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A DISCUSSION ON TYPES, CAUSES, PATHOGENESIS & PREVENTION OF PERIODONTITIS

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Periodontium,
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ABSTRACT

Periodontal diseases are one of the common microbial infections in the adults. They are of different types. Periodontitis is an inflammatory disease of supporting tissue of the teeth. Aggressive form of periodontitis can be localized and are associated with micro organisms therefore treatment by local antimicrobial agents are most appropriate¹. The main aim of antibiotic therapy is to establish a concentration of drug that inhibits the pathogenic bacteria. There are various reasons for the development of this disease. Many of the aerobics and anaerobic bacteria are the main cause of this disease. Ineffective oral hygiene, tobacco use, disease affecting immune system etc are also a supporting reason of periodontitis. Daily oral hygiene measures should be taken to prevent this type of disease⁴.

INTRODUCTION

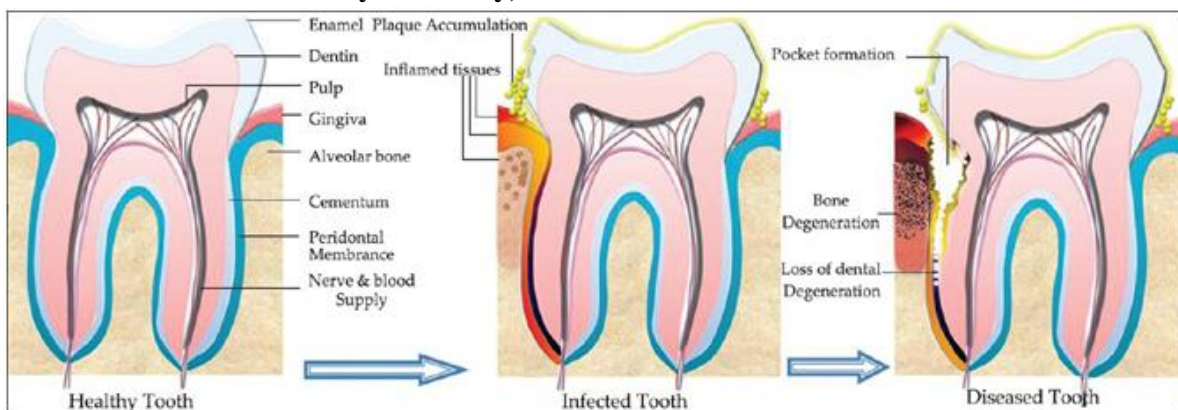
Periodontal diseases are infections affecting a significant proportion of people in all populations. The "periodontal diseases" is a general term of various inflammatory diseases of parodontium. It includes a number of pathological conditions described by inflammation and degeneration of the gums (gingival) and the supporting structures of the teeth³. The diseases include a series of diseases exhibiting various syndromes which vary from each other according to the stage or situation of the diseases or the age of the patient. The term "periodontal diseases" is given to any inflammatory disease which initially occurs at marginal gingival area and finally reaches the alveolar bone.

The major periodontal diseases are

- Mucositis,
- Gingivitis(inflammation of the gingival)
- Periodontitis(inflammation of the periodontal ligament) &
- Dental caries.

Periodontitis or pyorrhea is a set of inflammatory diseases affecting the periodontium, i.e., the tissues that surround and support the teeth. The word "periodontitis" comes from the Greek word peri, means "around" and odous (genitive odontos) means "tooth", and the suffix -itis, in medical terminology "inflammation". Periodontitis involves progressive loss of the alveolar bone around the teeth, and if left untreated, can lead to the loosening and subsequent loss of teeth. It is caused by microorganisms that adhere to and grow on the tooth's surfaces, along with an overly aggressive immune response against these microorganisms. Periodontal disease includes conditions such as chronic periodontitis, aggressive periodontitis, systemic disease associated periodontitis, and necrotizing periodontitis¹. These conditions are characterized by destruction of the periodontal ligament, resorption of the alveolar bone, and the migration of the junctional epithelium along with the tooth surface. The clinical signs of periodontitis are changes in the morphology of gingival tissues, bleeding as well as periodontal pocket formation. This pocket provides an ideal environment for the growth and proliferation of anaerobic pathogenic bacteria.

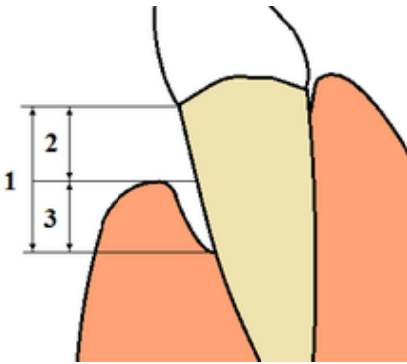
Anatomy of healthy, infected and diseased tooth



It is a localized inflammatory response caused by bacterial infection of a periodontal pocket associated with subgingival plaque. This periodontal pocket provides ideal conditions for the proliferation of microorganisms. The disease may then require extensive treatment, failing which the teeth may be lost. The therapeutic goal can be achieved by removing bacteria, by mechanical

cleaning of plaque and topical application of antimicrobial agents. In periodontal diseases the supporting structures become infected and as a result lose the strength to hold the teeth in the cavity. The periodontal diseases are generally degenerative or neoplastic in nature. Initially the disease is localized to the marginal gingiva but later progresses to the marginal periodontitis⁴. Oral bleeding results in bacterial infection (bacteremia) which leads to serious fetal health problem known as infective endocarditis. Oral inflammation and swelling of gums makes drug difficult to reach at the site of action, so it is necessary to give large dose to get desired pharmacological action. To take care of oral-dental infection, gingival bleeding, pus and local ulceration, it is necessary to give drug which act quickly and achieves highest concentration at site of action⁵.

SIGNS AND SYMPTOMS



- 1: Total loss of attachment (clinical attachment loss, CAL)
- 2: Gingival recession, and
- 3: Probing depth

In the early stages, periodontitis has very few symptoms; and in many individuals the disease has progressed significantly before they seek treatment.

