oral flora on platelets: Possible consequences in cardiovascular disease. *J Periodontol 1996;67,10 (Suppl.):1138-1142.*

# Risikofaktor für kardiovaskuläre Erkrankungen

Eine generalisierte marginale Parodontitis erhöht das Risiko für eine koronare Herzerkrankung um den Faktor 1,5 bis 1,9. Die Wahrscheinlichkeit, einen Schlaganfall zu erleiden erhöht sich um den Faktor 2,8.

Beck J, Garcia R, Heiss G, Vokonovas P S, Offenbacher S. Periodontal disease and cardiovaskular disease. *J Periodontol 1996;67,10 (Supplement):1123-1137.*

Es besteht eine direkte Korrelation zwischen koronarer Herzerkrankung und Attachmentverlust.

Arbes SJ Jr, Slade GD, Beck JD. Association between extent of periodontal attachment loss and self-reported history of heart attack: an analysis of NHANES III data. *J Dent Res 1999;78(12):1777-1782.*

Bone loss was associated with complex multiple coronary lesions, beyond systemic inflammation. These findings may bear important clinical implications for the prevention and treatment of coronary artery disease.

Romagna C, Dufour L, Troisgros O, Lorgis L, Richard C, Buffet P, Soulat G, Casillas JM, Rioufol G, Touzery C, Zeller M, Laurent Y, Cottin Y. Periodontal disease: a new factor associated with the presence of multiple complex coronary lesions. *J Clin Periodontol 2012;39:38-44.*

# Risikofaktor für kardiovaskuläre Erkrankungen

Conclusions: The results of this study indicate that recurrent ACS events are predicted by serum WBC counts, serum creatinine levels, and a diagnosis of periodontitis. Significantly higher counts of putative pathogens are found in subjects with ACS, but these counts do not predict future ACS events.

Renvert S., Ohlsson O, Pettersson T, Persson R. Periodontitis: A future risk of acute coronary syndrome? A follow-up study over 3 years. *J Periodontol 2010;81(7):992-1000.*

Conclusion: These findings indicate that periodontal disease may be an important factor in determining recurrent cardiovascular events in MI patients and not merely a marker for the effects of cigarette smoking.

Dorn JM, Genco RJ, Grossi SG, Falkner KL, Hovey KM, Iacoviello L, Trevisan M. Periodontal disease and recurrent cardiovascular events in survivors of myocardial infarction (MI): The Western New York acute MI study. *J Periodontol 2010;81(4):502-511.*

# Risikofaktor für kardiovaskuläre Erkrankungen

Schwere und moderate Parodontitisformen können eine Rolle bei der Entstehung von Atheromen und koronaren Herzerkrankung spielen. Es besteht eine Korrelation zwischen Parodontitis und Verdickungen der Carotiswand (IMT ≥ 0,82 mm, auch bei jungen gesunden Patienten) neben Covariablen wie Alter, Diabetes, Cholesterin, Hochdruck, Rauchen usw.


Beck JD, Elter JR, Heiss G, Couper D, Mauriello SM, Offenbacher S. Relationship of periodontal disease to carotid artery intima-media wall thickness: the atherosclerosis risk in communities (ARIC) study. *Arterioscler Thromb Vasc Biol 2001;21(11):1816-1822*.

Beck JD, Offenbacher S, Williams R, Gibbs P, Garcia R. Periodontitis: a risk factor for coronary heart disease? *Ann Periodontol 1998;3(1):127-141.*

Mattila KJ, Valtonen VV, Nieminen M, Huttunen JK. Dental infection and the risk of new coronary events: prospective study of patients with documented coronary artery disease. *Clin Infect Dis 1995;20(3):588-92.*

Geismar K, Stoltze K, Sigurd B, Gyntelberg F, Holmstrup P. Periodontal disease and coronary heart disease. *J Periodontol 2006;77(9):1547-1554.*

Cairo F, Castellani S, Gori AM, Nieri M, Baldelli G, Abbate R, Pini-Prato GP. Severe periodontitis in young adults is associated with sub-clinical atherosclerosis. *J Clin Periodontol 2008;35:465-472.*

# Risikofaktor für kardiovaskuläre Erkrankungen

Aim: We investigated the association between angiographically verified coronary artery disease (CAD) and subgingival *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis, Tannerella forsythia and Treponema denticola*.

Conclusions: The presence of subgingival *A. actinomycetemcomitans* associates with an almost twofold risk of Stable CAD independently of alveolar bone loss.

Mäntylä P, Buhlin K, Paju S, Persson GR, Nieminen MS, Sinisalo J, Pussinen PJ. Subgingival Aggregatibacter actinomycetemcomitans associates with the risk of coronary artery disease. *J Clin Periodontol 2013;40:583-590.*

# Risikofaktor für kardiovaskuläre Erkrankungen

Parodontitis führt zu einer Zunahme systemischer Entzündung und vaskulären Störungen (C-reaktives Protein, Interleukin-6, D-Dimer and s-E-Selectin…). Durch parodontale Therapie kommt es nach kurzfristiger Verschlechterung zur Abnahme der Entzündung und zur Verbesserung von endothelialen Dysfunktionen.


Teeuw WJ, Slot DE, Susanto H, Gerdes VEA, Abbas F , D'Aiuto F , Kastelein JJP , Loos BG. Treatment of periodontitis improves the atherosclerotic profile: a systematic review and meta-analysis. *J Clin Periodontol 2014;41:70-79.*

D'Aiuto F, Parkar M, Tonetti MS. Acute effects of periodontal therapy on bio-markers of vascular health. *J Clin Periodontol 2007;34(2),124-129.*

Seinost G, Wimmer G, Skerget M, Thaller E, Brodmann M, Gasser R, Bratschko RO, Pilger E. Periodontal treatment improves endothelial dysfunction in patients with severe periodontitis. *Am Heart J 2005;149:1050-1054.*

Offenbacher S, Beck JD. A perspective on the potential cardioprotective benefits of periodontal therapie. *Am Heart J 2005;149:950-954.*

D'Aiuto F, Ready D, Tonetti MS. Periodontal disease and C-reactive protein-associated cardiovascular risk. *J Periodontal Res 2004;39:236-241.*

Slade GD, Gezzi EM,Heiss G, Beck JD, Riche E, Offenbacher S. Relationship between periodontal disease and C-reactive protein among adults in the atherosclerosis risk in communities study. *Arch Intern Med 2003;163:172-179.*


HDL levels or factors closely associated with HDL levels appear to modify the association between periodontal infection and certain parameters of subclinical atherosclerosis.


Ylöstalo P, Anttila S, Rajala U, Päivänsalo M, Keinänen-Kiukaanniemi S, Sakki T, Knuuttila M. Periodontal infection and subclinical atherosclerosis: the role of high-density lipoprotein as a modifying factor. *J Clin Periodontol 2010;37(7):617-624.*

# Risikofaktor für kardiovaskuläre Erkrankungen

Conclusions: It was concluded that: (i) there is consistent and strong epidemiologic evidence that periodontitis imparts increased risk for future cardiovascular disease; and (ii) while in vitro, animal and clinical studies do support the interaction and biological mechanism, intervention trials to date are not adequate to draw further conclusions. Well-designed intervention trials on the impact of periodontal treatment on prevention of atherosclerotic cardiovascular disease (ACVD) hard clinical outcomes are needed.

Tonetti MS, VanDyke TE and on behalf of working group 1 of the joint EFP/AAP workshop and. Periodontitis and atherosclerotic cardiovascular disease: consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. *J Clin Periodontol 40(suppl.14):S24-S29*.

# Risikofaktor für kardiovaskuläre Erkrankungen

Background: The aim of this investigation is to quantify periodontal pathogens (*Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Campylobacter rectus*, and *Tannerella forsythia*) in vascular, blood, and subgingival samples.

