JSP Clinical Practice Guideline for the Periodontal Treatment, 2015

Edited by The Japanese Society of Periodontology

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Preface

Periodontal disease is a chronic inflammation induced by chronic bacterial infection and results in the destruction and loss of periodontal tissue. In severe periodontitis, daily bacteremia from local bacterial infectious lesions occurs and the intensity of total inflammation is as large as to influence the whole body. Therefore, chronic infection and inflammation of periodontal tissue affects the establishment or complication of systemic diseases such as diabetes mellitus, chronic kidney disease, blood vessel disorder, non-alcoholic steatohepatitis, and rheumatoid arthritis. Moreover, tooth loss by severe periodontitis results in oral dysfunctions such as masticatory dysfunction and induces systemic complication. Adequate periodontal treatment greatly contributes the promotion of overall health in people. In Japan, there are reports that people without periodontal disease have lower medical costs than others and periodontal treatment may contribute to reduce total medical cost. Since patient self-care in plaque control is base of periodontal treatment and the period of periodontal treatment is generally long, communication with patients is a key to treatment success. It is important for better results in periodontal treatment that patients understand the significance of periodontal treatment in promotion of not only oral health but also systemic health and that the entire treatment plan be based on effectual examinations and diagnosis and that patients collaborate with their periodontists.

This treatment guideline is the English version of "JSP Clinical Practice Guideline for the Periodontal Treatment, 2015" written in Japanese and published by the Japanese Society of Periodontology (JSP) in 2016 against the background of a super-aged society. This guideline covers all clinical procedures of the standard periodontal treatment in Japan. JSP publishes this English version in order to introduce our concept and treatment flow of periodontal treatment that JSP has established, and to help the development of and standardization of periodontal treatment in Asian developing countries. In Asian developing countries, periodontal treatment has not permeated enough to whole country. Periodontal treatment may reduce the prevalence of systemic diseases and enhance social activity by the health promotion of periodontal treatment in these countries. It will be great pleasure for JSP if this treatment guideline written in English will help the expansion of periodontal treatment in Asian developing countries. Also, JSP expects to develop new relationships with foreign periodontal specialists through active discussion of the treatment concept or methods.

November 22, 2017

Hidemi Kurihara

President of the Japanese Society of Periodontology

(from April, 2017)

Foreword to the "JSP Clinical Practice Guideline for the Periodontal treatment, 2015"

The advent of the super-aging society in Japan in 2007, supported by high levels of education, economy and healthcare, has led to the highest longevity in the world. The increased number of elderly patients with periodontitis and other diseases is a major problem, and periodontitis is a strong risk factor for systemic health-threatening conditions. Appropriate guidelines for periodontal therapy including prevention are required because it is extremely important to manage both oral care and systemic healthcare. The JSP published the "2007 Guidelines for Diagnosis and Treatment of Periodontal Disease" (henceforth referred to as the 2007 Guidelines), as an outline of periodontal therapy, and the "2008 Guidelines for Examination, Diagnosis and Therapeutic Strategies for Periodontal Disease" (the 2008 Guidelines), which give details of examinations, diagnosis and therapy. However, several years have passed since these guidelines were published, and thus the JSP has revised the guidelines based on the changes in social conditions described above. Since guidelines proposed by academic societies have major effects on health care, the JSP thoroughly discussed future periodontal therapy strategies prior to compilation of the current guidelines.

These guidelines were compiled based on the following concepts.

1. The guidelines are integrated with the 2007 Guidelines and the 2008 Guidelines.
2. The guidelines include examination and diagnosis for periodontal disease, supportive periodontal therapy, and coping with peri-implant diseases.
3. For periodontal therapy in the elderly, sick persons and perioperative patients, the guidelines focus on multiple considerations, including cooperation with medical science.
4. The aim of the guidelines is to provide objective criteria for periodontal therapy by dentists, including dental residents.
5. The guidelines refer to lectures on periodontology at various educational institutions and questions in the national dentist examination.

We expect that these guidelines will contribute to maintenance and promotion of oral and systemic health by providing a correct understanding of periodontal disease and delivery of appropriate treatment and high-quality periodontal therapy to the public, including elderly and sick persons. We gratefully acknowledge the chairperson, Dr. Kazuhiro Gomi, and members of the Guidelines Development Subcommittee, Dr. Hidemi Kurihara, chairperson of the JSP Medicine Committee, the JSP Board members, and Ishiyaku Publishers, Inc.

March 2016

Yuichi Izumi

President of the Japanese Society of Periodontology

(April, 2015～March, 2017)

Edited by the Japanese Society of Periodontology

"JSP Clinical Practice Guideline for the periodontal treatment, 2015"

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1 What is periodontal disease?

1. Current status of periodontal disease in Japan

Two major dental diseases, periodontal disease and caries, develop and proceed to tooth loss, resulting in oral dysfunction that has adverse effects on both dental and oral health and general health. To maintain dental and oral health is the basis for living a productive life through enjoyment of a meal and conversation, as well as to ingest and chew foods. Elderly people with loss of 10 teeth or less have no serious problems in dietary habits; therefore, the "80-20 Campaign", which supports people aged 80 years to have at least 20 teeth, was proposed and promoted to allow people to eat what they want and maintain their conversation and smile[1].

Owing to improved attitudes of people toward oral hygiene and efforts of dental professionals (dentists and dental hygienists), 80-year-old people with 20 teeth or more (80-20 keepers) exceeded 20% in 2005[2], and accounted for 38.3% in 2011. The mean number of remaining teeth was 13.9[3]. The goal of the National Health Promotion Movement in the 21st century (Health Japan 21) was to reach at least 20% of people in the 80-20 keeper category and at least 50% of people as 60-24 keepers. This goal has been partially achieved, but the number of elderly people with periodontal pockets ≥4 mm is increasing.

Japan is still among countries with the highest longevity, but Japanese people aged around 80 years have few remaining teeth. As shown in the "number of existing teeth" and "dental disease survey", middle-aged and older people are likely to lose teeth rapidly[1]. Furthermore, the prevalence of periodontal disease in Japan is much higher than that of other diseases and prevention and treatment of periodontal disease are critical issues.

1) Definition of periodontal disease

Periodontal disease is roughly classified into gingival lesions and periodontitis. Periodontal disease, except for non-plaque-induced gingival disease, is an inflammatory and infectious disorder caused by periodontopathic bacteria that develops in the periodontium, which consists of the gingiva, cementum, periodontal ligament and alveolar bone. Periodontal disease also includes septic periodontal disease, periodontal abscess, periodontal-endodontic lesions, gingival recession and occlusal trauma caused by a powerful bite force or abnormal force (Table 1). Herein, periodontal disease does not include apical periodontitis due to dental pulp disease or neoplasms (e.g. malignant tumors) that destroy the periodontium[4]. Periodontal disease is also considered to be a lifestyle disease involved with eating and tooth brushing habits, smoking and systemic diseases including diabetes (periodontal disease has systemic health effects: periodontal medicine), showing the importance of health guidance by dental professionals. It is necessary for patients to improve their lifestyle by themselves and to be supported by healthcare professionals (systemic disease).

2) Morbidity of periodontal disease

The 2011 dental disease survey showed that gingival lesions were found less in youth and more in the elderly. The prevalence of gingival disease increases with age, reaching a peak at approximately 87% in the 45-49 age group. The prevalence in the population of productive workers (35-69 years) accounted for almost 80%. The population with periodontal pockets ≥4 mm decreased in age groups of 64 years or younger, but increased in those aged 65 years or more. This result suggests increasing tooth number by age[3].

3) Visit conditions

The 2011 dental disease survey[3] estimated that approximately 94 million patients had gingival symptoms, but only about 2.6 million patients visited dental clinics. This number doubled from approximately 1.2 million in 1999, but remains insufficient. The difference suggests that there are many people who are not aware of periodon-

tal disease and those who are aware of it but are not treated. It is preferable for these patients to visit clinics and hospitals.

2. Types of periodontal disease

The JPS classification system of periodontal disease (2006)[4] is shown in Table 1.

1) Gingival lesions (classified into localized and generalized types)

(1) Plaque-induced gingivitis

Plaque-induced gingivitis is gingival inflammation caused by bacteria in the gingival border. Clinical findings are gingival redness, edema, bleeding, pain and swelling. However, there is no radiographic finding or attachment loss of supporting tissues. Histopathological findings reveal junctional epidermal growth to the periapical or lateral region, telangiectasia surrounding the junctional epiderma, destruction of collagen fibers, and inflammatory cell infiltration. A classification of plaque-induced gingivitis by virulence factor is shown in Table 2.