Symptoms may include:

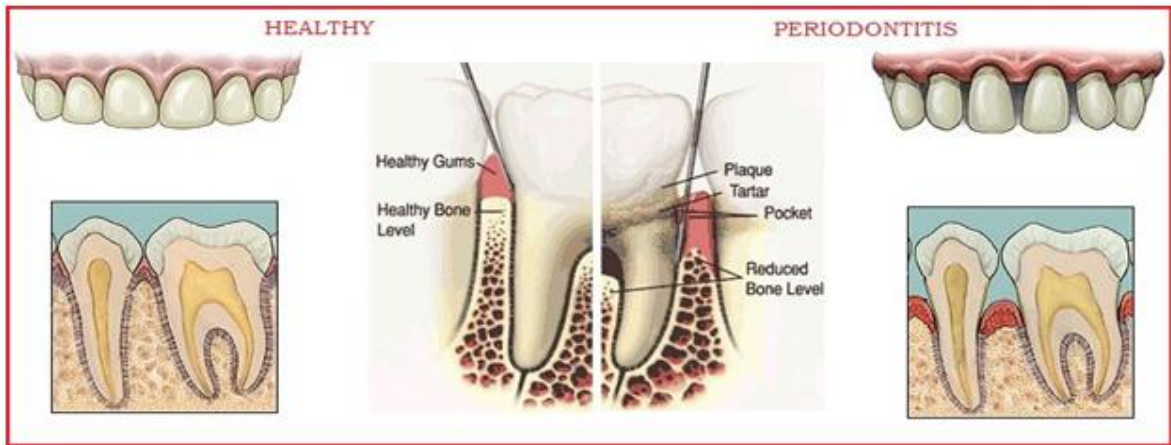
- Redness or bleeding of gums while brushing teeth, using dental floss or biting into hard food (e.g. apples) (though this may occur even in gingivitis, where there is no attachment loss)
- Gum swelling that recurs
- Spitting out blood after brushing teeth
- Halitosis, or bad breath, and a persistent metallic taste in the mouth
- Gingival recession, resulting in apparent lengthening of teeth. (This may also be caused by heavy-handed brushing or with a stiff tooth brush.)
- Deep pockets between the teeth and the gums (pockets are sites where the attachment has been gradually destroyed by collagen-destroying enzymes, known as collagenases)
- Loose teeth, in the later stages

Patients should realize gingival inflammation and bone destruction are largely painless. Hence, people may wrongly assume painless bleeding after teeth cleaning is insignificant, although this may be a symptom of progressing periodontitis in that patient.

FEATURES OF PERIODONTITIS

Periodontitis are the group of conditions, which affect the supportive structures of the teeth¹. The development of periodontitis involve breakdown of the periodontal tissues, probably due to both

direct effect of bacteria on the tissue and also the associated inflammatory response and the formation of the periodontal pocket between the surface of the tooth and the soft tissues. The periodontal pocket provides diverse environment for the colonization of microorganism. The bacteria accumulate in the periodontal pocket that develops between the roots of affected teeth and soft tissues³. If the disease is allowed to progress, increased tooth mobility and possibly tooth loss may result. One of the clinical features of the periodontal disease is the formation of a periodontal pocket, which is pathologically deepened sulcus. In normal sulcus, the gap between the gingiva and the tooth is normally between 1 and 3 mm deep. However, during periodontitis, the depth of pocket usually exceeds 5mm⁶. Clinical signs such as bluish red thickened marginal gingiva, bluish red vertical zone from the gingival margin to the oral mucosa, gingival bleeding and localized pain are suggestive of the presence of periodontal pockets⁸.



CAUSES OF PERIODONTITIS

Periodontitis is an inflammation of the periodontium, i.e., the tissues that support the teeth. The periodontium consists of four tissues:

- Gingiva, or gum tissue,
- Cementum, or outer layer of the roots of teeth,
- Alveolar bone, or the bony sockets into which the teeth are anchored, and
- Periodontal ligaments (PDLs), which are the connective tissue fibers that run between the cementum and the alveolar bone.

The primary etiology of gingivitis is poor or ineffective oral hygiene, which leads to the accumulation of a mycotic²⁵⁻²⁸ and bacterial matrix at the gum line, called dental plaque. Other contributors are poor nutrition and underlying medical issues such as diabetes²⁴. In some people, gingivitis progresses to periodontitis with the destruction of the gingival fibers, the gum tissues separate from the tooth and deepened sulcus, called a periodontal pocket. Subgingival microorganisms (those that exist under the gum line) colonize the periodontal pockets and cause further inflammation in the gum tissues and progressive bone loss. Examples of secondary etiology are those things that, by definition, cause microbial plaque accumulation, such as restoration overhangs and root proximity. The excess restorative material that exceeds the natural contours of restored teeth [these are termed "overhangs"] and serves to trap microbial plaque, potentially leading to localized periodontitis. Smoking is another factor that increases the occurrence of periodontitis, directly or indirectly²⁹⁻³¹ and may interfere with or adversely affect its treatment. If

left undisturbed, microbial plaque calcifies to form calculus, which is commonly called tartar. The primary cause of both gingivitis and periodontitis is the microbial plaque that adheres to the tooth surfaces; there are many other modifying factors. A very strong risk factor is one's genetic susceptibility. Several conditions and diseases, including Down syndrome, diabetes, and other diseases that affect one's resistance to infection, also increase susceptibility to periodontitis. According to some researchers periodontitis may be associated with higher stress³².

1. Oral microorganisms

The mouth, like all external surfaces of the body and the gut, has a substantial microflora living in symbiosis with a healthy host. The microflora of the mouth contains hundreds of species of aerobic and anaerobic bacteria. These organisms grow on tooth surfaces as complex, mixed, interdependent colonies in bio-films, and are attached and densely packed against the tooth in the deeper layers with more motile forms in the superficial layers⁹. Cultural studies indicate that more than 500 distinct microbial species can be found in dental plaque¹⁰. However, molecular methods of 16S rDNA amplification reveal an even more diverse view of the subgingival bacterial flora and suggest that a large proportion of even this well-studied and familiar microbial environment remains uncharacterised^{11, 12}. As dental plaque matures to a state that is associated with periodontal disease, the number of gram-negative and anaerobic bacteria increases¹³⁻¹⁶. Bacterial counts above the gums (supragingival) on one tooth surface can exceed 1-10⁹ bacteria. Below the gum, the number of bacteria ranges from 1-10³ in a healthy shallow crevice to more than 1-10⁸ in a periodontal pocket¹⁷. Tooth cleanings every 48 h can maintain the bio-film mass at an amount compatible with gingival health¹⁸. Unfortunately, few individuals achieve this, and exhortations to the public to clean teeth more thoroughly are generally ineffective in public-health care¹⁹. An enormous research effort has been devoted to the study of periodontal-disease-associated microflora, from classic cultural methods to modern approaches on the molecular, whole genomic, and proteomic level^{20, 21}. Certain clusters of bacterial species commonly cohabit subgingival sites and are reproducibly associated with disease²². These putative pathogens include *Porphyromonas gingivalis*, *Tannerella forsythensis*, and the spirochaete *Treponema denticola*. Infection of periodontal tissues with these and other organisms is accompanied by the release of bacterial leucotoxins, collagenases, fibrinolysins, and other proteases²³. *Actinobacillus actinomycetemcomitans* is another species commonly associated with disease, especially in young adults^{24, 25}. Recent work implicates herpes viruses in the pathogenesis of periodontitis²⁶⁻²⁸ and *Candida albicans* and other fungi in immunocompromised individuals²⁹. Clearly, a variety of microorganisms can contribute differently in populations and individuals in the pathogenesis of periodontal disease³⁰. In addition to the widely accepted causal factor of pathogenic microflora in the periodontal biofilm, several genetic and environmental effects on the periodontal diseases have been identified³¹. The most commonly grown gram negative facultative or obligate anaerobic pathogenic bacteria are *Actinobacillus actinomycetemcomitans*, *Bacteroides gingivalis*, *Bacteroides melaninogenicus sub species intermedius*, *Bacteroides fragilis*, *Bacteroides oralis*, *Bacteroides forsythus*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Capnocytophaga species*, *Campylobacter rectus*⁷, *Escherichia coli*, *Staphylococcus aureus*, *Fusobacterium nucleatum* and *Peptostreptococcus micros*.