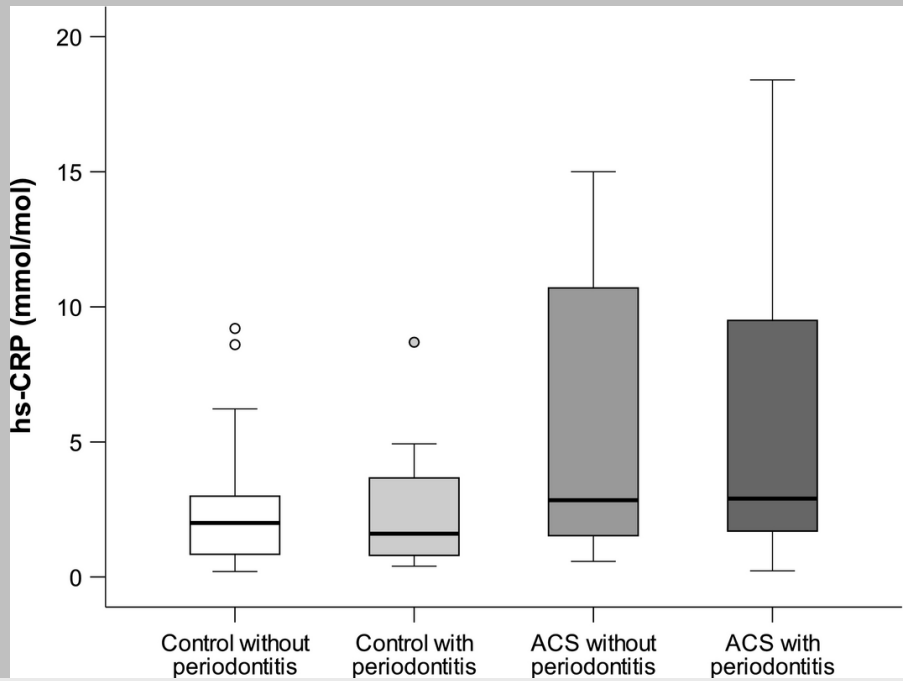
Conclusions: The presence of *A. actinomycetemcomitans* was demonstrated in vascular, blood, and subgingival samples in one of 36 patients. These results, although with a very low frequency, may support the hypothesis of a translocation of periodontal pathogens from subgingival microbiota to the bloodstream and then to atheromatous plaques in carotid or other peripheral arteries.

Figuero E, Lindahl C, Marín MJ, Renvert S, Herrera D, Ohlsson O, Wetterling T, Sanz M. Quantification of periodontal pathogens in vascular, blood, and subgingival samples from patients with peripheral arterial disease or abdominal aortic aneurysms. *J Periodontol 2014;85(9):1182-93.*

# Risikofaktor - Akutes Koronarsyndrom

Aim: A causative relationship between acute coronary syndrome (ACS) and periodontitis has yet to be defined. The aim of this study was to assess differences in levels of serum cytokines between individuals with or without ACS or periodontal comorbidity.

Results: … Independent of periodontal conditions, individuals with ACS had significantly higher serum levels of IL8 (mean: 44.3 and 40.0 pg/ml) and vascular endothelial growth factor (VEGF) than control individuals.




Conclusions: Elevated serum levels of VEGF were associated with ACS. Serum cytokine expression in individuals with ACS is unrelated to periodontal conditions.

Widén C, Holmer H, Coleman M, Tudor M, Ohlsson O, Sättlin S, Renvert S, Persson GR. Systemic inflammatory impact of periodontitis on acute coronary syndrome. *J Clin Periodontol 2016;43:713–719.*

# Risikofaktor: Anzahl der Zähne - Arteriosklerose

Background: Periodontal disease has been associated with cardiovascular disorders with an atherosclerotic background, and number of teeth (NT) has been suggested as a possible risk indicator for cardiovascular disease. The objective of this study is to investigate whether NT was related to the intima-media thickness (IMT) and to atherosclerotic plaque in carotid arteries in an elderly population.

Results: A significant inverse relationship was found between the NT and the number of carotid arteries with plaque after adjustment for age, sex, smoking, body mass index, waist/hip ratio, blood glucose, triglycerides, cholesterol, C-reactive protein, leukocyte count, blood pressure, and Framingham risk score…

However, no relationship to IMT was seen.

Conclusion: The present study further emphasizes that tooth loss could be an easily obtained risk indicator for atherosclerosis.

Holmlund A, Lind L. Number of teeth Is related to atherosclerotic plaque in the carotid arteries in an elderly population *J Periodontol 2012;83:287-291.*

# Risikofaktor - Arteriosklerose

Abstract: …The 2 disorders (Periodontal Disease and AtheroSclerotic Vascular Disease) share several common risk factors, including cigarette smoking, age, and diabetes mellitus. Patients and providers are increasingly presented with claims that PD treatment strategies offer ASVD protection; these claims are often endorsed by professional and industrial stakeholders…

Conclusions: Observational studies to date support an association between PD and ASVD independent of known confounders. They do not, however, support a causative relationship. Although periodontal interventions result in a reduction in systemic inflammation and endothelial dysfunction in short-term studies, there is no evidence that they prevent ASVD or modify its outcomes.

Lockhart PB, Bolger AF, Papapanou PN, Osinbowale O, Trevisan M, Levison ME, Taubert KA, Newburger JW, Gornik HL, Gewitz MH, Wilson WR, Smith SC, Baddour LM. Periodontal disease and atherosclerotic vascular disease: does the evidence support an Independent association? A scientific statement from the American Heart Association. Circulation. 2012;125:published online.

# Risikofaktor für kardiovaskuläre Erkrankungen

Aim: We wanted to investigate whether periodontal conditions and/or oral care habits are associated with new cardiovascular events among patients with coronary vascular disease (CVD).

Material and Methods: In this longitudinal cohort study, 1002 inpatients with CVD were included. They were examined regarding prevalence of severe periodontitis, bleeding upon probing (BOP), number of missing teeth and oral care habits. The combined endpoint was defined as myocardial infarction, stroke/transient ischaemic attack, cardiovascular death and death caused by stroke. Survival analyses were carried out after a 3-year follow-up period. Hazard ratios (HRs) were adjusted for known cardiac risk factors using Cox regression.

Conclusions: Periodontal conditions and oral care habits are not independent indicators for further adverse events in patients with CVD.

Reichert S, Schulz S, Benten A-C, Lutze A, Seifert T, Schlitt M, Werdan K, Hofmann B, Wienke A,Schaller H-G, Schlitt A. Periodontal conditions and incidence of new cardiovascular events among patients with coronary vascular disease. *J Clin Periodontol 2016;43:918-925.*

# Risikofaktor - Pneumonie

Mundhygiene und Parodontitis zeigen eine Korrelation zu infektiösen und obstruktiven Lungenerkrankungen. Parodontopathogene Keime besiedeln die Lunge – respiratorische Keime werden in dentaler Plaque gefunden. Neben Aspiration wird die Wirkung von parodontal-assoziierten Enzymen und Zytokinen als Erklärung angenommen.

Liu Z, Zhang W, Zhang J, Zhou X, Zhang L, Song Y, Wang Z. Oral hygiene, periodontal health and chronic obstructive pulmonary disease exacerbations. *J Clin Periodontol 2012;39:45-52.*
Scannapieco FA, Wang B, Shiau HJ. Oral bacteria and respiratory infection: effects on respiratory pathogen adhesion and epithelial cell proinflammatory cytokine production. *Ann Periodontol 2001 Dec;6(1):78-86.*
Scannapieco FA, Genco RJ. Association of periodontal infections with atherosclerotic and pulmonary diseases. *J Periodontal Res 1999;34:340-345.*
Scannapieco FA. Role of oral bacteria in respiratory infection. *J Periodontol 1999;70:793-802.*

Spülung mit 0,12%-CHX-Lösung reduzierte nach Bypass-Operationen die postoperative respiratorische Infektion mit gram- Keimen um 59%-67%. Die Mortalitätsrate betrug in der CHX-Gruppe 1,16% gegenüber der Kontrollgruppe von 5,65%.

DeRiso AJ 2nd, Ladowski JS, Dillon TA, Justice JW, Peterson AC. Chlorhexidine gluconate 0.12% oral rinse reduces the incidence of total nosocomial respiratory infection and nonprophylactic systemic antibiotic use in patients undergoing heart surgery. *Chest 1996;109(6):1556-1561.*

# Risiko - Chron. Obstruktive Lungenerkrankung (COPD)

Aim: To evaluate the associations of serum 25-Hydroxyvitamin D [25(OH)D] levels with periodontal health and chronic obstructive pulmonary disease (COPD).

Results: Mean serum 25(OH)D concentrations were significantly lower in the COPD group than in the controls (32.1 *versus* 35.8 nmol/l; $p = 0.002$). Serum 25(OH)D concentrations were positively correlated with lung function among non-smokers and negatively correlated with plaque index (PLI) among former smokers.

Lower serum 25(OH)D concentrations were significantly associated with an increased risk of COPD among former smokers (Odd ratio 4.11; 95% confidence interval 1.47–11.5; $p = 0.007$) after adjustment for periodontal indexes and other variables.

Conclusions: Lower serum 25(OH)D concentrations were significantly associated with poor periodontal health and an increased risk of COPD.