(2) Non plaque-induced gingival lesions

Non-plaque-induced gingival lesions are caused by reasons other than bacterial plaque. A classification is shown in Table 3.

(3) Gingival overgrowth

Gingival overgrowth is gingival hypertrophy caused by hyperplasia of fibrillar collagen in gingival tissues. Onset and recurrence can be partially prevented by thorough plaque control.

a) Drug-induced gingival overgrowth

The responsible agents include phenytoin (antiepileptic drug, hydantoin product), nifedipine (antihypertensive, calcium blocker) and cyclosporine A (immunosuppressant, calcineurin inhibitor).

b) Hereditary gingival fibromatosis

Hereditary gingival fibromatosis is a rare idiopathic disease that results in proliferative gingival swelling at the gingival border, interdental papilla and attached gingiva. This disease develops in infants and swelling is found in the buccolingual side of the maxillary and mandibular bones, but disappears after extraction. Case reports show an autosomal-dominant and hereditary tendency.

(4) HIV infection-related gingival lesions

The JPS classification system of periodontal disease (2006) does not describe this type of gingivitis; however, HIV-infected patients may develop gingivitis, including linear gingival erythema and necrotizing ulcerative gingivitis. Linear gingival erythema, which is rarely found in people without HIV infection, is characterized by linear redness with a width of 1-2 mm along gingival borders of multiple teeth. These two characteristic lesions are caused by reduced immune function (low CD4 lymphocyte counts); therefore, abnormal gingival findings lead to early detection of HIV infection.

2) Periodontitis (classified into localized and generalized types)

Periodontitis is an inflammatory destructive disease caused by bacteria in periodontal tissues.

Inflammation spreads from the gingival border to deep periodontal tissues. Traumatic occlusion accelerates local lesion progression, but the progression rate is relatively slow. In the specific type, progression is acute and rapid and depends on the defense mechanism in the body. The classification of periodontitis by risk factor is shown in Table 4.

(1) Chronic periodontitis

Chronic periodontitis is a chronic inflammatory disease associated with attachment loss caused by periodontopathic bacteria and alveolar bone resorption. This disease was originally called adult periodontitis and onset is generally at 35 years and older. Symptoms include periodontal pocket formation, drainage, bleeding, alveolar bone

Table 1. Classification system of periodontal disease by the JPS（2006）

Classification by pathology	Classification by virulence factor（risk factor）	Note
Ⅰ. Gingival lesions †		
1. Plaque-induced gingivitis ‡	1）Gingivitis induced by dental plaque only ‡ 2）Gingivitis modified by systemic conditions ‡ 3）Gingivitis modified by malnutrition ‡	Table 2
2. Non-plaque-induced gingival lesions	1）Gingival lesions induced by other infections 2）Mucocutaneous disorders ‡ 3）Allergic reactions ‡ 4）Traumatic lesions of gingiva ‡	Table 3
3. Gingival hyperplasia, Gingival overgrowth	1）Drug-induced gingival overgrowth 2）Hereditary gingival fibromatosis	
Ⅱ. Periodontitis †		
1. Chronic periodontitis ‡ 2. Aggressive periodontitis ‡	1）Periodontitis associated with systemic diseases 2）Periodontitis associated with smoking 3）Periodontitis associated with other risk factors	Table 4
3. Periodontitis associated with genetic disorders ‡		Table 5
Ⅲ. Necrotizing periodontal diseases †, ‡ 1. Necrotizing ulcerative gingivitis ‡ 2. Necrotizing ulcerative periodontitis ‡		
Ⅳ. Abscesses of periodontium ‡ 1. Gingival abscess ‡ 2. Periodontal abscess ‡		
Ⅴ. Combined periodontal-endodontic lesions ‡		
Ⅵ. Gingival recession		
Ⅶ. Occlusal trauma ‡ 1. Primary occlusal trauma ‡ 2. Secondary occlusal trauma ‡		

† Classified into localized and generalized types.
‡ Same disease name as that described in the New Periodontal Disease Classification System of the American Academy of Periodontology（1999）. Other diseases are defined by JSP.

resorption, and tooth movement. This disease has a chronic course, but results in acute symptoms due to host defense mechanisms.

（2）Aggressive periodontitis

Aggressive periodontitis is characterized by acute periodontal lesions（alveolar bone resorption, attachment loss）and intrafamilial clustering in systemically healthy individuals. Attachment of bacterial plaque is generally small and age of patients ranges from 10 to the 30s. Some patients have large colonies of *Aggregatibacter actinomycetemcomitans*（*A. actinomycetemcomitans*）, and secondary characteristics are abnormal defense mechanism and immune response. The prevalence of aggressive periodontitis in Japan is 0.05% to 0.1% in the 2012 report of the Japan Intractable Diseases Information Center[6].

（3）Periodontitis associated with genetic disorders

This is rapidly progressive periodontitis that develops as an oral symptom of genetic disorder associated with systemic abnormality. Genetic disorders include familial and cyclic neutropenia, Down syndrome, Papillon-Lefèvre syndrome, and Chédiak-Higashi syndrome（Table 5）.

3）Necrotizing periodontal diseases（classified into localized and generalized types）

These disorders are characterized by gingival necrosis and ulceration. The diseases are classified into gingivitis and periodontitis.

Table 2. Classification of plaque-induced gingivitis

1) Gingivitis induced by plaque only
2) Gingivitis modified by systemic conditions
   ①Puberty-associated gingivitis
   ②Menstrual cycle-associated gingivitis
   ③Pregnancy-associated gingivitis
   ④Diabetes-associated gingivitis
   ⑤Leukemia-associated gingivitis
   ⑥Others
3) Gingivitis modified by malnutrition
   ①Ascorbic acid-deficiency gingivitis
   ②Others

Table 3. Classification of non-plaque-induced gingival lesions

1) Gingival lesions induced by other infections
   ①Gingival lesions of specific bacterial origin
   ②Gingival lesions of viral origin
   ③Gingival lesions of fungal origin
2) Mucocutaneous disorders
   ①Lichen planus
   ②Pemphigoid
   ③Pemphigus vulgaris
   ④Lupus erythematosus
   ⑤Others
3) Allergic reactions
4) Traumatic lesions of gingiva

Table 4. Classification of periodontitis by risk factor

1) Periodontitis associated with systemic diseases
   ①Leukemia
   ②Diabetes
   ③Osteoporosis／osteopenia
   ④Acquired immunodeficiency syndrome (AIDS)
   ⑤Acquired neutropenia
   ⑥Others
2) Periodontitis associated with smoking
3) Periodontitis associated with other risk factors

Table 5. Genetic disorders with periodontitis

1) Familial and cyclic neutropenia
2) Down syndrome
3) Leukocyte adhesion deficiency syndrome
4) Papillon-Lefèvre syndrome
5) Chédiak-Higashi syndrome
6) Histiocytosis syndrome
7) Infantile genetic agranulocytosis
8) Glycogen storage disease
9) Cohen syndrome
10) Ehlers-Danlos syndrome (TypeⅣ and Ⅷ)
11) Hypophosphatasia
12) Others

(1) Necrotizing ulcerative gingivitis

(2) Necrotizing ulcerative periodontitis

These diseases are distinguished as acute or chronic at diagnosis. Symptoms include gingival pseudomembrane formation, bleeding, pain, fever, lymphadenopathy, and foul smell. The disorders are associated with Fusobacterium, Spirochaeta and *Prevotella intermedia* (*P. intermedia*). The pathogenesis includes poor oral sanitary conditions, stress, smoking, and immunodeficiency. The disorders are also oral findings in HIV-infected patients.

4) Abscesses of periodontium

(1) Gingival abscess

Gingival abscess develops in gingival connective tissues and is caused by bacterial infection from adjacent periodontal pockets, external stimulation of the gingiva, and gingival trauma and infection. Localized redness and swelling are found in the gingiva near the causal site and pain is a frequent complication. Abscess develops regardless of periodontal pockets.

(2) Periodontal abscess

Periodontal abscess is the state of pus pooling in local tissue destruction by localized pyogenic inflammation in the periodontium. Abscess develops in patients with deep periodontal pockets, localized pyogenic inflammation in deep tissues with closed inlet of periodontal pockets, occlusal trauma, and poor resistance to infection in diabetic patients.

5) Combined periodontal-endodontic lesions

Lesions in periodontal and endodontic regions affect each other. Marginal periodontal and periapical tissues are anatomically close, and lesions are likely to affect each other. Specifically, abnormality in marginal periodontal tissues affects the dental pulp via the root canal lateral shoot and apical pores, whereas lesions in dental pulp have effects on periodontal tissues via the root canal lateral shoot, medullary tube and apical pore.