List of the microorganisms associated with endodontal and periodontal infections.

Aerobic and Facultative Anaerobic Bacteria	Anaerobic bacteria
<p>Gram- positive cocci Streptococcus spp Beta-hemolytic streptococci Streptococcus milleri group (Viridans) Streptococcus mutans group*</p> <p>Gram-possitive bacilli Rothia dentocariosa Lactobacillus spp*</p> <p>Gram-negative cocco-bacilli Actinobacillus spp Actinobacillus actinomycetemcomitans Campylobacter spp Campylobacter rectus Capnocytophaga spp Eikenella spp</p> <p>Gram-negative rods Pseudomonas spp* Enterobacteriaceae*</p>	<p>Gram- positive cocci Peptostreptococcus spp Peptostreptococcus micros</p> <p>Gram-negative bacilli Veillonella spp</p> <p>Gram-positive bacilli Actinomyces spp Eubacterium spp Propionibacterium spp Lactobacillus spp</p> <p>Spirochetes Spirochetes Treponema denticola Treponema sokranskii</p> <p>Gram-negative bacilli Prevotella spp Prevotella intermedia Prevotella nigrescens Porphyromonas gingivalis Bacteroides spp Bacteroides forsythus Fusobacterium spp Fusobacterium</p>

* Micro organisms associated with dental caries

Due to the invasion of these pathogenic microorganisms leads to loosening and ultimately loss of teeth. This disease affects virtually the whole world population and is a major source of tooth loss after the age of 25 years⁴⁹.

2. Genetics

Rare syndromes affecting phagocytes, the structure of the epithelia, connective tissue, or teeth, could have severe periodontal manifestations. For some disorders, the responsible gene or tissue defect has been identified. Haim-Munk and Papillon-Lefèvre syndromes are rare autosomal recessive disorders associated with periodontitis onset at childhood and early loss of both deciduous and permanent teeth. These syndromes are caused by mutations in the cathepsin C gene³²⁻³⁴. Prepubertal periodontitis in some families could represent partly penetrant Papillon-Lefèvre syndrome³⁵. Other disorders that have severe periodontal manifestations include Chédiak-Higashi, Ehlers-Danlos (types 4 and 8), Kindlers, and Cohen syndromes. Data from twin studies indicate that about half the population variance in periodontitis can be attributed to genetic factors³⁶⁻³⁹. Moreover, accumulating evidence shows that genetic variations in or near cytokine genes could affect the systemic inflammatory response in people with periodontitis^{40, 41}. Although several genetic polymorphisms have been associated with periodontal disease, not enough

evidence at present supports the widespread use of genetic tests to either assess risk for disease or predict treatment response^{42, 43}.

3) Tobacco and alcohol use

Smokers are much more likely than non-smokers to develop periodontitis⁴⁴. Moreover, oral smokeless tobacco can lead to gingivitis, loss of tooth support, and precancerous gingival leucoplakia at the site of quid placement⁴⁵⁻⁴⁸. The risk of periodontal disease in long term smokers is equal to that of lung cancer, and smoking has a strong negative effect in response to periodontal treatment and other oral surgical interventions⁴⁴. In the USA, about half the risk of periodontitis can be attributable to smoking^{49, 50}. By contrast with tobacco use, a small but significant association exists between alcohol consumption and loss of periodontal support⁵¹.

4) HIV and AIDS

Although HIV disease has a relatively minor effect on the progression of chronic periodontitis compared with other pathogenic factors⁵², patients who are HIV-positive and immune-suppressed can present with distinctive forms of necrotizing gingivitis and periodontitis⁵³. Acute necrotizing ulcerative gingivitis was formerly known as trench mouth, because of its high prevalence in the trenches of World War I, when stress, fatigue, malnutrition, and poor hygiene often came together to cause the disease. The disorder is characterized by pain, bleeding gums, halitosis and low at an amount compatible with gingival health¹⁸. Unfortunately, few individuals achieve this, and exhortations to the public to clean teeth more thoroughly are generally ineffective in public-health care¹⁹. An enormous research effort has been devoted to the study of periodontal-disease-associated microflora, from classic cultural methods to modern approaches on the molecular, whole genomic, and proteomic level^{20, 21}. Certain clusters of bacterial species commonly cohabit subgingival sites and are reproducibly associated with disease²². These putative pathogens include *Porphyromonas gingivalis*, *Tannerella forsythensis*, and the spirochaete *Treponema denticola*. Infection of periodontal tissues with these and other organisms is accompanied by the release of bacterial leucotoxins, collagenases, fibrinolysins, and other proteases²³. *Actinobacillus actinomycetemcomitans* is another species commonly associated with disease, especially in young adults^{24, 25}. Recent work implicates herpes viruses in the pathogenesis of periodontitis²⁶⁻²⁸ and *Candida albicans* and other fungi in immune-compromised individuals²⁹. Clearly, a variety of microorganisms can contribute differently in populations and individuals in the pathogenesis of periodontal disease³⁰. In addition to the widely accepted causal factor of pathogenic micro flora in the periodontal biofilm, several genetic and environmental effects on the periodontal diseases have been identified³¹.

5) Nutrition

Historically, specific, overt nutritional deficiencies have been associated with periodontal disease. Vitamin C deficiency leads to scurvy with decreased formation and maintenance of collagen, increased periodontal inflammation, hemorrhage, and tooth loss. However, extensive epidemiological studies in Europe and the USA have failed to show an effect of minor hypovitaminoses on periodontal disease. In impoverished societies, the effect of deficiencies in vitamins, trace elements, and protein-calories is important, but poorly quantified. For example, noma (cancrum oris) is common in parts of sub-Saharan Africa. This devastating necrosis of oral and facial soft tissues, which usually starts as acute necrotizing ulcerative gingivitis, is more common in individuals who are malnourished (especially kwashiorkor), who are immune

suppressed after an acute viral disease (commonly measles), or perhaps who have acquired unusual species of oral bacteria from living near cattle.