Zhou X, Han J, Song Y, Zhang J, Wang Z. Serum levels of 25-hydroxyvitamin D, oral health, and chronic obstructive pulmonary disease. *J Clin Periodontol 2012;39:350-356.*

# Risikofaktor - Lungenkarzinom

Methods: PubMed, Scopus, and ScienceDirect were searched up to June 10, 2015. Cohort and nested case-control studies investigating risk of lung cancer in patients with periodontal disease were included. Hazard ratios (HRs) were calculated, as were their 95% confidence intervals (CIs) using a fixed-effect inverse-variance model. Statistical heterogeneity was explored using the Q test as well as the I(2) statistic. Publication bias was assessed by visual inspection of funnel plots symmetry and Egger's test.

Results: Five cohort studies were included, involving 321,420 participants in this meta-analysis. Summary estimates based on adjusted data showed that periodontal disease was associated with a significant risk of lung cancer (HR = 1.24, 95% CI = 1.13 to 1.36; I(2) = 30%). Subgroup analysis indicated that the association of periodontal disease and lung cancer remained significant in the female population.

Conclusions: Evidence from cohort studies suggests that patients with periodontal disease are at increased risk of developing lung cancer.

Zeng XT, Xia LY, Zhang YG, Li S, Leng WD, Kwong JS. Periodontal disease and incident lung cancer risk: A meta-analysis of cohort studies. *J Periodontol 2016;87(10):1158-1164*.

# Risikofaktor - Nierenerkrankungen

Aim: The aim of this systematic review (SR) was to evaluate the association between periodontitis and chronic kidney disease (CKD) and the effect of periodontal treatment (PT) on the estimated glomerular filtration rate (eGFR).

Results: Search strategy identified 2456 potentially eligible articles, of which four cross-sectional, one retrospective, and three interventional studies were included. Four S1, 80.0% reported some degree of association between periodontitis and CKD. Similarly, such an outcome was supported by pooled estimates (OR: 1.65, 95% Confidence Interval: 1.35, 2.01, $p < 0.00001$, $\chi^2 = 1.70$, $I^2 = 0\%$). All interventional studies found positive outcomes related to treatment.

Conclusion: There is quite consistent evidence to support the positive association between periodontitis and CKD, as well as the positive effect of PT on eGFR.

Chambrone L, Foz AM, Guglielmetti MR, Pannuti CM, Artese HPC, Feres M, Romito GA. Periodontitis and chronic kidney disease: a systematic review of the association of diseases and the effect of periodontal treatment on estimated glomerular filtration rate. *J Clin Periodontol 2013;40:443-456.*

# Risikofaktor - Nierenerkrankungen

Background: The aim of the present study is to compare periodontal inflammatory burden related to the salivary matrix metalloproteinase (MMP)-8 concentration among patients with chronic kidney disease (CKD) at the predialysis stage.

Conclusions: Elevated salivary MMP-8 associated significantly with more severe oral/periodontal inflammatory burden among patients with CKD at the predialysis stage. Thus, salivary MMP-8 analysis could give adjunctive information regarding oral health.

Nylund KM, Meurman JH, Heikkinen AM, Honkanen E, Vesterinen M, Furuholm JO, Tervahartiala T, Sorsa T, Ruokonen HM. Periodontal Inflammatory burden and salivary matrix metalloproteinase-8 concentration among patients with chronic kidney disease at the predialysis stage.
*J Periodontol. 2015;86(11):1212-1220.*

# Risikofaktor - Prostataerkrankungen

Background: Chronic prostatitis (CPr) and benign prostatic hyperplasia (BPH) are complex inflammatory conditions for which etiologic determinants are still poorly defined. The purpose of this study is to isolate oral pathogens from expressed prostatic secretions of patients with periodontal disease and CPr or BPH.

| Urology diagnosis | n |
|---|---|
| BPH | 10 |
| Prostatitis | 14 |
| Periodontal diagnosis | |
| Mild | 4 |
| Moderate | 7 |
| Severe | 6 |
| Periodontal measures | |
| Clinical AL (mm) | 17 |
| Plaque score | 17 |
| Gingival score | 17 |

Conclusions: An association between chronic inflammatory prostate and periodontal diseases has been demonstrated by the presence of similar bacterial DNA in both prostatic secretion and subgingival dental plaque from the same individual.

Estemalik J, Demko C, Bissada NF, Joshi N, Bodner D, Shankar E, Gupta S, Simultaneous detection of oral pathogens in subgingival plaque and Prostatic fluid of men with periodontal and prostatic diseases. *J Periodontol 2017;88(9):823-829.*

# Risikofaktor - Erektile Dysfunktion

Methods: A total of 70 patients (mean age: 35.3 – 3.64 years) clinically diagnosed with ED were included in the study. They were given the Sexual Health Inventory for Men Questionnaire and subjected to colored penile Doppler ultrasound. Periodontal parameters of probing depth and periodontal attachment level were recorded.

Results: Association of CP and vasculogenic ED was found to be correlated positively, but it showed no statistical significance.

Conclusions: It can be hypothesized that an association exists between vasculogenic ED and CP in young males. However, a large-scale study with confounder analysis and a longitudinal follow-up is warranted.

Eltas A, Oguz F, Uslu OM, Akdemir E. The effect of periodontal treatment in improving erectile dysfunction: a randomized controlled trial. *J Clin Periodontol 2013;40:148–154.*

Keller JJ, Chung S-D, Lin H-C. A nationwide population-based study on the association between chronic periodontitis and erectile dysfunction. *J Clin Periodontol 2012;39:507-512.*

Sharma A, Pradeep AR, Raju P A. Association between chronic periodontitis and vasculogenic erectile dysfunction. *J Periodontol 2011;82:1665-1669.*

# Risikofaktor - Arthritis

Objectives: As periodontal bacteria might be involved in the aetiology of rheumatic diseases, we analysed synovial fluid obtained from patients with rheumatoid arthritis (RA) and controls for the presence of DNA of *Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Prevotella intermedia, Tannerella forsythia, and Treponema denticola*.

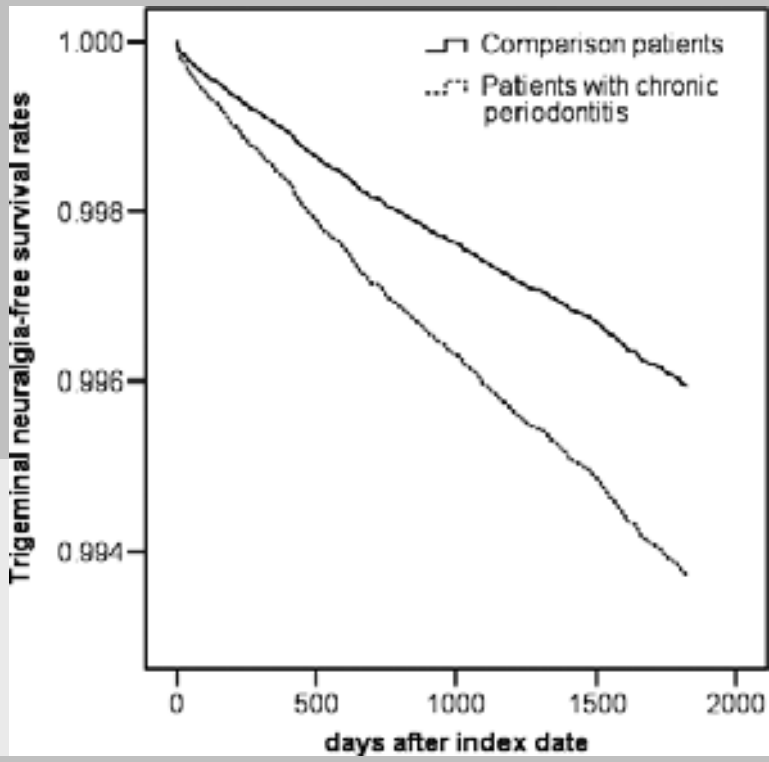
Conclusions: DNA of periodontopathogens can be found in synovial fluid and oral bacteria may play a role in the pathogenesis of arthritis.

Reichert S, Haffner M, Keyßer G, Schäfer C, Stein JM, Schaller H-G, Wienke A, Strauss H,Heide S, Schulz S.Detection of oral bacterial DNA in synovial fluid. *J Clin Periodontol 2013;40:59-598.*

# Risikofaktor - Trigeminusneuralgie

Aim: This study set out to explore the possibility that chronic periodontitis (CP) may also be a condition that could potentially result in secondary or symptomatic trigeminal neuralgia (TN) by utilizing a population-based dataset and cohort study design in Taiwan.