6) Gingival recession

Gingival recession is the state in which marginal gingiva transfers from the cement-enamel junction (CEJ) toward the periapical direction and the root surface is exposed. Recession is also caused by aging, mechanical processes due to incorrect brushing, inflammation in the marginal gingiva, and disuse atrophy with pairing tooth loss. After the root surface is exposed, caries, abrasion and dentin sensitivity sometimes develop.

7) Occlusal trauma

Occlusal trauma is a bite force-induced injury in deep periodontal tissues (cementum, periodontal ligament and alveolar bone). When no inflammation develops in the gingiva, attachment loss does not occur and X-ray findings indicate bone impermeability surrounding the tooth root. Disruption of the periodontium is expanded by excessive bite force to tissues with periodontitis (see Page 15, "5. Characteristics of occlusal trauma").

3. Characteristics of gingival lesions

Gingival lesions are inflammation only in the gingiva; the cementum, periodontal ligament and alveolar bone are not disrupted. Of various gingival lesions, plaque-induced gingivitis is clinically important and its characteristics are given below.

(1) Bacterial plaque is pathogen

Bacteria attached to teeth grow due to poor oral hygiene control and bacterial plaque is formed, resulting in an inflammatory manifestation. The inflammation grade depends on host resistance, etc.

Bacterial plaque is formed from numerous bacteria attached to teeth, gingiva, and dental repair and prosthesis products and their metabolites. As a result of bacterial plaque maturation, coaggregation of different bacterial species occurs, and coverage with extracellular polymeric substances (EPS) including glycocalyx, results in bacterial biofilm formation.

(2) Inflammation is localized in the gingiva

No inflammation expands to the cementum, periodontal ligament or alveolar bone.

(3) Gingival pockets are formed, but without attachment loss

The gingiva swells and proliferates in the crown-side direction due to inflammation, which results in formation of a gingival pocket (pseudopocket). Clinically, the bottom of this pocket is positioned at the CEJ. Since the attachment level does not change, there is no attachment loss or alveolar bone resorption.

(4) Gingival lesions are exacerbated by plaque retention factors

If plaque retention factors (factors that make plaque control difficult and accelerate bacterial plaque retention: see Page 25 "(9) Plaque retention factors" and page35 "Figure 6-2") are present, bacterial plaque is retained or increased, resulting in aggravated gingivitis.

(5) Gingival lesions are improved by plaque control

Gingival lesions are markedly improved by thorough oral hygiene control, including brushing and elimination or reduction in bacterial plaque, the major cause. Gingival inflammation is further improved by removal or revision of plaque retention factors.

(6) Gingival lesions are considered to be a stage prior to periodontitis

In general, untreated plaque-induced gingivitis makes inflammation expand to the cementum, periodontal ligament and alveolar bone, resulting in periodontitis. Plaque-induced gingivitis may remain unchanged, but generally advances to periodontitis after it remains untreated for a long time.

4. Characteristics of periodontitis

Periodontitis is a disorder in which inflammation that initially developed in the gingiva expands to deep periodon-

tal tissues, including the cementum, periodontal ligament and alveolar bone. Long-term continuous stimulation of bacterial plaque, the major cause, is required for progression of plaque-induced gingivitis to periodontitis. Such progression is strongly associated with lifestyle and plaque retention factors that accelerate bacterial plaque and make it difficult to remove this plaque.

The progression rate of periodontitis is relatively slow and takes several years. However, traumatic occlusion accelerates disruption. Furthermore, host defense response has effects on periodontitis. For example, severe diabetes-reduced resistance of periodontal tissues（e.g. leukocyte dysfunction, wound repair delay）and lifestyle factors, including smoking, are involved in progression of periodontitis. Chronic periodontitis is the major type. Its characteristics are shown below.

1）Characteristics of onset of periodontitis

（1）Plaque-induced gingivitis progresses to periodontitis, resulting in destruction of cementum, periodontal ligament and alveolar bone

Enzymes produced by periodontopathic bacteria and their metabolites enhance the defense mechanism, i.e., immune function; consequently, gingival inflammatory destruction expands to the cementum, periodontal ligament and alveolar bone.

（2）Attachment loss occurs and a periodontal pocket develops

The attachment function between teeth and periodontal tissues is destroyed, resulting in attachment loss. Specifically, gingival junctional epiderma（attached epidema）and connective tissue attachment transfer from the CEJ toward the periapical direction and the gingiva detaches from the root. Consequently, a periodontal pocket（true pocket）is formed.

（3）Periodontopathic bacteria are increased in deep periodontal pockets and inflammation continues

The inside of the pocket is under anaerobic conditions, in which periodontopathic bacteria are likely to grow. Consequently, bacteria and metabolites invade the gingiva through the epiderma of a periodontal pocket. In patients with chronic periodontitis, *Porphyromonas gingivalis*（*P. gingivalis*）, Tannerella forsythia, A. actinomycetemcomitans, Fusobacterium nucleatum and *Treponema denticola*（*T. denticola*）are frequently detected in active lesions of periodontitis.

2）Characteristics of progression of periodontitis

（1）Gingival lesions are exacerbated by plaque retentions factors

Similarly to plaque-induced gingivitis, if plaque retention factors that make plaque control difficult（e.g. calculus, malalignment, abnormal gingiva and alveolar mucosa, faulty dental restoration, dental morphological defect, food impaction, mouth breathing, abnormal oral vestibule, caries in the tooth cervix, periodontal pocket）are present, periodontitis is aggravated. After periodontal pocket formation, the insides of pockets cannot be controlled by the patient; consequently, bacterial plaque increases and periodontitis progresses.

（2）Complicated traumatic occlusion accelerates periodontitis

Complicated traumatic occlusion including early contact, strong lateral pressure and bruxism, aggravates inflammation in periodontal tissues and tissue disruption rapidly progresses, resulting in angular bone resorption and infrabony pocket formation. Therefore, traumatic occlusion is a significant local modifier for aggravating periodontitis.

（3）Site-specificity in progression rate

Differences in the quality（type）and mass of infected periodontopathic bacteria and local modifiers induce significant differences in progression of periodontitis between regions in the oral cavity of a patient.

（4）Quiescence stage and active stage

In general, periodontitis is considered to be a chronic disorder; however, disruption of the periodontium does not

always proceed at a constant rate, but rapidly proceeds in active stages. There is no diagnostic procedure for determining resting and active stages in a single test. Rapid progression of attachment loss and alveolar bone resorption are considered to be the active stage and the region of their occurrence is called active region.

(5) Advanced periodontitis produces a vicious cycle and is likely to advance rapidly

Periodontopathic bacteria increase in a deep periodontal pocket. Attachment loss is likely to occur in this kind of pocket in comparison with that in a shallow pocket. Furthermore, reduced supporting ability due to alveolar bone resorption induces secondary occlusal trauma, which is complicated with bacterial infection, and disruption of periodontal tissues proceeds.

3) Characteristics of periodontal therapy

(1) Cause elimination improves or arrests periodontitis

Basic periodontal therapy mainly using cause elimination improves mild periodontitis and stops its progression. However, periodontal surgery and oral rehabilitation are frequently used for moderate or severe periodontitis, and more complicated periodontal therapy is required. In general, it is difficult to regenerate lost periodontal tissues completely using current periodontal therapy, including periodontal guided tissue regeneration.

(2) Supportive periodontal therapy (SPT) and maintenance throughout lifetime are required in periodontal therapy

Periodontitis has a high risk for recurrence because the major causes of bacterial plaque and traumatic factors are always present inside the oral cavity; deep periodontal pockets and furcation involvement often remain even after completion of appropriate periodontal therapy; and periodontitis is affected by systemic factors for a long time. SPT and maintenance are necessary as part of periodontal therapy to maintain periodontal tissues that are recovered by basic periodontal therapy, periodontal surgery and oral rehabilitation, or are stable. SPT is performed mainly using plaque control, scaling, root planing and occlusal adjustment by dental professionals, whereas maintenance consists of self care (home care) by patients and professional care (special care) by specialists. Periodontal disease is likely to recur due to insufficient plaque control; therefore, SPT and maintenance are essential. Teeth can be preserved by SPT and maintenance for appropriate intervals and this approach can work for a long time.