6) Osteoporosis

Emerging evidence indicates that osteoporosis raises an individual's susceptibility to periodontal breakdown. A 3-year longitudinal study of 179 Japanese people older than 70 years showed significantly increased progression of periodontal attachment loss in patients with osteopenia. NHANES III data (From the 1999-2004 National Health and Nutrition Examination Survey III data) from more than 5900 US women indicated that, in the presence of high dental calculus scores, women with osteoporosis are at increased risk for periodontal attachment loss, and that this risk could be attenuated by estrogen replacement therapy⁴⁸.

7) Diabetes

Results from cross-sectional and prospective cohort studies are strikingly consistent; people with type 1 diabetes at all ages and adults with type 2 diabetes have more widespread or severe periodontal disease than individuals without diabetes^{54, 55}. Although people with well-controlled diabetes do not seem to be at increased risk of periodontal disease than people without diabetes, those with poorly controlled diabetes (who are at risk for retinopathy, nephropathy, neuropathy, and macrovascular diseases) are at raised risk for periodontitis and progressive bone loss⁵⁴⁻⁵⁷. In light of the macroscopic and microscopic sequelae of diabetes, the fact that individuals with diabetes of both types are at raised risk for periodontitis is not unexpected. Diabetes is associated with impaired wound healing, exaggerated monocyte response to dental plaque antigens⁶⁸ and impaired neutrophil chemotactic responses all of which can lead to increased local tissue destruction. With the possible exception of *P. gingivalis*, the bacterial composition of subgingival periodontal biofilm does not seem to differ substantially between individuals with and without diabetes.

8) Stress

As with many diseases, emotional and psychosocial stress clearly is factors in periodontal disease, but their precise role in the pathogenesis of this disease is unknown. For example, traumatic life events that lead to depression or an individual's inability to cope with stressful stimuli could increase his or her risk for periodontal disease.³³

9) Impaired host response

As an inflammatory disease, severe periodontal disease and loss of tooth-supporting tissues often occurs if the individual's host response or immune function is impaired. Various systemic diseases such as leukaemia, thrombocytopenia, and leucocyte disorders such as agranulocytosis, cyclic neutropenia, and leucocyte adhesion deficiency could be associated with increased severity of periodontal disease.

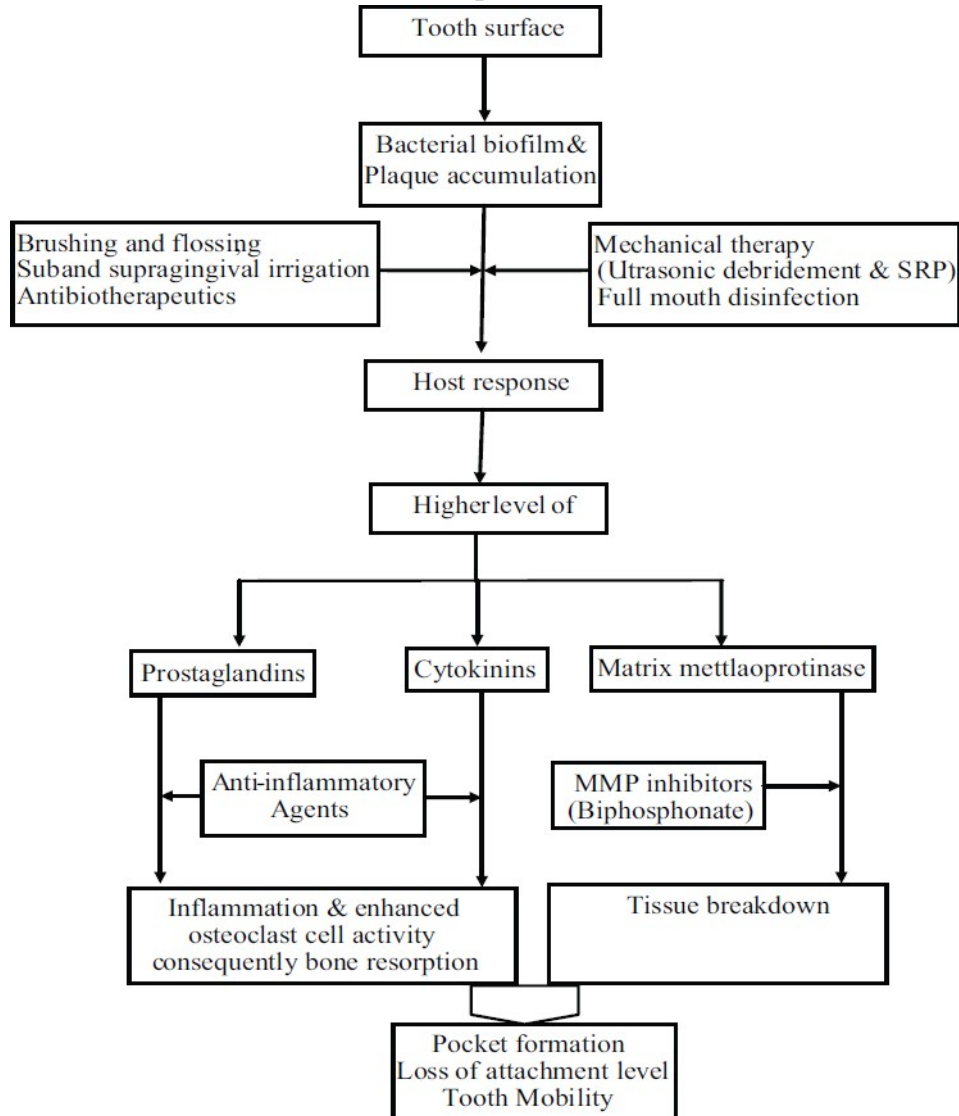
PATHOGENESIS OF PERIODONTITIS⁵⁸⁻⁶²

Although bacteria are necessary for periodontal disease to take place, a susceptible host is also needed. The immune-inflammatory response that develops in the gingival and periodontal tissues in response to the chronic presence of plaque bacteria results in destruction of structural components of the periodontium leading, ultimately, to clinical signs of periodontitis. An individual's risk for periodontal disease could be linked to gingival inflammation (bleeding) in response to plaque accumulation. The host response is essentially protective, but both hypo-responsiveness and hyper-responsiveness of certain pathways can result in enhanced tissue