Materials and Methods: We included 110,104 subjects with CP in our study cohort, and randomly selected 110,104 subjects without a history of CP as a comparison cohort. We individually tracked each patient in this study for a 5-year period to identify those who received a subsequent diagnosis of TN.

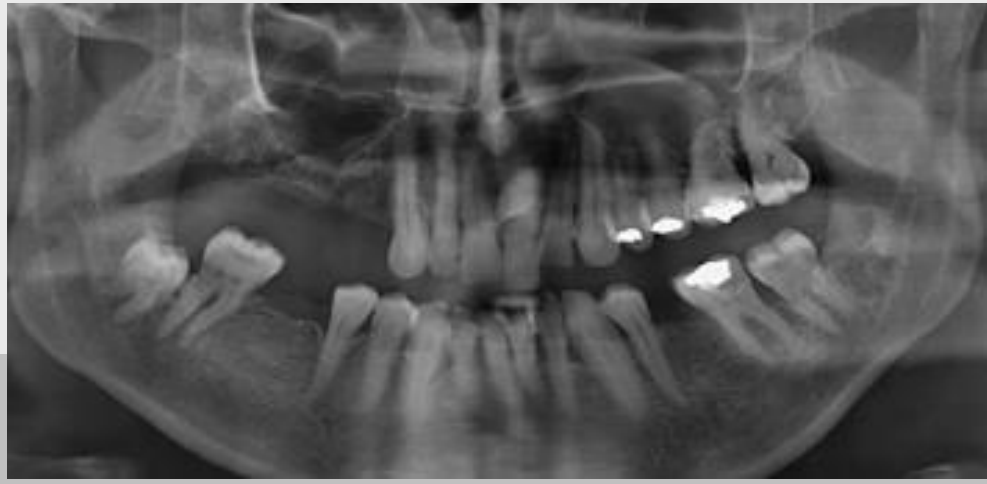



Conclusion: Our study detected a greater risk For TN among patients with CP than matched comparison subjects.

Keller JJ, Sheu J-J, Lin H-C. Chronic periodontitis and the subsequent risk of trigeminal neuralgia: a 5-year follow-up study. *J Clin Periodontol 2012; 39:1017-1023.*

# Risikofaktor - Hirnabszess

Case report: A 42-year-old patient with no underlying medical conditions presented with multiple brain lesions initially thought to be metastatic lesions of a tumour of unknown origin. Findings during drainage and subsequent histopathological conclusions made infection more likely. Culture of drained material remained negative; however, 16S rDNA polymerase chain reaction and sequence analysis on direct material revealed *A. actinomycetemcomitans* as the causative agent of the infection. The most likely source of infection was the poor dentition of the patient.



Rahamat-Langendoen JC, van Vonderen MGA, Engström LJ, Manson WL, van Winkelhoff AJ, Mooi-Kokenberg EANM. Brain abscess associated with *Aggregatibacter actinomycetemcomitans*: case report and review of literature. *J Clin Periodontol 2011;38:702-706.*

# Parodontitis - Mortalität

Objective: To investigate the association between periodontitis and mortality from all causes in a prospective study in a homogenous group of 60- to 70-year old West European men.

Results: In total, 152 (10.9%) of the men died during a mean follow-up of 8.9 (SD 0.7) years; 37 (7.9%) men in the third with the lowest PAL (<1.8 mm) died compared with 73 (15.7%) in the third with the highest PAL (>2.6 mm). The unadjusted hazard ratio (HR) for death in the men with the highest level of PAL compared with those with the lowest PAL was 2.11 (95% CI 1.42–3.14), $p < 0.0001$. After adjustment for confounding variables (age, smoking, hypertension, BMI, diabetes, cholesterol, education, marital status and previous history of a cardiovascular event) the HR was 1.57 (1.04–2.36), $p = 0.03$.

Conclusion: The European men in this prospective cohort study with the most severe loss of periodontal attachment were at an increased risk of death compared with those with the lowest loss of periodontal attachment.

Linden GJ, Linden K, Yarnell J, Evans A, Kee F, Patterson CC. All-cause mortality and periodontitis in 60–70-year-old men: a prospective cohort study. *J Clin Periodontol 2012;39:940-946.*