5. Characteristics of occlusal trauma

Occlusal trauma is injury in deep periodontal tissues (i.e., the cementum, periodontal ligament and alveolar bone) caused by traumatic occlusion (excessive bite force and abnormal lateral force) and is classified into primary and secondary occlusal trauma. Histopathological findings include degenerative necrosis in the pressed region of the periodontal ligament and alveolar bone resorption, and primary findings include tooth movement, enhanced cavity of the periodontal ligament and vertical (wedge-shaped) bone resorption in X-ray films. Occlusal trauma is a factor in increasing disruption of the periodontium in periodontitis.

(1) Primary occlusal trauma

Primary occlusal trauma is trauma in the periodontal tissues caused by excessive bite force to teeth.

(2) Secondary occlusal trauma

Secondary occlusal trauma is trauma that occurs in teeth with reduced capacity of bite force due to reduction of the supporting alveolar bone by progression of periodontitis, and is caused by physiological bite force.

Occlusion that causes occlusal trauma is called traumatic occlusion. Causes include malalignment, early contact, biting interference, bruxism, excessive bite force, lateral pressure, oral and labial parafunctional habit, and food impaction.

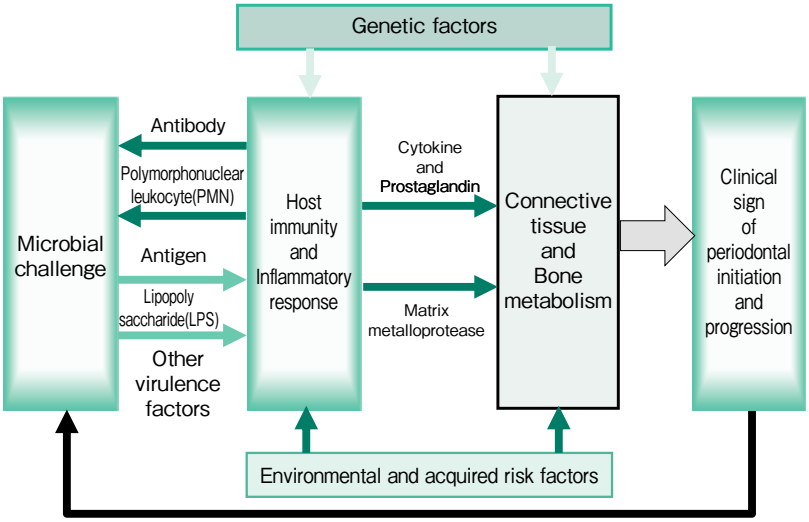

Figure 1. Etiology of periodontal disease (ref 7, revised)

6. Systemic conditions and periodontal disease

Patients with periodontal disease who have or are suspected to have systemic disease should receive sufficient consultation before the start of periodontal therapy, and immediate referral to attending physicians about symptoms. Patients are treated with periodontal therapy together with sufficient control of systemic disease. Some patients have difficulty undergoing both periodontal and dental therapy, depending on the type and symptoms of systemic disease. In such a case, communication with advanced care facilities for systemic disease is recommended, with the request that they provide the information necessary for treatment and control of systemic disease. Close attention should also be given to patients in whom systemic conditions are sufficiently controlled.

1) Factors affecting periodontal disease (Figure 1)

(1) Congenital factors

a) Genetic risk factors

Genetic risk factors are associated with metabolic gene defects, and abnormal polymorphism and gene expression. Patients with Down syndrome, Papillon-Lefèvre syndrome and Chédiak-Higashi syndrome are known to have severe periodontal disease.

b) Age and sex

Periodontal disease with disruption of the periodontium in youth or with rapid progression has a poor prognosis (e.g. aggressive periodontitis). Increased sex hormones induces *P. intermedia*, resulting in pregnancy/puberty-related periodontitis. On the other hand, postmenopausal women with reduced estrogen secretion have increased production of inflammatory cytokines, which sometimes results in alveolar bone resorption and deeper periodontal pockets[8].

c) Racial/ethnic difference

Racial/ethnic differences are not important in Japan. In comparison of Caucasian, Mexican and African-Americans, attachment loss, probing values and prevalence of periodontitis are lowest in Caucasians. Racial/ethnic differences depend on oral bacterial flora, differences in host response, food habits, socioeconomic factors, and understanding of dental therapy.

(2) Environmental and acquired risk factors

a) Smoking

Smoking is the strongest risk factor among environmental and acquired factors. Smokers are likely to have peri-

odontal disease at a rate of 2-8 times higher than non-smokers. In addition, smoking decreases the response of periodontal disease to curative therapy.

b) Stress stimulation

Stress stimulation is related to aggravation of periodontal disease and stress stimulation-induced mental tension (stress response) has effects on immune response.

c) Diabetes

Periodontitis complicated with diabetes is not induced by diabetes, but by immune system disorder, peripheral circulatory disturbance and wound repair delay due to diabetes, which modulate the pathology of periodontitis.

d) Obesity

Obese individuals are likely to have periodontal disease and the causes are thought to be related to tumor necrosis factor alpha (TNF-α) produced from visceral adipose tissues.

e) Routine medicines

Periodontal disease is an inflammatory disease induced by bacterial infection, resulting in bone metabolism, including disruption of the alveolar bone (Figure 1). Therefore, immunosuppressants, inflammatory cytokine-targeted agents, bone metabolism-related agents and corticosteroids have effects on the pathology of periodontal disease. For example, phenytoin (antiepileptic drug, hydantoin group), nifedipine (antihypertensive, calcium blocker) and cyclosporine (immunosuppressant, calcineurin inhibitor) at routine medication induce drug-induced gingival hyperplasia.

f) HIV infection

HIV infection sometimes causes necrotizing ulcerative gingivitis (periodontitis)-like symptoms that require attention.

2) Diseases influenced by periodontal disease

(1) Angiopathic disorder

In arteriosclerosis and ischemic heart disease (angina, cardiac infarction), cytokines are suspected to be involved in thrombus formation.

(2) Aspiration pneumonia

Oral bacteria including periodontopathic bacteria pass through the trachea and invade the lung with the saliva, resulting in aspiration pneumonia.

(3) Preterm and low birth weight infant delivery

Mothers with moderate periodontitis have higher risks for delivering a low birth weight infant.

(4) Diabetes

TNF-α, a chemical mediator of inflammation caused by periodontitis, increases insulin resistance and aggravate diabetes.

(5) Rheumatoid arthritis

Patients with rheumatoid arthritis have large attachment loss and dental loss. Periodontal disease has many common causes and pathological conditions to rheumatoid arthritis. Inflammatory cytokines and prostaglandin E_2 (PGE_2); i.e., enhanced production is involved in tissue disruption.

(6) Other diseases

Periodontal disease has effects on onset and progression of bacteremia, chronic kidney disease and nonalcoholic steatohepatitis (NASH).

2 Process of periodontal therapy (see Figure 2)

1. Systemic disease

Systemic factors are extremely important in onset and progression of periodontal disease and it is likely that periodontal disease induces systemic disorders. Regardless of susceptibility to infection and the progression rate of periodontal disease, sufficient removal of causative bacterial plaque improves periodontal disease. Patients with systemic disease (including diabetes, obesity [metabolic syndrome] and hematologic disease), related to onset