destruction. Both the host and bacteria in the periodontal bio-film release proteolytic enzymes that damage tissue. They release chemo tactic factors that recruit polymorph nuclear leucocytes into the tissues; if sustained, these cells release various enzymes that break down tissues. Hundreds or even thousands of microbial antigens evoke both hum oral antibody-mediated and cell mediated immune responses. These responses are usually protective, but a sustained microbial challenge in the presence of the fore-mentioned risk factors results in the breakdown of both soft and hard tissues, mediated by cytokine and prostanoid cascades. Histologically, non-progressive inflammatory foci tend to be composed predominantly of T lymphocytes and macrophages, suggesting that the cell-mediated response can control disease. Destructive lesions are dominated by B lymphocytes and plasma cells, suggesting that hum oral immunity is not always effective. Once a periodontal pocket forms and becomes filled with bacteria, the situation becomes largely irreversible. Gingival epithelium proliferates to line the pocket and even if treatment resolves the inflammation and some bone and connective tissue are regenerated, complete restoration of the lost tooth support is impossible. Without adequate treatment, active periodontitis leads to tooth loss.

The inflammatory response in periodontal disease includes the activation of leucocytes, neutrophils, T-lymphocytes and plasma cells and the release of antibodies, lipo-polysaccharides and chemical inflammatory mediators that include cytokines, chemokines and C-reactive protein. The lipo-polysaccharides are present in the gram-negative bacterial cell walls and act as powerful stimulants for the complex host response. The initial increased presence of neutrophils at the site is followed by the release of cytokines by neutrophils and macrophages. Chemical mediators released include tumor necrosis factor alpha (TNF α), interleukin-1 (IL-1) and prostaglandins. The inflammatory process includes the stimulation of fibroblasts by IL-1 and the secretion of matrix metalloproteinases (MMPs, of which collagenase is the most prominent) by polymorphonuclear neutrophils. MMPs are responsible for increased collagen breakdown, and TNF α is primarily responsible for increased osteoclast activity resulting in bone resorption. MMPs can also activate cytokines and chemokines, exacerbating the destructive process. Collagen production is inhibited by the reduced activity of fibroblasts in response to TNF- α . The lymphocytes release antibodies as protective mechanisms but also activate the osteoclasts, resulting in bone loss. T-lymphocytes secrete receptor activator of nuclear factor kappa-B ligand (RANKL), which is involved in osteoclast activity and therefore bone resorption. These destructive inflammatory mediators are inhibited by the secretion of osteoprotegerin and tissue inhibitors of metallo proteinases (TIMPs). The level of periodontal destruction depends on the balance between destructive and protective inflammatory mediators. While periodontal bacteria are required for infective periodontal disease, individual response determines disease progression. In vitro, it has been found that individual response is affected by genetic signaling pathways that influence the expression of inflammatory mediators in response to bacterial lipopolysaccharides.³⁴⁻³⁸

Progression of Disease and intervention therapies



1.7 CLASSIFICATION OF PERIODONTITIS

The classification system for periodontal diseases and conditions are listed below^{9,33}.

- 1) Chronic Periodontitis
 - A. Localized
 - B. Generalized
- 2) Aggressive Periodontitis
 - A. Localized
 - B. Generalized
- 3) Periodontitis as a Manifestation of Systemic Diseases
 - A. Associated with hematological disorders
 1. Acquired neutropenia
 2. Leukemias
 3. Other
 - B. Associated with genetic disorders

1. Familial and cyclic neutropenia
 2. Down syndrome
 3. Leukocyte adhesion deficiency syndromes
 4. Papillon-Lefèvre syndrome
 5. Chediak-Higashi syndrome
 6. Histiocytosis syndromes
 7. Glycogen storage disease
 8. Infantile genetic agranulocytosis
 9. Cohen syndrome
 10. Ehlers-Danlos syndrome (Types IV and VIII)
 11. Hypophosphatasia
 12. Other
- 4) Necrotizing Periodontal Diseases
 - A. Necrotizing ulcerative gingivitis (NUG)
 - B. Necrotizing ulcerative periodontitis (NUP)
 - 5) Abscesses of the Periodontium
 - A. Gingival abscess
 - B. Periodontal abscess
 - C. Pericoronal abscess
 - 6) Periodontitis Associated With Endodontic Lesions
 - A. Combined periodontic-endodontic lesions
 - 7) Developmental or Acquired Deformities and Conditions
 - A. Localized tooth-related factors that modify or predispose to plaque-induced gingival diseases/periodontitis
 1. Tooth anatomic factors
 2. Dental restorations/appliances
 3. Root fractures
 4. Cervical root resorption and cemental tears
 - B. Muco-gingival deformities and conditions around teeth
 1. Gingival/soft tissue recession
 - a. facial or lingual surfaces
 - b. interproximal (papillary)
 2. Lack of keratinized gingiva
 3. Decreased vestibular depth
 4. Aberrant frenum/muscle position
 5. Gingival excess
 - a. pseudopocket
 - b. inconsistent gingival margin
 - c. excessive gingival display
 - d. gingival enlargement
 6. Abnormal color
 - C. Mucogingival deformities and conditions on edentulous ridges
 1. Vertical and/or horizontal ridge deficiency

2. Lack of gingiva/keratinized tissue
3. Gingival/soft tissue enlargement
4. Aberrant frenum/muscle
5. Decreased vestibular depth
6. Abnormal color