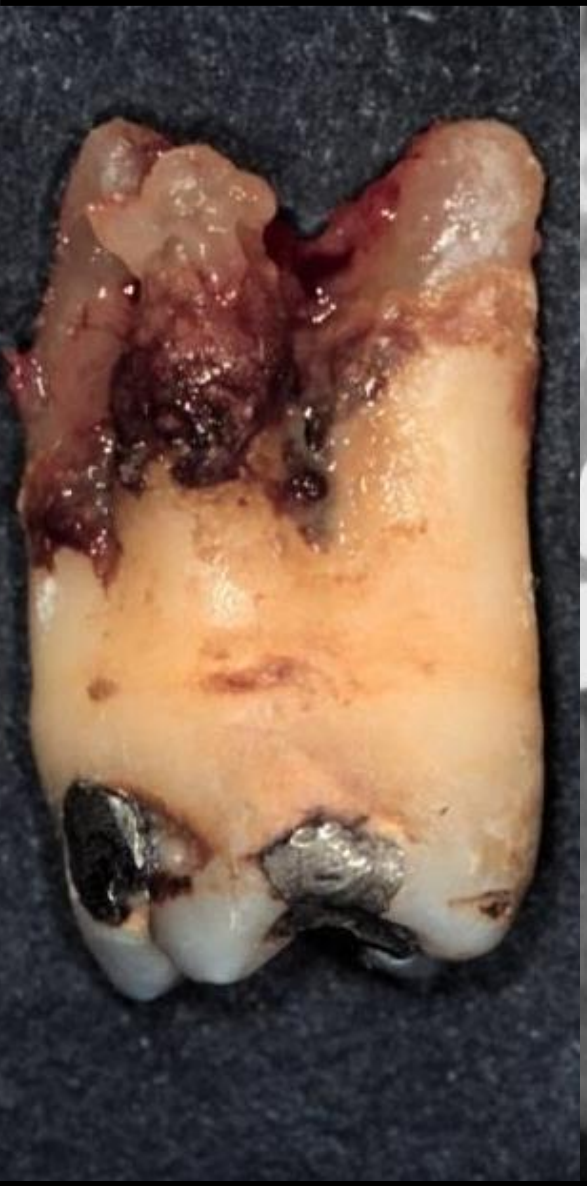
# Parodontitis - Komorbität

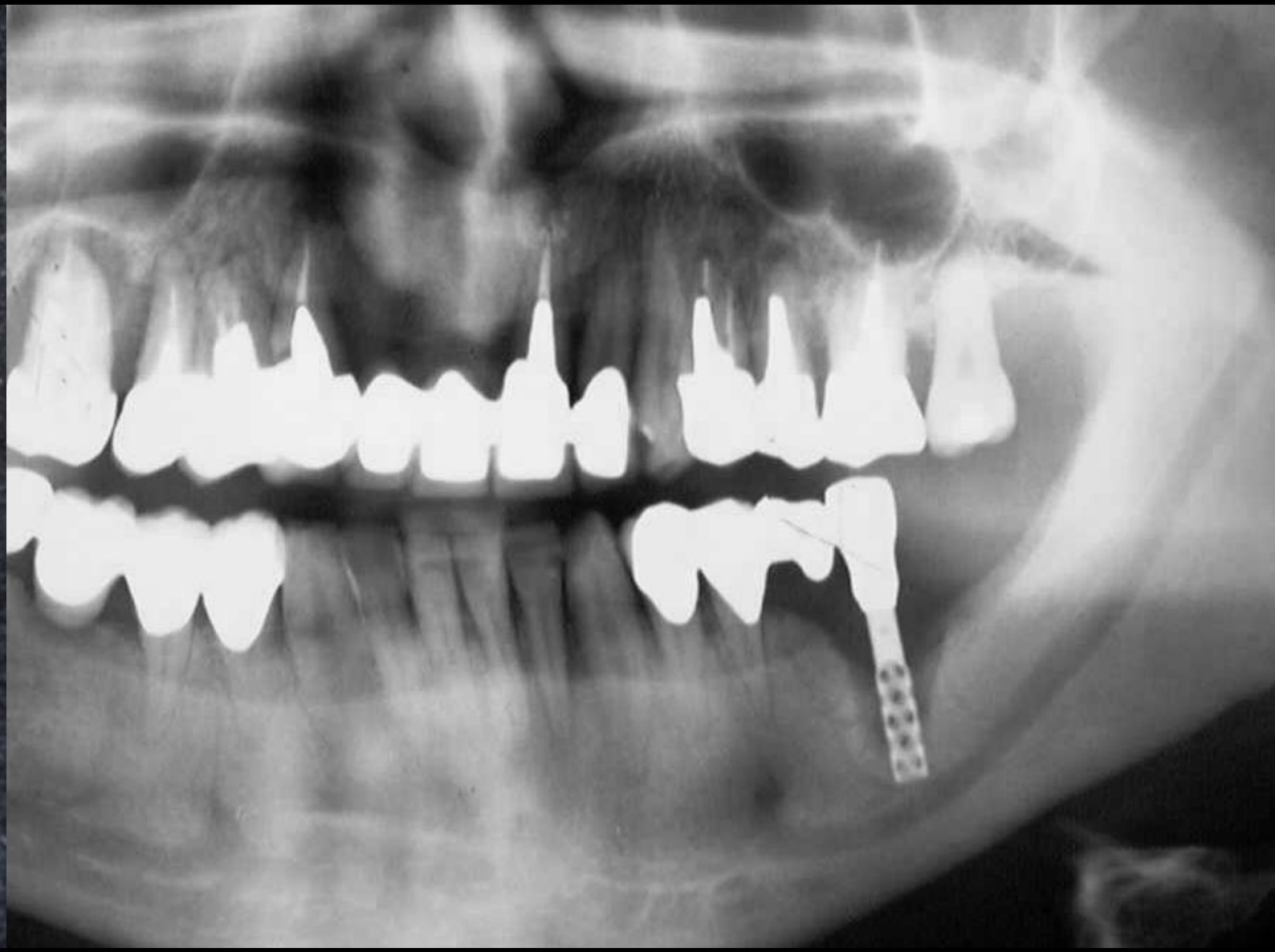
Results: Comorbidities were found in 821 of 1,199 (68.5%) patients. Allergies had the highest prevalence (29.2%), followed by hypertension (19.4%), musculoskeletal (11.2%), and endocrine disorders (9.7%). Chronic pulmonary disorders (no influenza/pneumonia) were associated with a higher approximal plaque index (72% versus 63%, $P = 0.02$). No association between characteristics of periodontitis and comorbidities was observed. Prevalence of allergies (29.2% versus 22.9%) and pulmonary disorders (8.5% versus 4.3%) was significantly higher in periodontitis patients compared with the Austrian population ($P < 0.001$), whereas asthma (1.5% versus 5.6%), cardiovascular disorders (1.8% versus 10.5%), depression (7.1% versus 10.4%), headache (1.3% versus 20%), hyperlipidemia (6.4% versus 14.8%), hypertension (14.2% versus 24.5%),

Conclusion: In Austria, the majority of patients with periodontitis present with comorbidities, and the adjusted prevalence differs significantly from the general population.

Sperr M, Kundi M, Tursic V, Bristela M, Moritz A, Andrukhov O, Rausch-Fan X, Sperr WR. Prevalence of comorbidities in periodontitis patients compared with the general Austrian population. *Journal of Periodontology 2018 89:1,19-27.*

# Parodontitis und Allgemeinerkrankungen

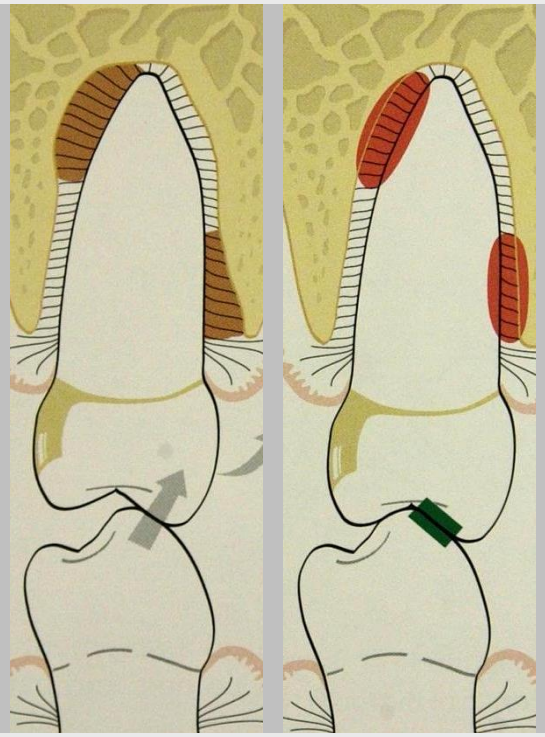




M. Haas Graz

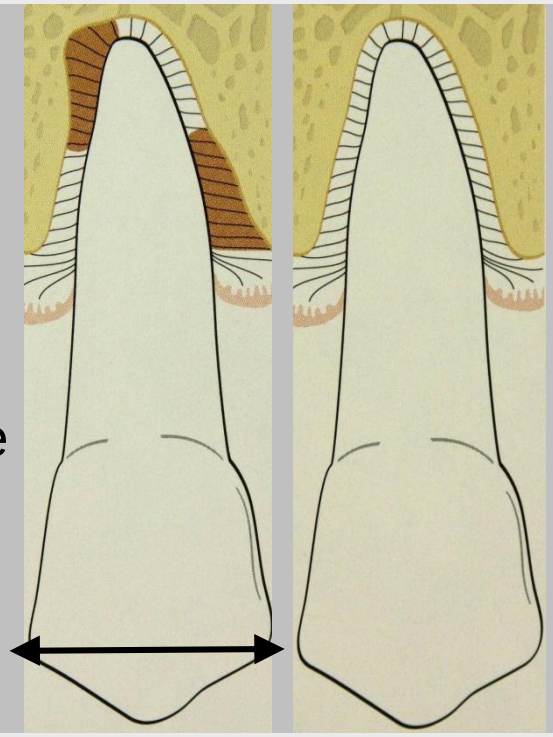
# Okklusion und Parodont

Horizontale okklusale Kräfte führen zu Knochenresorption, Verbreiterung des Parodontalspaltes und erhöhter Zahnbeweglichkeit.



Normale Knochenhöhe

Reduzierte Knochenhöhe

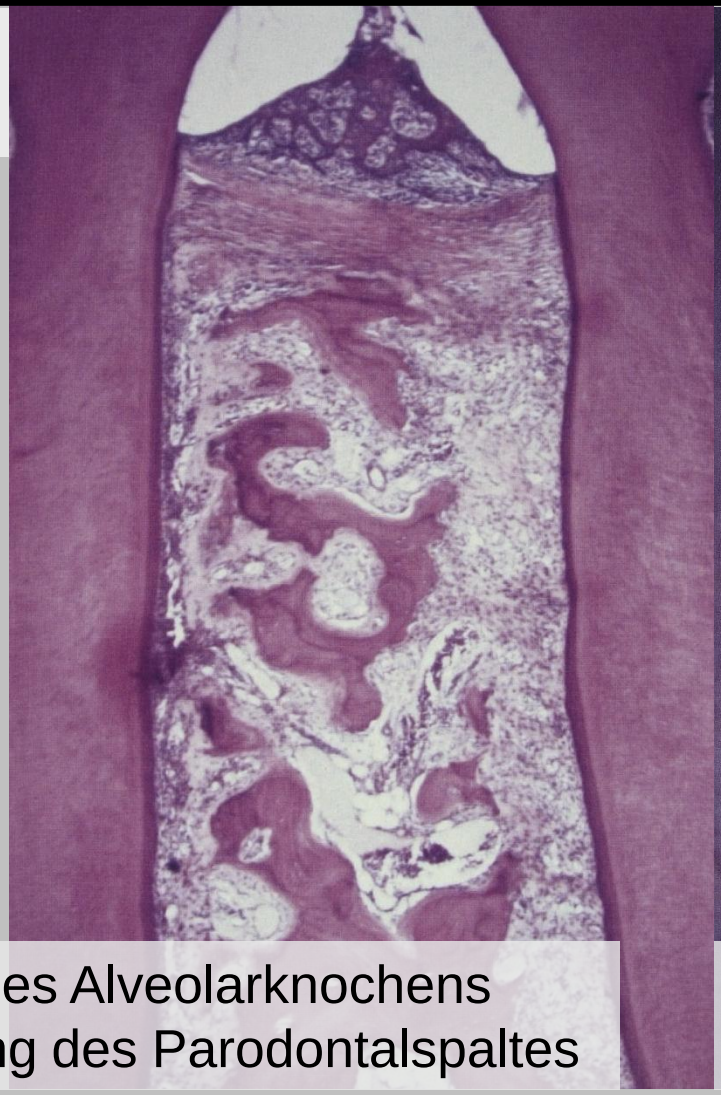


Nach Eliminierung der Störfaktoren kommt es bei Entzündungsfreiheit zu einer Knochenapposition und Normalisierung der Beweglichkeit.