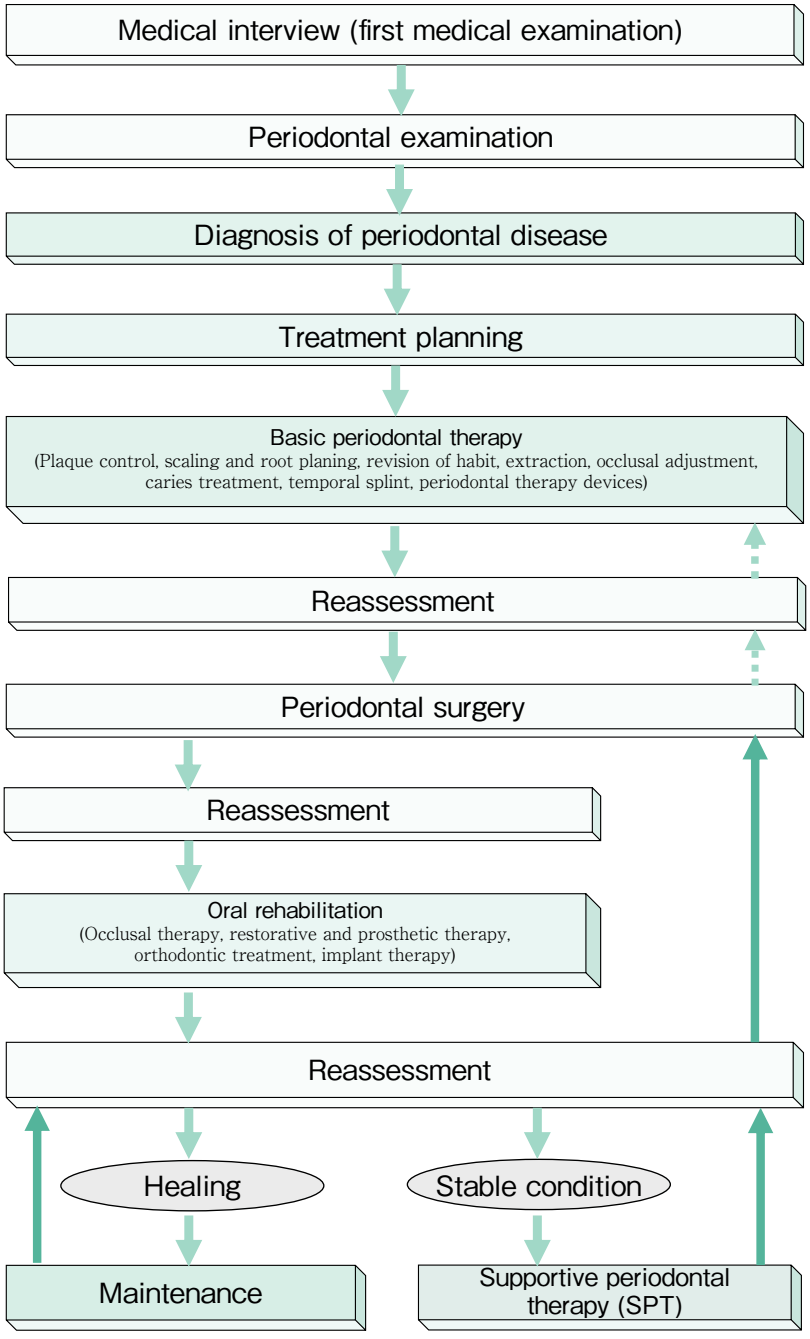

Figure 2. Standard procedures for periodontal therapy

* Therapy considered unnecessary in a test can be skipped.

and progression of periodontal disease, require thorough elimination of local factors for periodontal disease and improvement of systemic disease by attending physicians[1]. Environmental factors including smoking and stress also induce progression of periodontal disease; therefore, it is important to improve these factors.

1) Affected individuals

Affected individuals are frequently given many agents, and sufficient consultation is required before the start of periodontal therapy, with referral to attending physician(s) for symptoms and development of appropriate team treatment. In elderly and affected individuals, prevention of complications is needed to determine resting blood pressure, heart rate and oxygen saturation before surgery and monitor vital signs during therapy, even if treatment has no problems. Dental therapy can be difficult in some patients with certain systemic diseases and symptoms. In such cases, it is necessary to communicate with advanced care facilities for systemic disease and request that they provide the information necessary for treatment and control of systemic disease.

2) Diabetic patients

For immunocompromised patients with periodontitis who have a decreased host defense mechanism due to poorly-controlled diabetes and those who have endothelial dysfunction due to atherosclerotic disease, combination with antibiotic therapy is recommended to improve the response of periodontal therapy and reduce adverse effects on the body and organs[2].

3) Elderly patients

The elderly are likely to have decreased resistance to periodontal disease and develop aspiration pneumonia due to age-related impaired immune functions. There are no particularly specific procedures for periodontal therapy in the elderly; however, it is important to have sufficient information on past and current medical history and medication, as well as careful observation of patients because of physical dysfunction and various systemic diseases. It is necessary to refer to physicians with regard to the patient's systemic conditions, as required.

2. Examination-based diagnosis, therapeutic strategy and informed consent

For appropriate periodontal therapy, correct examination and diagnosis of the current symptoms of periodontal disease are required (see Page 24 "1. Periodontal disease examination"). The first step is to conduct a periodontal tissue examination to confirm gingival inflammation and tissue destruction, and plan the therapeutic strategy based on the systemic conditions in cooperation with physicians, as required. The next step is to obtain informed consent from the patient after giving a thorough explanation and start treatment in accordance with the therapeutic strategy. The standard procedures for periodontal therapy are shown in Table 2. If the test results in each step indicate no need for therapy, skip and go to the next test.

3. Basic periodontal therapy

The principle of periodontal therapy is to elucidate causes and precipitating factors of periodontal disease and eliminate them.

1) Proactive participation of patients in treatment

Daily plaque control (self care) by patients is important in periodontal therapy[3]. This is necessary to prepare conditions in which patients proactively participate in treatment based on appropriate instructions for oral hygiene. Therefore, dentists and dental hygienists should fully explain that periodontal disease is caused by bacte-

rial infection and that systemic diseases are involved in periodontal disease, so that patients recognize the importance of prevention and therapy.

2) Establishment of plaque control

Successful basic periodontal therapy depends on continuous plaque control in all therapeutic stages. Plaque control is roughly classified into self care by patients and professional care by dental specialists. If essential plaque control is not performed successfully, an effect of the following therapy cannot be obtained.

3) Elimination of plaque retention factors

It is important to eliminate plaque retention factors that are causes of accumulation of bacterial plaque and factors that make them difficult to eliminate to make it easier to control oral hygiene[4].

4) Recovery of masticatory function

Traumatic factors that cause occlusal trauma in periodontal tissues and aggravate periodontitis must be eliminated. In patients who have extreme tooth mobility due to periodontal destruction after disease are eliminated, it is important to splint and install devices for periodontal therapy temporarily for occlusal stabilization and recovery of masticatory function[5].

5) Abstention of palliative treatment

It is inappropriate to administer antibiotic and anti-inflammatory agents alone, conduct incisional drainage for the swelling gingiva, and just fix mobile teeth in patients with gingival inflammation and gingival and periodontal abscess. Such procedures are referred to as palliative treatment, and do not remove bacterial plaque causing periodontal disease. Bacterial plaque temporarily decrease and seem to be relieved by palliative treatment; however, plaque soon increase again, resulting in relapse. Therefore, periodontal therapy should be conducted to eliminate causes.

4. Periodontal surgery

After completion of basic periodontal therapy, appropriate surgery is conducted to repair and restore lost periodontal tissues in regions requiring this procedure, based on systemic conditions and the general need for surgery, with the goal of improvement of remaining deep periodontal pockets and morphological defects in the oral mucosa.

5. Oral rehabilitation

After completion of basic periodontal therapy and periodontal surgery, restorative and prosthetic therapy is performed and stable occlusion is established to restore oral functions (occlusion, mastication, dental esthetics, articulation function, etc.). Plaque retention factors and traumatic occlusion are improved and dental esthetics is restored by orthodontic treatment.

6. Cure and disease stabilization of periodontal disease

Patients who have periodontal pocket(s) <4 mm without inflammation are considered to be cured by basic periodontal therapy and periodontal surgery or occlusal function restoration; therefore, they are in the maintenance state. On the other hand, patients who have periodontal pocket(s) ≥ 4 mm and furcation involvement but no inflammation are considered to be clinically stable and in the stable condition. However, they are likely to have

relapse of periodontal disease and need to visit a dental clinic at appropriate intervals to undergo SPT. It is important to continue maintenance and SPT for long-term maintenance of oral health[6]. The designation of "cure" or "stable condition" depends on the progression of the disease.

1) Plaque-induced gingivitis

Plaque-induced gingivitis is cured by basic periodontal therapy and diagnosed by reassessment after therapy. Periodontal therapy is not discontinued, but maintained at appropriate intervals.

2) Periodontitis

Mild periodontitis is often cured by basic periodontal therapy. Moderate or severe periodontitis depends on lesions. Periodontal surgery is performed for lesions as required. Furthermore, after completion of this surgery, reassessment (including partial reassessment) is conducted to evaluate the effect of periodontal therapy and the state of periodontal tissues. Patients who are determined to be stable or cured at the completion of oral rehabilitation transfer to SPT or maintenance.

3) Stable condition

Patients who have healthy periodontal conditions, but periodontal pocket(s) $\geq$4 mm and furcation involvement without inflammation in the reassessment test are considered to be in the stable condition. These patients undergo SPT. Some of these patients who cannot undergo periodontal surgery due to systemic disease or other risk factors should frequently undergo a reassessment test and SPT. Patients who have bruxism and parafunctional habit, decreased tooth-supporting volume due to severe alveolar bone resorption resulting in occlusal trauma even with physiological occlusal force, or have systemic disease (e.g. diabetes), should also frequently undergo a reassessment and SPT.

4) Treatment after cure

Patients who have periodontal pocket(s) $<$4 mm, but gingival recession and exposed furcation are sometimes determined to be cured. However, these patients with an exposed root are likely to develop root caries and require careful maintenance.