D. Occlusal trauma

1. Primary occlusal trauma
2. Secondary occlusal trauma

RISK FACTORS FOR PERIODONTAL DISEASE

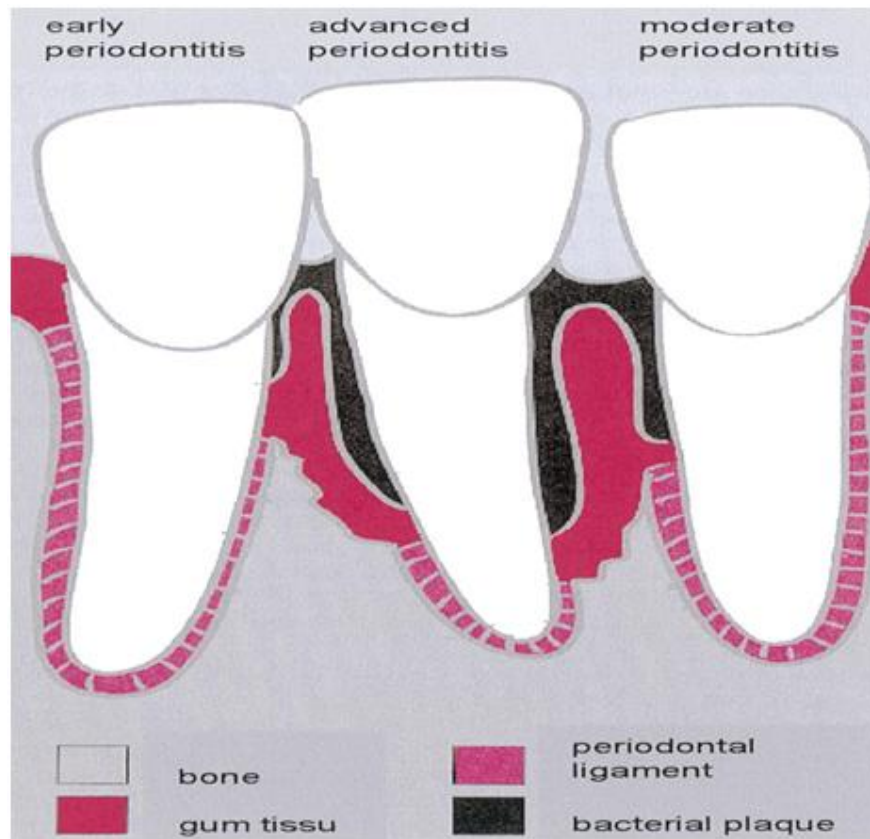
The initiation and progression of periodontal disease depend on the presence of pathogenic bacteria, host response and risk factors. These risk factors encompass systemic influences (such as poorly controlled or uncontrolled diabetes mellitus), external influences (such as smoking), intrinsic factors and local factors. They include oral hygiene, gender, race, and socio-economic status, age, and systemic health status, use of medications, smoking, and alcohol and drug abuse. Males have a higher prevalence of moderate periodontal disease than females. Low socioeconomic status and education level correlate with an increased prevalence of disease. One of the greatest risk factors is tobacco smoking. Higher levels of cigarette smoking (heavy versus light smoker; 10 cigarettes per day is a common cut off point) are associated with increased severity of periodontal disease. Smokers also experience deeper periodontal pockets than nonsmokers.³⁹ Based on a recent longitudinal study spanning 26 years, the investigators concluded that the two factors most predictive of periodontal disease progression were smoking and increased levels of calculus⁴⁰. Stress has also been found to influence periodontal disease status; periods of stress cause increased levels of adrenaline and nor-adrenaline, which are known to influence bacterial growth. Based on in vitro testing, increased and decreased growths of different bacterial species were found following exposure to increased levels of these hormones. The investigators concluded that such stress-related changes could influence periodontal disease status⁴¹. Sex hormones may also influence gingivitis and periodontal disease, as demonstrated in studies on increased levels of ovarian sex hormones in women⁴². Ethnicity (race) also plays a role; non-Hispanic blacks had the highest prevalence in the NHANES III data⁴³ (From the 1999-2004 National Health and Nutrition Examination Survey III data). Genetic makeup is now understood to play a significant role in the severity of periodontal disease. Studies of monozygotic and dizygotic twins have shown that 50% of the variance in periodontal disease may be attributed to genetics. The host response demonstrates an influence of genetics on periodontal disease and its progression. People who are genotype positive for IL-1 (IL- 1A and IL-1B) genes were found in one study of more than 100 patients to harbor higher levels of virulent bacterial complexes (red and orange complexes) than did genotype-negative patients. In addition, genotype-positive patients were found to have higher mean counts of individual virulent bacterial species in pockets deeper than 6 mm, including *T. forsythia* (*B. forsythus*), *P. gingivalis* and *T. denticola*. The importance of genetics is also suggested by experimental studies on the influence of the balance between protective and destructive chemical mediators as well as signaling pathways and gene expression. Over the years, there has been significant interest in the genetic component of localized aggressive periodontitis (LAP, formerly known as localized juvenile periodontitis). As study populations have been refined, it appears that predisposition to this disease is passed as an

autosomal dominant trait. In addition, there is evidence to suggest that the macrophages are in a hyper immune state, producing increased amounts of TNF- α , which may contribute to early and rapid bone loss in these individuals. Local risk factors include the presence of carious lesions at gingival margins, overhanging and defective restorations, and inter dental areas subject to food impaction. Finally, systemic disease – including uncontrolled or poorly controlled diabetes, autoimmune disease and hematological cancers – and drug use can impact the progression of periodontal disease⁴³.

DIAGNOSIS OF PERIODONTITIS

A diagnosis of periodontitis is established by inspecting the soft gum tissues around the teeth with a probe (i.e a clinical examination) and by evaluating the patient's X-ray films (i.e. a radiographic examination), to determine the amount of bone loss around the teeth¹. In 1976, Page & Schroeder introduce an innovative new analysis of periodontal disease based on histo-pathologic and ultra structural of the diseased gingival tissue¹⁷. Plaque-induced periodontal lesions are divided into four stages:

1. Initial lesion
2. Early lesion
3. Established lesion
4. Advanced lesion



1. Initial lesion

The oral cavity is perpetually populated by pathogenic microorganisms; because there is a constant challenge to the mucosa in the form of these microorganisms and their harmful products,

it is difficult to truly characterize the boundary between health and disease activity in the periodontal tissues. The oral cavity contains over 500 different microorganisms. It is very hard to distinguish exactly which periodontal pathogen is causing the breakdown of tissues and bone. As such, the initial lesion is said to merely reflect "enhanced levels of activity" of host response mechanisms "normally operative within the gingival tissues"¹⁷⁻¹⁹.

Features of the Initial Lesion:¹⁷

- Vasculitis of vessels subjacent to junctional epithelium
- Increased migration of leukocytes into junctional epithelium
- Extra vascular presence of serum proteins, especially fibrin
- Alteration of the most coronal portion of junctional epithelium
- Loss of perivascular collagen

2. Early lesion

While the early lesion is not entirely distinct from the initial lesion, it is said to encompass the inflammatory changes that occur from day's four to seven after plaque accumulation has commenced¹⁹. It is characterized by a matured leukocytic infiltrate that features mainly lymphocytes. Immunoblasts are quite common in the area of infiltration, while plasma cells, if present, are only at the edges of the area¹⁷. The early lesion can occupy up to 15% of the connective tissue of the marginal gingiva and up to 60-70% of collagen may be dissolved²⁰.

Features of the Early Lesion: ¹⁷

- Accentuation of features of the initial lesion, such as the considerably greater loss of collagen
- Accumulation of lymphocytes subjacent to junctional epithelium
- Cytopathic alterations in resident fibroblasts
- Preliminary proliferation of basal cells of junctional epithelium

3. Established lesion

The hallmark of the established lesion is the overwhelming presence of plasma cells in relation to the prior stages of inflammation. Beginning two to three weeks after first plaque formation, the established lesion is widespread in both human and animals populations²¹ and can be seen commonly associated with the placement of orthodontic bands on molars²².