Polson AM, Meitner SW, Zander HA. Trauma and progression of marginal periodontitis in squirrel monkeys. *J Periodont Res 1976 a,b;11:279-298.*

# Okklusion und Parodont

Jiggling-Kräfte an Prämolaren



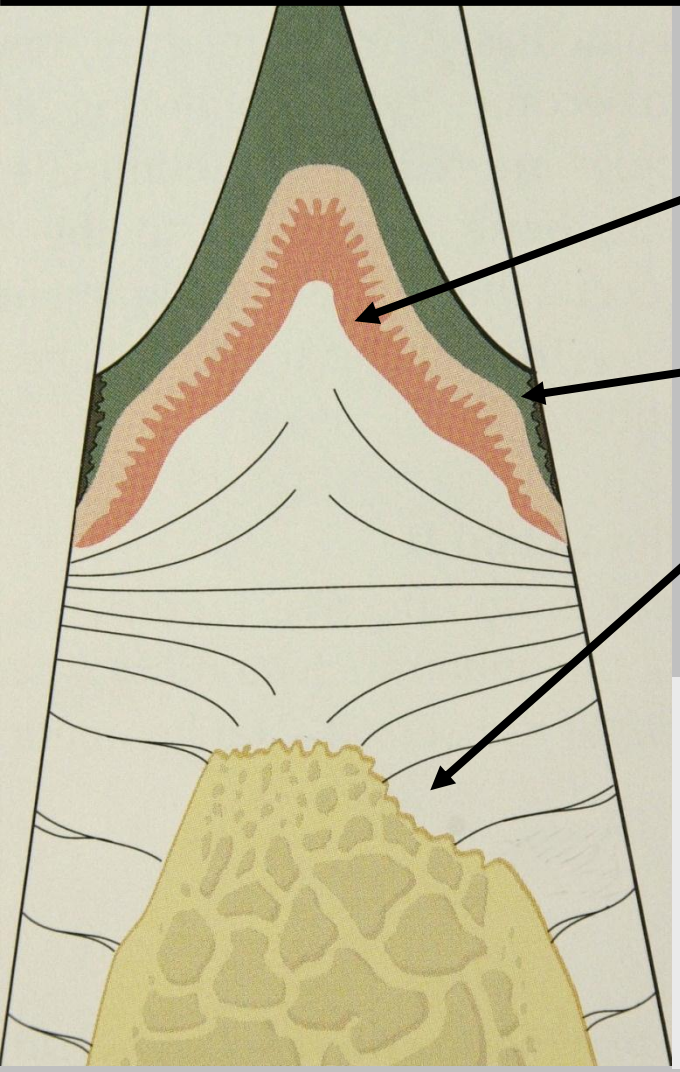
10 Monate nach Beendigung

- ⇨ Reduktion des Alveolarknochens
- ⇨ Verbreiterung des Parodontalspaltes

- ⇨ Knochenregeneration
- ⇨ Normalisierung des Parodontalspaltes

Polson AM, Meitner SW, Zander HA. Trauma and progression of marginal periodontitis in squirrel monkeys. *J Periodont Res 1976 a,b;11:279-298.*

# Okklusion und Parodont

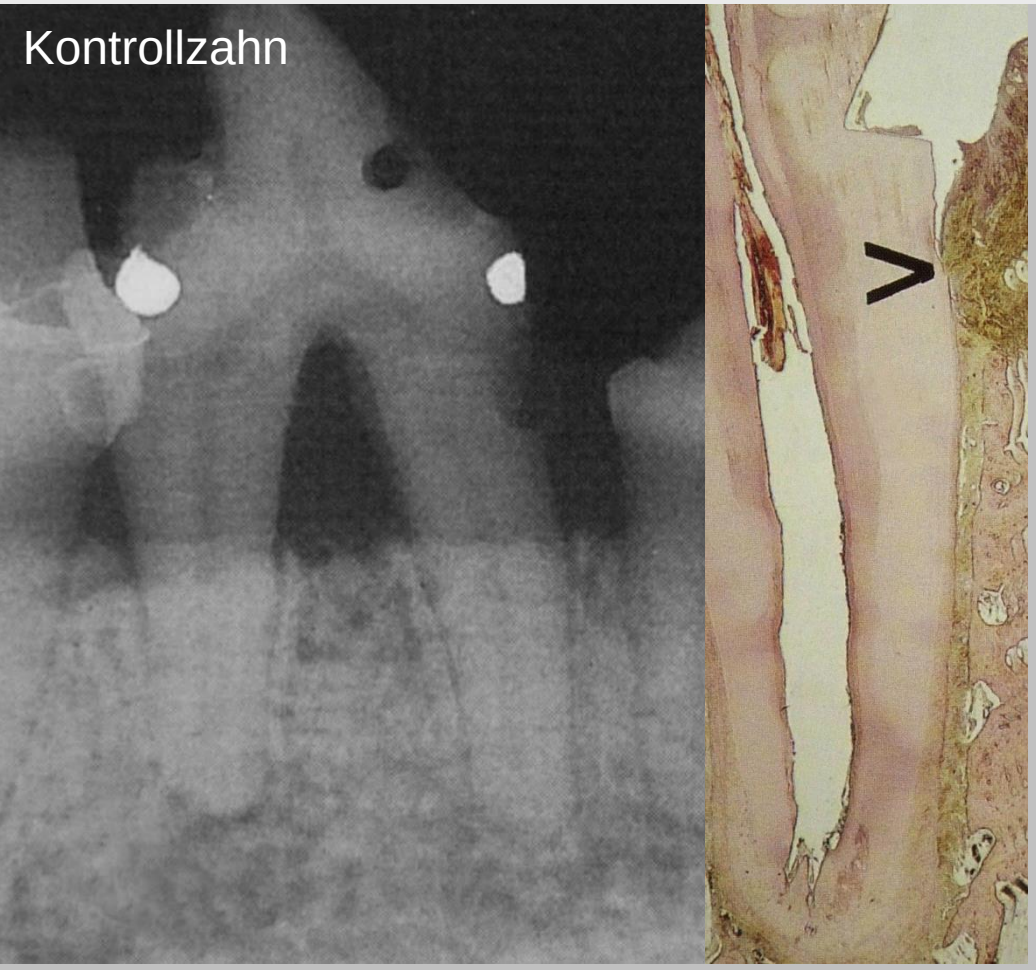



In Gegenwart einer marginalen Parodontitis regeneriert der durch Jiggling hervorgerufene Knochenverlust nach Eliminierung des Traumas nicht immer.

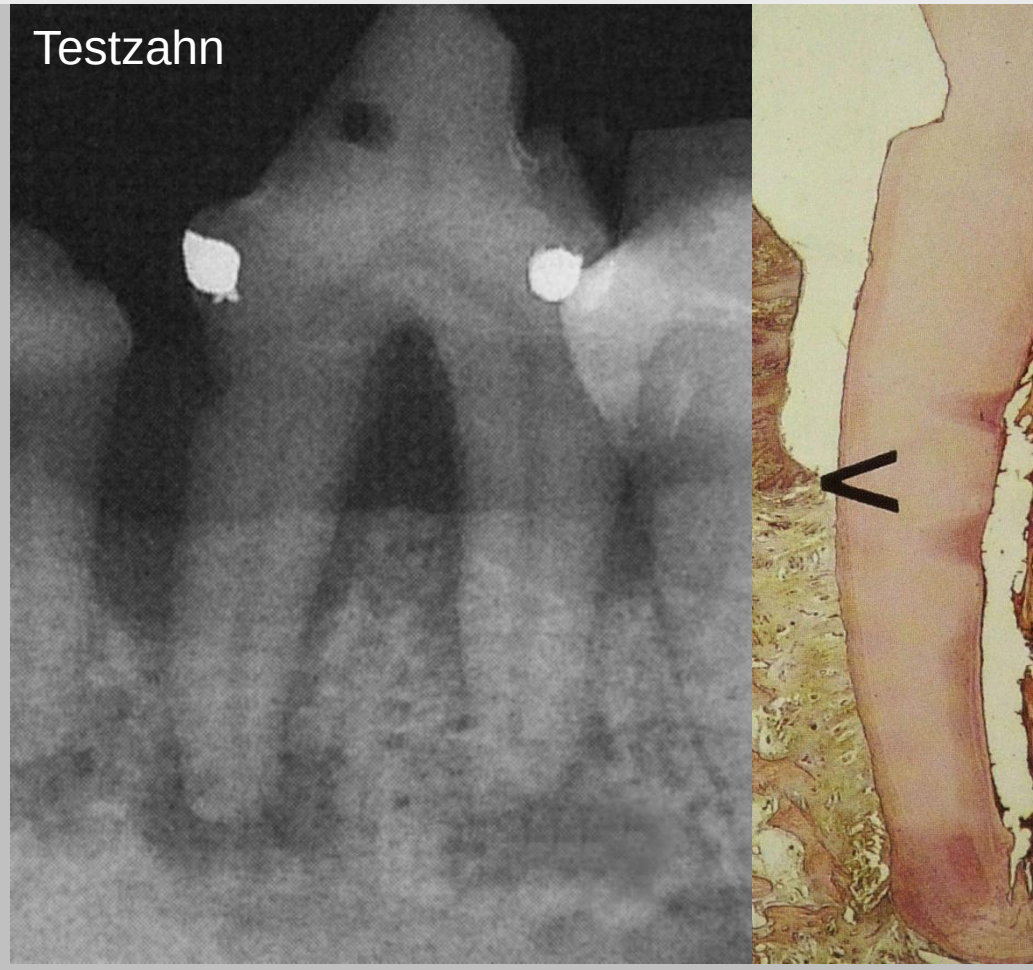
Polson AM, Meitner SW, Zander HA: Trauma and progression of marginal periodontitis in squirrel monkeys. *J Periodont Res 1976 a,b;11:279-298.*