3 Medical interview, patient reference and liaison with medicine

1. Medical interview

The major reason（chief complaint）for the patient's visit, and particularly their wish for periodontal therapy, should be asked. This is important to communicate well with patients and conduct treatment without problems. Patients with a chief complaint of periodontal disease visit a clinic with a strong wish for treatment, and it is important to determine anxiety, discomfort and subjective symptoms of periodontal disease. For patients with a chief complaint other than periodontal disease, treatment of their chief complaint and direction for them to recognize the periodontal pathology are recommended.

For patients with systemic disease to be considered for dental treatment, interview and inspection are necessary to determine systemic health conditions. Furthermore, it is important to obtain information on periodontal disease-related systemic disease, including diabetes, obesity, ischemic heart disease, aspiration pneumonia, preterm and low birth weight infant delivery, osteoporosis, and immune/allergic disease, as well as environmental factors（smoking, stress, etc.）and genetic factors.

2. Reference of patients to periodontal specialists and advanced care facilities

Patients with severe periodontal disease should be referred to periodontal specialists and advanced facilities with therapeutic information, including medical history and treatment record.

3. Liaison with medicine

Recently, aging patients with periodontal disease complicated with different systemic diseases have visited dental clinics. If a patient has a medical history of systemic disease or is currently under treatment, it is necessary to ask an attending physician to provide medical records. A patient who is suspected to have systemic disease in the interview before periodontal therapy should be immediately referred to a hospital with provision of the available symptoms. Dentists are required to have the information and knowledge about the type and symptoms of systemic diseases and prescribed drugs, and should refer patients to appropriate facilities with appropriate timing. With regard to diseases including diabetes that are deeply involved in onset and progression of periodontal disease （see Page 46 "2. Periodontal therapy for patients with other diseases"）, it is preferable to interact with attending physicians to share respective symptoms and treat patients.

1）Disease state and drugs administered

If a patient is suspected to have drug-induced gingival hyperplasia due to phenytoin（antiepileptic drug, hydantoin group）, nifedipine（antihypertensive, calcium blocker）and cyclosporine（immunosuppressant, calcineurin inhibitor）, the patient is informed of this possibility and the effect of the prescribed drugs is communicated to the attending physician. To ask about the possibility of replacing these drugs, close coordination with the attending physician is important to allow a decision on drug replacement based on mutual understanding.

Bisphosphonate（BP）drugs and RANKL antibody products are used for treatment of osteoporosis and bone metastasis（bone modifying agents: BMA）. Osteonecrosis of the jaw（ONJ）is an adverse event caused by these agents. There are studies showing that appropriate oral control decreases onset of ONJ during BMA treatment[1,2], and it is recommended that all patients undergo dental examination before BMA treatment and preventive dental

procedures[3]. Therefore, physicians ask dentists about these agents and an appropriate therapeutic strategy should be designed in cooperation with each other.

2) Precautions for invasive treatment in the oral cavity

Dentists provide information on diagnosis of periodontal disease and treatment details, and particularly invasive procedures including extraction, subgingival scaling and root planing (SRP), in basic periodontal therapy. The type and dose of local anesthetics scheduled, use of epinephrine and surgical time are added. Invasive dental procedures including extraction are performed without withdrawal of antiplatelet agents and anticoagulants when possible.

4 Examination, diagnosis and therapeutic strategy for periodontal disease

1. Periodontal examination

The objectives of this examination are to find the progression stage and causes of periodontal disease and obtain information to make a correct diagnosis and plan an appropriate therapeutic strategy. It is important to conduct tests systematically for patients, analyze the results, and plan or revise the therapeutic strategy based on these results. Tests are also necessary to assess the conditions of periodontal tissues in SPT and maintenance. Test results are always described in medical records to facilitate planning of the therapeutic strategy and compare with reassessed results.

1) Periodontal examination

A periodontal tissue examination includes the following items.

(1) Gingival inflammation

Gingival inflammation is assessed with the gingival index (GI)[1] and bleeding on probing (BOP)[2,3].

(2) Probing depth

The standard method is to measure one tooth at 6 measurement points (6-point method), with the measurement points increased or decreased as required.

(3) Attachment level (AL)

The attachment level is the distance from the unchanged baseline such as the enamel cement junction to the pocket base and is measured using a pocket probe as an indicator to examine the status of progression and improvement in periodontal disease. The standard method is to use the 6-point method, with the measurement points increased or decreased as required.

(4) Oral hygiene conditions (O'Leary plaque control record)

Bacterial plaque-accumulating conditions are recorded and assessed using plaque charts. A tooth is divided into four regions, mesial, distal, labiobuccal and lingopalatal sides, and it is determined whether bacterial plaque is present in the tooth cervix of each side[4].

(5) Tooth mobility

Tooth mobility is measured using the Miller's classification of tooth mobility: Grade 0 (physiological mobility $\leq$0.2 mm), Grade 1 (slight: labiolingual 0.2-1 mm), Grade 2 (moderate: labiolingual/mesiodistal 1-2 mm), and Grade 3 (severe: labiolingual/mesiodistal $\geq$2 mm or vertically movement).

(6) Radiograph

Digital dental radiography or panoramic radiography is normally used and a combination of these radiographies is also used, as required. The number of radiographs is variable. Cone-beam computed tomography (CBCT) widely used in recent years provides a three-dimensional structure of periodontal tissues. CBCT is an excellent procedure for finding the bone defect type and relationship with periapical lesions.

(7) Occlusion

The occlusal relation in whole tooth alignment (e.g. malocclusion) and traumatic occlusion due to premature contact and cuspal interference are examined (see Page 28 "2) Diagnostic procedure for occlusal trauma").

(8) Furcation involvement

Furcation involvement in multi-(double-) rooted teeth is examined using a furcation probe and a radiographs, with progression classified into 3 grades (Lindhe and Nyman furcation classification) or 4 grades (Glickman furcation classification).

a) Lindhe and Nyman furcation classification[5)]

This is a procedure for examining horizontal attachment loss of periodontal support in furcation. Class Ⅰ: Horizontal attachment loss of periodontal support not exceeding one-third of the width of the tooth. Class Ⅱ: Horizontal attachment loss of periodontal support exceeding one-third of the width of the tooth, but not encompassing the total width of the furcation area. Class Ⅲ: Horizontal through-and-through destruction of the attachment in the furcation and buccolingual or mesiodistal penetration of the periodontal probe.

b) Glickman furcation classification[6)]

Grade Ⅰ: Lesion in furcation area, but no clinical or radiographic evidence of bone loss. Grade Ⅱ: Destruction and resorption of alveolar bone in partial furcation area, but no penetration of periodontal probe through furcation area. Grade Ⅲ: Resorption of bone beneath furcation area and buccolingual or mesiodistal penetration of periodontal probe, but furcation area covered with gingiva. Grade Ⅳ: Exposed furcation area in oral cavity and complete penetration of periodontal probe.

(9) Plaque retention factors

Factors accumulating and increasing plaques to be examined include calculus, faulty dental restoration, caries, wedge shape detect, malalignment, abnormal gingiva and alveolar mucosa, abnormal frenulum, abnormal oral vestibule, mouth breathing, dental morphological abnormality, food impaction, and periodontal pocket.

(10) Oral photograph

Oral photography provides records of correct oral status that are difficult to record in words or as a figure. Oral photography is performed at 5 points: frontal, right and left molars, and maxillary and mandibular occlusions, and 5 labiobuccal and 6 lingopalatal sides are also photographed.

(11) Study model

Malalignment, attrition and soft tissue morphological abnormalities are examined in a study model.

2) Microbiological assays

(1) Bacteria test

Subgingival plaque or saliva samples are collected to examine periodontopathic bacteria such as *P. gingivalis* and *A. actinomycetemcomitans*. Polymerase chain reaction (PCR) analysis and PCR invader are used in bacteria tests. The procedure for determining enzymes, a chair-side test, does not identify bacterial species, but is used as a convenient method. Bacteria test kits using monoclonal antibody for *P. gingivalis* are also under development.

(2) Serum bactericidal antibody titer test

An enzyme-linked immuno sorbent assay (ELISA) is used to determine antibodies in serum produced against periodontopathic bacteria and shows sensitivity to bacteria. Increased serum antibody titers against these bacteria show the history of bacterial infection or infection on testing[7)].

3) Other examinations

(1) Gingival crevicular fluid (GCF) test (fluid from periodontal pockets)

Periodontal disease activity at sampling sites is examined by testing the fluid volume or free hemoglobin, aspartate aminotransferase (AST), elastase, bacteria-derived enzymes, and cytokines, etc.