Features of the Established Lesion: ¹⁷

- Predominance of plasma cells without bone loss
- Presence of extra vascular immunoglobulin in the connective tissue and junctional epithelium
- Continuing loss of collagen
- Proliferation, apical migration and lateral extension of the junctional epithelium, with or without pocket formation

4. Advanced lesion

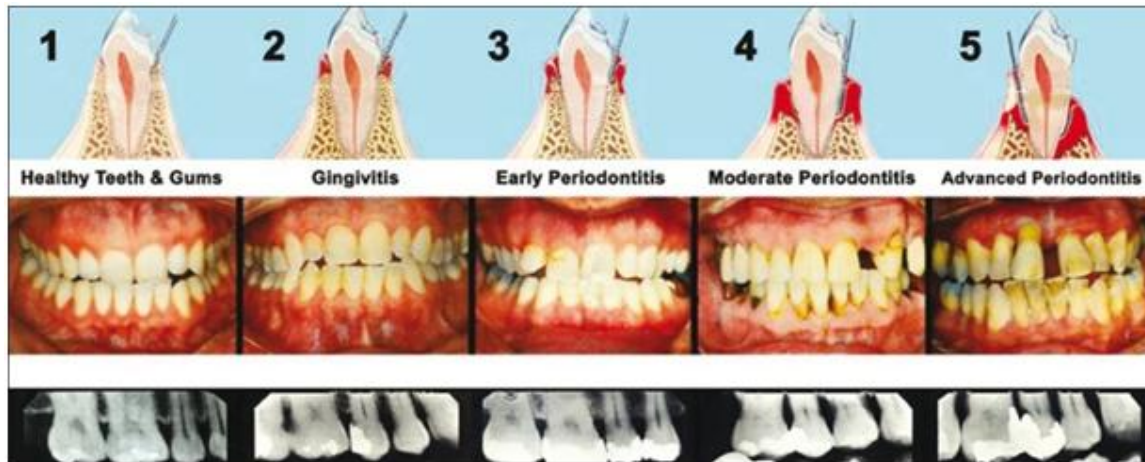
Many of the features of the advanced lesion are described clinically rather than histologically: ²³

- Periodontal pocket formation
- Gingival ulceration and suppuration
- Destruction of the alveolar bone and periodontal ligament
- Tooth mobility, drifting and eventual loss

Features of the Advanced Lesion: ¹⁷

- Extension of the lesion into alveolar bone, periodontal ligament with significant bone loss
- Continued loss of collagen
- Cytopathic alterations in plasma cells in the absence of altered fibroblasts
- Formation of periodontal pocketing
- Conversion of bone marrow into fibrous connective tissue

Progress of periodontal disease stage



Microbial assessment of periodontal biofilm

Although diagnoses and treatment decisions are sometimes helpful to guide antibiotic therapy for a few patients, they are not usually based on microbiological findings. There is insufficient evidence that microbial assessment can improve treatment outcomes for common forms of chronic periodontitis, and there is only limited evidence that such assessment can improve outcomes for refractory or aggressive forms of periodontal disease.

Emerging diagnostic methods

The inflammatory exudate adjacent to the teeth contains several biomarkers of periodontal inflammation that might be useful in the prediction of future disease risk (prostaglandin E₂, cathepsin B, neutrophil elastase, collagenase, α -glucuronidase, aspartate aminotransferase, arylsulphatase, non-specific neutral proteinase). Commercial assays are available for some of these biomarkers, but they are not used widely in clinical practice because of uncertainties about their predictive value and the added time and cost needed. Intraoral CT is used in various oral and craniofacial applications including placement of dental implants. Future advances could provide practitioners with three dimensional views of the alveolar bone and the ability to detect subtle changes in bone height and density over time⁴⁴. The area of salivary diagnostics is in its infancy and, one day, saliva could replace blood as the fluid of choice for medical laboratory assessment. For example, saliva has been used to non-invasively monitor viral loads and systemic drug concentrations, to measure C-reactive protein as a risk marker for cardiovascular disease by use of a laboratory microchip.

PREVALENCE OF PERIODONTITIS WITH AGE & SEVERITY

From the 1999-2004 National Health and Nutrition Examination Survey III (NHANES III) data, Eke and Barker estimated that the prevalence of moderate and severe periodontal disease was less than 1% in the under-35 age group, with increasing prevalence in older age groups. In the 75-and-

older age group, it is estimated that the prevalence in the United States is approximately 18% for moderate periodontitis and 7% for severe periodontitis⁶⁰.

PREVENTION OF PERIODONTAL DISEASE

Daily oral hygiene measures to prevent periodontal disease include:

- Brushing properly on a regular basis (at least twice daily), with the patient attempting to direct the toothbrush bristles underneath the gum-line, helps disrupt the bacterial-mycotic growth and formation of subgingival plaque.
- Flossing daily and using interdental brushes (if the space between teeth is large enough), as well as cleaning behind the last tooth, the third molar, in each quarter
- Using an antiseptic mouthwash: Chlorhexidine gluconate-based mouthwash in combination with careful oral hygiene may cure gingivitis, although they cannot reverse any attachment loss due to periodontitis.
- Using periodontal trays to maintain dentist-prescribed medications at the source of the disease: The use of trays allows the medication to stay in place long enough to penetrate the biofilms where the micro-organism are found.
- Regular dental check-ups and professional teeth cleaning as required: Dental check-ups serve to monitor the person's oral hygiene methods and levels of attachment around teeth, identify any early signs of periodontitis, and monitor response to treatment.
- Microscopic evaluation of bio-film may serve as a guide to regain commensal health flora⁵⁵.