# Experimentelle Parodontitis (240 Tage)

## Ohne okklusales Trauma




## Jiggling (180 Tage)




Lindhe J, Svanberg G: Influences of trauma from occlusion on progression of experimental periodontitis in the Beagle dog.
*J Clin Periodontol 1974;1:3-14.*

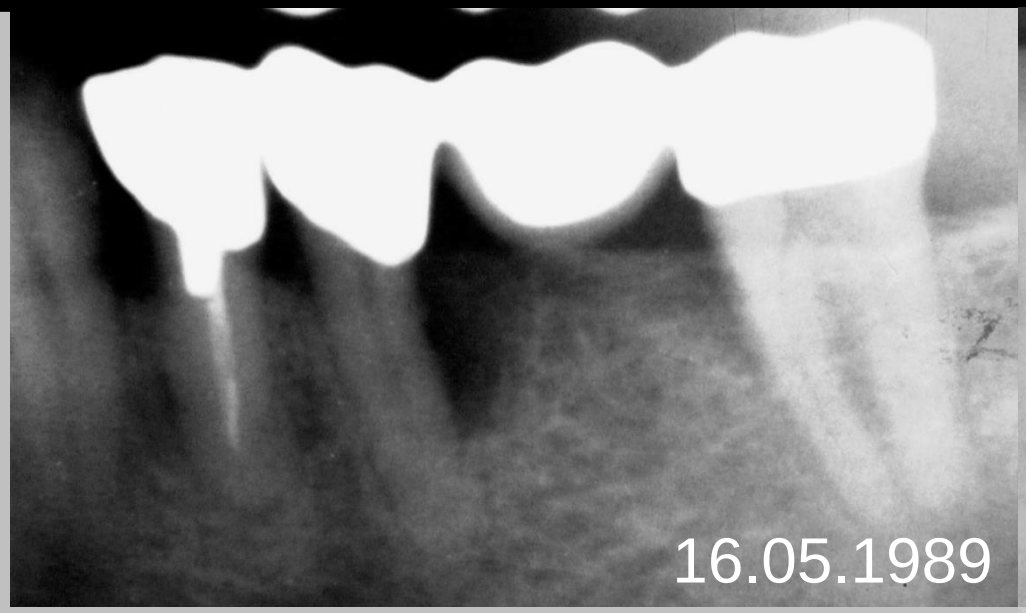
# Okklusion und Parodont

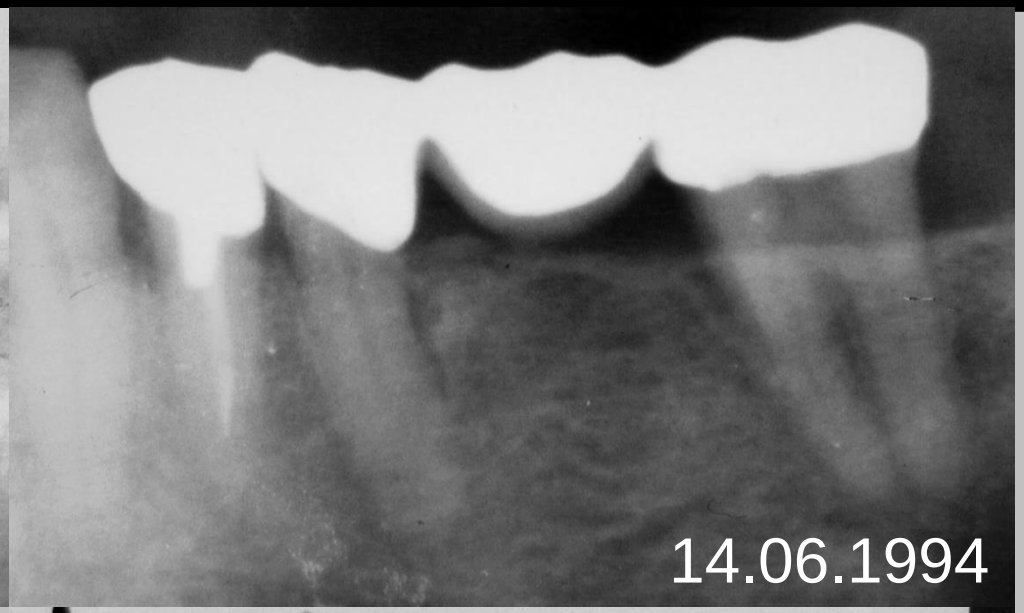
- Okklusales Trauma verursacht keine parodontale Gewebezerstörung.
- Weder einseitige noch Jiggling-Kräfte können bei einem gesunden Zahn Gingivitis, Taschenbildung oder Attachmentverlust auslösen.
- Okklusales Trauma kann Knochenresorption verursachen, die eine erhöhte Zahnlockerung (vorübergehend oder permanent) ergibt. Dies kann als physiologische Anpassung des Desmodonts an das Trauma (funktionell veränderte Anforderungen) aufgefasst werden.
- An Zähnen mit progressiver Parodontitis kann okklusales Trauma als Kofaktor für das Fortschreiten des destruktiven Prozesses fungieren.

Glickman I 1965, Svanberg G 1973, Svanberg 1974, Lindhe J 1974, Meitner S 1975, Waerhaug J 1979, Lindhe J 1982, Ericsson I 1982, Polson A 1983, Hakkarainen K 1986, Wennström J 1987, Ericsson I 1993, Giargia M 1994, Svanberg G 1995.

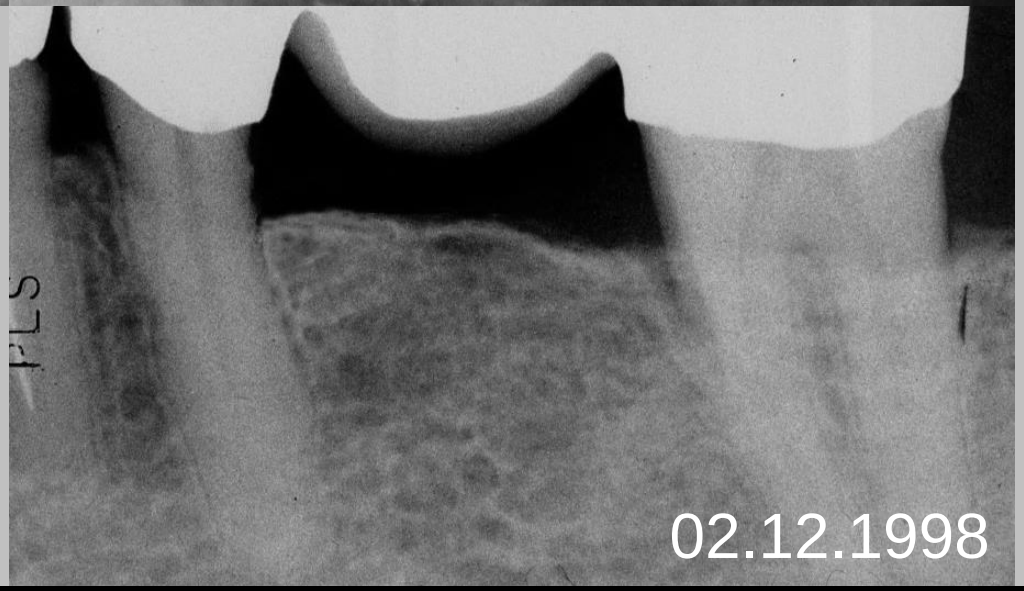
Rand. cont. trials: Burgett FG 1992, Wang HL 1995, Grant DA 1995. Cohort or longutudinal studies: Ismail AI 1990, Jin LJ 1992, McGuire MK 1996.