(2) Saliva test

Periodontal disease activity in the whole oral cavity is examined by testing salivary occult blood, free hemoglobin, lactate dehydrogenase (LDH), AST, and alkaline phosphatase (ALP), etc.

(3) Blood test

If a patient with aggressive periodontitis is suspected to have leukocyte dysfunction, blood tests including blood cell morphology and blood biochemistry are conducted.

4) Psychological, social and behavioral assessment

In addition to surgeon-driven examination of the above-mentioned biomedical parameters, patient-centered psychological, social and behavioral assessments are introduced to evaluate periodontal therapy. For example, oral-related QOL scales are used[8,9].

2. Diagnosis of periodontal disease

1) Diagnostic procedure for plaque-induced gingivitis and periodontitis

Plaque-induced gingivitis and periodontitis are diagnosed using the classification of periodontal disease (see Page 10). First, the cause of periodontal disease is roughly identified: [1] bacterial plaque, [2] traumatic occlusion, [3] systemic factors, and [4] lifestyle. Next, each tooth unit is diagnosed with plaque-induced gingivitis or periodontitis. Based on these diagnoses, a patient is identified to have plaque-induced gingivitis or periodontitis. A patient with periodontitis is diagnosed with slowly progressive chronic periodontitis, rapidly progressive aggressive periodontitis, or periodontitis associated with a genetic disorder (Figure 4). The disease is also identified as localized or generalized, and mild, moderate or severe.

(1) Diagnosis by tooth unit (Figure 3)

Gingival inflammation without and with attachment loss is diagnosed as plaque-induced gingivitis and periodontitis, respectively. The degree of tissue destruction and inflammation is also considered in diagnosis.

a) Periodontitis classification by degree of tissue destruction

* Mild periodontitis has bone resorption (bone level: BL) or attachment loss (AL) of <30% of the root length and no furcation involvement.
* Moderate periodontitis has BL or AL of 30-50% and furcation involvement.
* Severe periodontitis has BL or AL of ≥50% and Class Ⅱ or Ⅲ furcation involvement.

b) Periodontitis classification by inflammation severity

* Mild, moderate and severe periodontitis have probing depths of <4 mm, 4 to <6, and ≥6 mm. respectively.

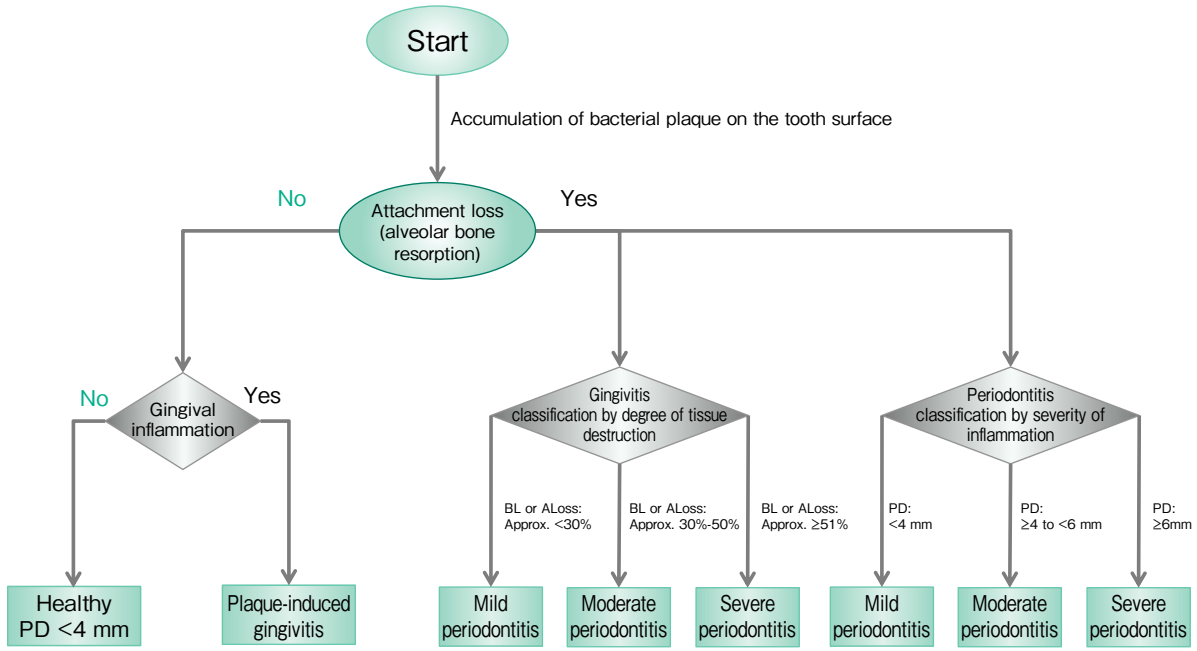

Figure 3. Diagnosis of plaque, induced gingivitis and periodontitis by tooth level
PD: probing depth; BL: alveolar bone resorption; AL: attachment loss

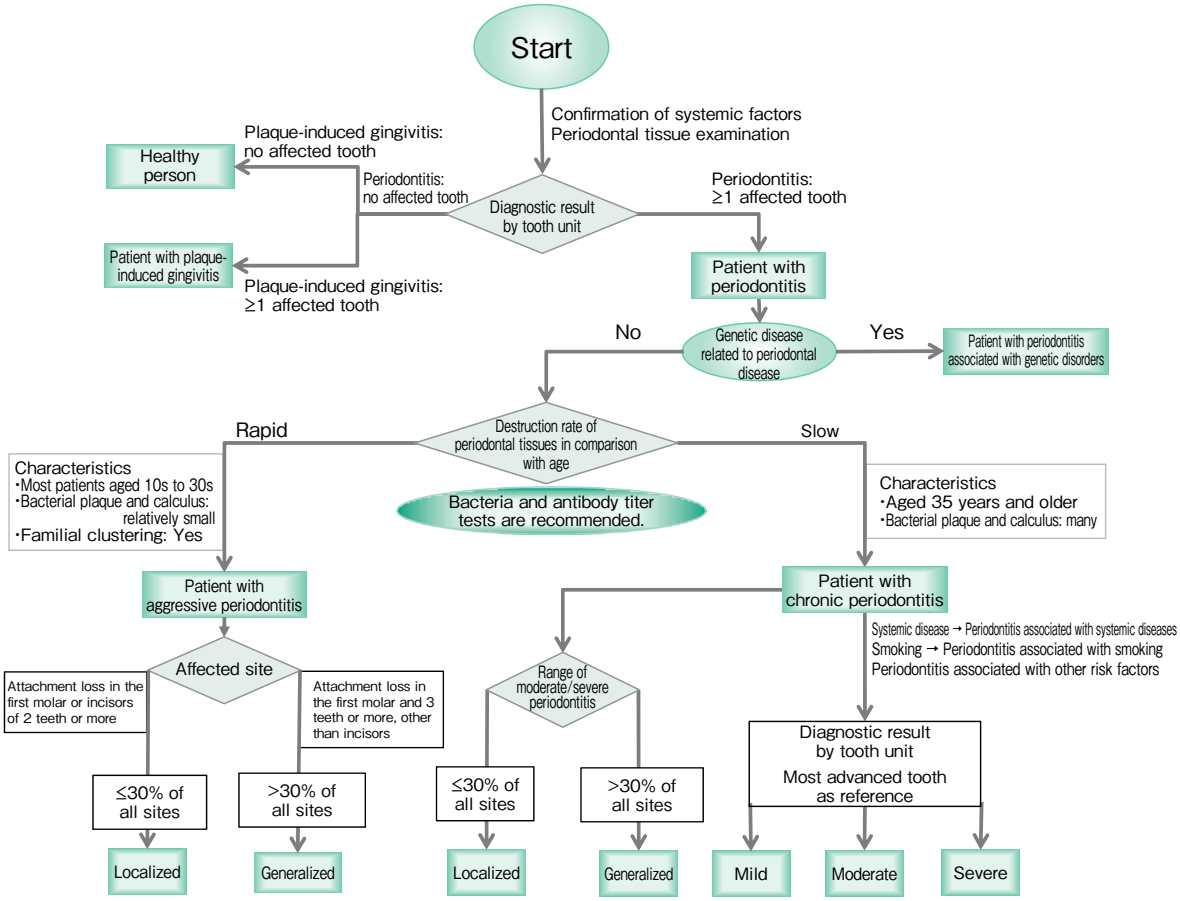

Figure 4. Diagnosis of plaque-induced gingivitis and periodontitis at individual levels

c) Diagnosis of periodontitis by tooth unit

The diagnostic classification is based on the degree of tissue destruction and inflammation severity.