Typically, dental hygienists (or dentists) use special instrument to clean (debride) teeth below the gum line and disrupt any plaque growing below the gum line. This is a standard treatment to prevent any further progress of established periodontitis. Studies show that after such a professional cleaning (periodontal debridement), microbial plaque tends to grow back to pre-cleaning levels after about three to four months. Nonetheless, the continued stabilization of a patient's periodontal state depends largely, if not primarily, on the patient's oral hygiene at home, as well as on the go. Without daily oral hygiene, periodontal disease will not be overcome, especially if the patient has a history of extensive periodontal disease. Periodontal disease and tooth loss are associated with an increased risk, in male patients, of cancer⁵⁶. Contributing causes may be high alcohol consumption or a diet low in antioxidants⁵⁷. Prevention of gingivitis and periodontitis is based on the control of their causal and risk factors (as defined by an attribute that is causally related its pathogenesis). The most widely accepted risk factor is the periodontal bio-film that forms on the teeth in the absence of effective oral hygiene. However, various factors such as smoking, diabetes, and ethnic origin, specific types of gram negative anaerobic bacteria in the periodontal bio-film, poor education, infrequent dental attendance, genetic effects, increased age, male sex, diabetes, psychosocial stress, and depression have also been shown to be associated with loss of periodontal support, and are important considerations in the prevention and treatment of periodontitis. After all oral hygiene procedures (such as tooth brushing) are ceased, the bio-film begins to develop on the teeth within 24 h and causes gingivitis in 10–21 days. Thorough tooth cleaning returns the gingiva to a healthy condition in about 1 week. Control of the periodontal bio-film with professionally administered oral hygiene can slow or stop periodontitis and tooth loss for many years. Although community-based or school-based health education or promotion programmes are effective at reducing dental plaque and gingivitis for up to 6 months, neither the long-term effectiveness of such approaches nor their effect on tooth loss

or quality-of-life outcomes have been established¹⁹. In many developing countries, poor general health with compromised host defenses, restricted access to dental care, and inadequate oral hygiene usually translates into a high occurrence of gingivitis and periodontitis. In these high-risk areas, population-based prevention programmes aimed at self-care education and health promotion should be cost effective. In this regard, WHO recently issued a policy framework for oral-health promotion that addresses environmental, economical, behavioral causes of disease. Tooth brushing and the use of dental floss and other devices to remove bacterial plaque from the teeth are the most common ways of disrupting or removing the periodontal biofilm from teeth. Although these methods are effective if used every day, they require motivation and dexterity. Mouthwashes and dentifrices containing antibacterial drugs have been used as adjuncts for controlling the biofilm. These combinations contain various biocides, surfactants, polymers, or other components that can reduce the biofilm and are generally not associated with the emergence of a resistant micro biota. If mouthwashes and dentifrices are used as adjuncts to mechanical cleaning methods, they can reduce gingivitis, although their role in treating or preventing periodontitis has not been established. However, such substances could be promising treatments in the future; in view of the preliminary evidence showing that daily home use of antimicrobial compounds over an extended time could be beneficial with respect to reducing recurrence of periodontal disease after non-surgical periodontal treatment. Tobacco use is a major risk factor for periodontal disease. Moreover, the rate of periodontal disease progression is increased in smokers and decreases to the same as non-smokers after tobacco cessation. These data, coupled with evidence that smokers have a diminished response to treatment for periodontal disease, underscores the importance of the inclusion of tobacco cessation in any prevention or treatment programme for periodontal disease. Treatment for gingivitis and periodontitis should establish periodontal health, arrest the progression of disease, prevent recurrence of disease, and preserve the dentition in a state of health, comfort, and function. This goal can be accomplished by various non-surgical and surgical therapies, depending on the specific treatment objective.⁵⁶

Follow-up care

Successful treatment of periodontal disease is dependent on regular maintenance or supportive follow up therapy after active treatment is completed, especially for those with inadequate home care. Such treatment should be tailored to individual patients and generally consists of mechanical debridement, reinforcement of oral hygiene, and continued efforts to control or eliminate causal and risk factors. For patients with aggressive or refractory disease, retreatment with the adjunctive use of antibiotics dictated by appropriate microbial culture and sensitivity testing might be needed.

TREATMENT FOR PERIODONTITIS

The treatment of periodontal disease begins with the removal of sub-gingival calculus (tartar) and biofilm deposits. A dental hygienist procedure called scaling and root planing is the common first step in addressing periodontal problems, which seeks to remove calculus by mechanically scraping it from tooth surfaces. Another method for treatment of periodontal disease involves the use of an orally administered antibiotic, Periostat (Doxycycline). Periostat has been clinically proven to decrease alveolar bone loss and improve the conditions of periodontal disease with minimal side-effects. However, Periostat does not kill the bacteria, as it only inhibits the body's host response to destroy the tissue.

There are two possible approaches to improve the drug action:

- (i) Sustained and controlled drug release to reduce or eliminate side effects by improving the therapeutic index;
- (ii) Site-specific drug delivery to minimize systemic effects.

These two strategies have been explored by the association of drugs with different vehicles, either naturals or synthetics⁴¹.

Periodontal diseases are treated by antibiotics given by systemic route or by the local delivery system. The choice of the antimicrobial agents in periodontal diseases must be based on the bacterial etiology of the infection⁴². Several antibiotics have been tested for their clinical and microbiological efficacy in periodontal diseases. Antibiotics are usually given to supplement the beneficial effects of scaling and root canalling, a common treatment for periodontal disease. Systemic administration has been useful in treating periodontal pockets, but repeated and long term use of systemic drugs is fraught with potential danger including resistant strains and superimposed infections. These drawbacks can be markedly reduced if antimicrobial agent to be used is applied locally. Concentration of drug in tissues can be enhanced by incorporating the active agent into controlled release delivery system and placing them directly in to periodontal pocket⁴. A local drug delivery system delivering the therapeutic agent at sufficient levels inside the pocket and at the same time minimizing the side effects associated with systemic drug administration.

Gingivitis can usually be treated simply. Plaque and tartar are removed from teeth; the inflamed tissues around a tooth usually heal quickly and completely. More serious cases of periodontitis cannot be treated by routine dental procedures. Dental surgery may be necessary to remove plaque, tartar, and infected gums tissue. Surgical access to facilitate mechanical instrumentation of the roots has been utilized to treat chronic periodontitis for decades¹⁰. Appropriate therapy for patients with periodontitis varies considerably with the extent and pattern of attachment loss, local anatomical variations, type of periodontal disease, and therapeutic objectives¹¹. The primary objectives of therapy for patients with chronic periodontitis are to halt disease progression and to resolve inflammation¹². Therapy at diseased site is aimed at reducing etiologic factors below the threshold capable of producing breakdown, thereby allowing repair of the affected region. Local application into periodontal pocket could be very advantageous, both in terms of rising drug concentration directly in the action site, and in preventing systemic side effects such as gastrointestinal complaints, depression, and tachycardia. Controlled delivery of chemotherapeutic agents within periodontal pockets can alter the pathogenic flora and improve clinical signs of periodontitis¹¹.

CONCLUSION

Periodontal inflammation is not inevitable. The development of gingivitis and periodontitis can be prevented by adopting thorough oral hygiene habits, alongside regular professional examinations and support. Prevention of gingivitis and periodontitis is based on the control of their causal and risk factors. Successful treatment of periodontal disease is dependent on regular maintenance or supportive follow up therapy after active treatment is completed, especially for those with inadequate home care.

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