# F. A.

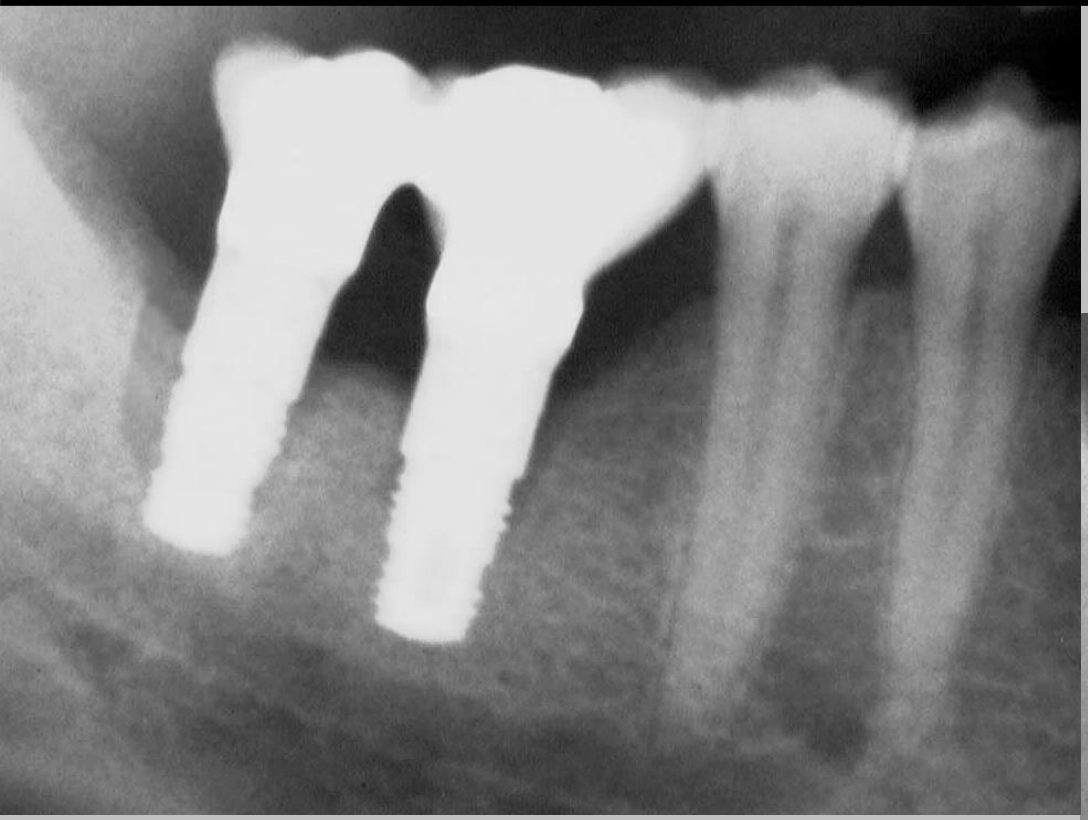


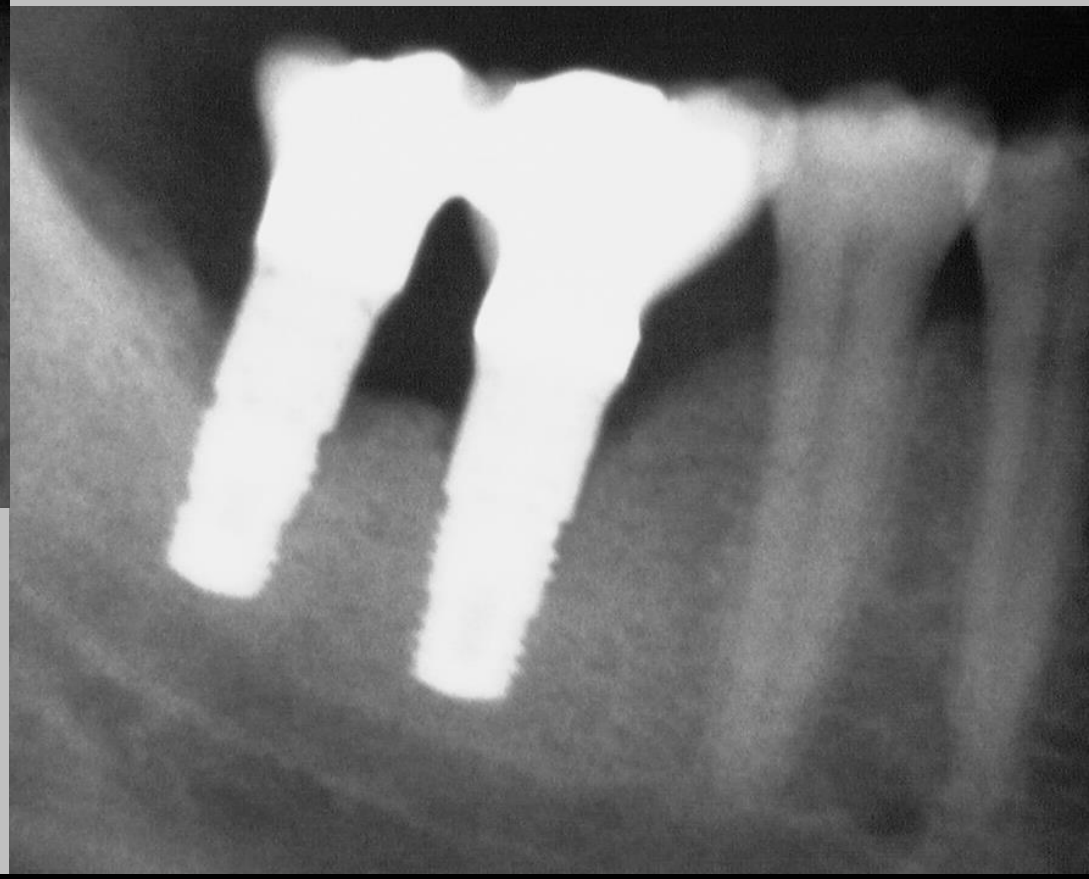

- ⇨ Initiale Parotherapie
- ⇨ Lappenoperation III, IV
- ⇨ Brücke 12 - 26
- ⇨ Okklusion
- ⇨ Recall



# S. A. - 34,2 J - w



- ⇨ Konservative Therapie
- ⇨ Okklusion
- ⇨ Stress ?



| | | |
|---|---|---|
| Periotest | 12.03.1993: | -5 |
| | 19.12.1994: | +8 |
| | 08.02.1999: | -4 |

# Bruxismus

Background: This paper systematically reviews the MEDLINE and SCOPUS literature to answer the following question: Is there any evidence that bruxism may cause periodontal damage per se?

Conclusions: Despite the scarce quantity and quality of the literature that prevents sound conclusions on the causal link between bruxism and the periodontal problems assessed in this review, it seems reasonable to suggest that bruxism cannot cause periodontal damage per se. It is also important to emphasize, however, that because of methodologic problems, particularly regarding sleep bruxism assessment, more high-quality studies (e.g., randomized controlled trials) are needed to further clarify this issue.

Manfredini D, Ahlberg J, Mura R, Lobbezoo F. Bruxism is unlikely to cause damage to the periodontium: findings from a systematic literature assessment. *J Periodontol. 2015 ;86(4):546-555.*

# Okklusion und Kiefergelenkserkrankungen

In einer kontrollierten klinischen Studie (randomisiert, doppelblind) wurde der Einfluss okklusaler Störungen auf Erkrankungen des Kiefergelenks (Temperomandibular Disorders - TMD) untersucht:

- Probanden ohne TMD zeigte eine sehr gute Adaptation auf artifizielle okklusale Interferenzen.
- Die Gruppe mit Vorerkrankung (TMD) zeigte im Gruppenvergleich eine signifikante Verschlechterung der klinischen Parameter.

„*We suggest that the etiological role of occlusal interferences in TMD may not have been correctly addressed in previous studies with artificial interferences and allow no conclusions as regards TMD etiology.*“

Le Bell Y, Jamsa T, Korri S, Niemi PM, Alanen P: Effect of artificial occlusal interferences depends on previous experience of temporomandibular disorders. *Acta Odontol Scand 2002;60(4):219-222.*

M. Haas



PARODONTOLOGIE UND PROPHYLAXE GRAZ

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