(2) Diagnosis at individual levels (Figure 4)

a) Diagnosis by disease type

* A patient with teeth with plaque-induced gingivitis and periodontitis is diagnosed with periodontitis.
* The effect on periodontal disease is estimated by confirming systemic disease, familial onset, smoking and stress.
* A patient in whom destruction of periodontal tissues is slower than that in the same age group is diagnosed with chronic periodontitis and those who with a more rapid rate are diagnosed with aggressive periodontitis.

b) Progression of periodontitis

* A patient who has mild, moderate and severe periodontitis is diagnosed with severe periodontitis, which may be described as "generally moderate and partially severe".
* In diagnosis of chronic periodontitis by tooth unit, classifications of localized and generalized periodontitis are used if the number of teeth diagnosed with moderate and severe periodontitis is ≤30% and >30%, respectively.
* Similarly, in diagnosis of aggressive periodontitis, classifications of localized and generalized periodontitis are used if the number of affected teeth is ≤30% and >30%, respectively. On the other hand, the AAP Consensus Report[10] indicates that a patient with attachment loss in the first molar or 2 incisors or more (at least one tooth is the first molar) has localized periodontitis and a patient with attachment loss in at least 3 teeth other than the first molar and incisors is has generalized periodontitis. It is important to classify patients with consideration of these definitions.

c) Periodontitis severity of the whole oral cavity

* Periodontitis severity by individual is estimated based on progression by tooth unit and the number of affected teeth because the severity is identified by diagnosis by oral cavity unit.

2) Diagnostic procedure for occlusal trauma

Occlusal trauma is injury in the deep periodontal tissues (cementum, periodontal ligament and alveolar bone) and is classified into primary occlusal trauma caused by excessive occlusal force to healthy periodontal tissues and secondary occlusal trauma caused by decreased supporting alveolar bone due to periodontal-induced periodontal destruction. Occlusal trauma is a diagnostic term used for each tooth unit. A tooth with occlusal trauma of tooth mobility Grade 1 or higher and enhanced cavity of the periodontal ligament and bone resorption on intraoral X-ray is diagnosed with occlusal trauma. Other findings include [1] excessive attrition, [2] pathological tooth migration, [3] tooth fracture, [4] lamina dura defect and hyperplasia, and [5] root resorption on X-ray.

3. Therapeutic strategy planning (see Figure 2)

The therapeutic strategy uses the best approach for the required treatment and outcomes based on diagnostic results, combined with the patient's chief complaint and the periodontist's technical capability. After planning this strategy, it is necessary to give clear and detailed explanation to the patient, including disease and treatment details. The therapeutic strategy depends on the severity of periodontal disease. The basic periodontal therapy approach is shown below.

1) Basic periodontal therapy (cause elimination)

Basic periodontal therapy consists of plaque control, scaling, root planing, elimination of plaque retention factors, occlusal adjustment, and temporary splint. This is cause-related therapy and is performed in all patients with periodontal disease.

2) Reassessment after basic periodontal therapy

Reassessment uses the same items as the first periodontal examination, in principle. Comparison of the results of these examinations provides feedback to the patient and an understanding of the correct pathology, and helps to judge the outcomes and revise the therapeutic strategy. In particularly, it is important to examine gingival inflammation, probing depth, oral hygiene conditions, tooth mobility, and furcation involvement. These results may show that basic periodontal therapy cannot cure the periodontal disease, and the next steps of periodontal surgery and procedures for furcation involvements can be planned as a revised therapeutic strategy, with informed consent from the patient after an explanation. For periodontal surgery, maintenance of at least 20% of O'Leary plaque control record, no inflammation including gingival redness, and no smoking are recommended.

3) Periodontal surgery

If active periodontal pocket(s) $\geq$4 mm remain after basic periodontal therapy or periodontal tissues destructed by periodontal disease are to be regenerated, periodontal surgery is considered. This surgery is roughly classified into tissue attachment therapy, resective therapy, tissue regenerative therapy, and periodontal plastic surgery. If tissue regeneration is needed, tissue regenerative therapy is considered, whereas gingival recession and oral vestibule are treated by periodontal plastic surgery.

4) Reassessment after periodontal surgery

After periodontal surgery, necessary examinations are conducted again to assess healing status. It takes about 4 weeks (depending on surgical type) for wound healing and an examination about 4 weeks after surgery is recom-

mended. If occlusal function needs to be restored earlier, partial reassessment of operative sites is conducted about 4 weeks after surgery. The items in partial reassessment are gingival inflammation, probing depth, attachment level and furcation involvement. If the therapeutic effect after reassessment is insufficient, the causes are analyzed and repeated basic periodontal therapy and periodontal surgery are considered.

5) Oral rehabilitation

Restorative and prosthetic therapy is required to restore oral functions (e.g., occlusion, mastication, dental esthetics, articulation function) after basic periodontal therapy and periodontal surgery. Decreased periodontal supporting tissues requires fixation. The main devices (crown, bridge, denture and implant) are designed to avoid development of occlusal trauma or bacterial plaque. Orthodontic treatment improves malalignment, plaque retention factors and traumatic occlusion, increases the effect of periodontal therapy, and restores esthetic outcomes.

6) Reassessment before SPT

SPT is performed in the same contents as in the first periodontal examination, in principle. Based on these results, the need for repeated basic periodontal therapy and periodontal surgery is determined. If this is not necessary, a patient is assessed to be in a stable condition or cured and transferred to SPT or maintenance therapy.

7) Supportive periodontal therapy (SPT)

In a case in which basic periodontal therapy, periodontal surgery and oral rehabilitation are complete, and most periodontal tissues are cured, but periodontal pockets in the progression-resting stage remain, SPT is performed for long-term stabilization of the disease stage of periodontal tissues. The main therapy includes plaque control, scaling, root planing and occlusal adjustment to eliminate causal factors, and instructions on oral hygiene and remotivation are added.

8) Maintenance

Periodontal disease is likely to recur and routine maintenance, including plaque control, scaling, root planing and occlusal adjustment, is necessary, even in cured patients. Maintenance consists of self care (home care) by patients to maintain clinically restored healthy periodontal tissues, motivation to encourage patients to undergo therapy, and professional care by dental specialists.

5 Home care, perioperative patients and periodontal therapy

1. Home care and periodontal therapy

Most immobile patients at home who cannot visit a dental clinic or hospital have functional impairment and heart disease and lower hemiparesis, including cerebral infarction sequelae. Long-term immobile status causes joint contracture, muscular atrophy and dementia, resulting in reduced mental and physical performance. Therefore, it is important for patients with mastication function to perform oral care to maintain oral health and QOL including mental activity. Patients with swallowing hypofunction require oral care, including feeding and swallowing training, to prevent aspiration pneumonia, and instructions to caregivers are also necessary[1]. Since these home care patients have difficulty undergoing radiography, interview and inspection play a role in planning of a therapeutic strategy. Periodontal tissue examination includes inspection of gingival inflammation and soft tissues, tooth mobility and periodontal pocket depth, if possible. In all cases, dentists are required to coordinate with physicians, nurses, dental hygienists, care workers and caregivers for improvement of the oral environment[2]. Treatment depends on the environment at home and finger motor activity of patients.

1) Self care

In addition to self care, patients should receive oral hygiene instructions by dental hygienists, nurses, care workers and caregivers under a dentist's instructions, and control oral hygiene with scaling supragingival plaques, mouth washing with agents and oral care devices (e.g. sponge). Patients can also improve their oral environment with a temporary splint and occlusal adjustment, as required.

2) Partial support for oral care

If a clean environment is maintained, the procedures are almost consistent with those described in 1). If a clean environment cannot be maintained and patients cannot stay in a sitting position, oral hygiene control using a toothbrush, etc. is routinely performed by nurses, dental hygienists, care workers and caregivers (patient's family) under a dentist's instructions. Basic periodontal therapy is also performed, depending on circumstances. Much attention should be paid to aspiration during oral hygiene control (narrow-sense oral care).

3) Full support for oral care

Regardless of the oral hygiene environment, oral hygiene control using a toothbrush, etc. is routinely performed by nurses, dental hygienists and care workers under a dentist's instructions. Local administration of agents to periodontal pockets is also considered, as required. Oral hygiene control is instructed to daily caregivers to maintain clean oral conditions as much as possible. In this situation, much attention should be paid to aspiration during oral hygiene control (narrow-sense oral care).

2. Perioperative patients and periodontal therapy

For patients who undergo cancer therapy and major surgery, treatment of periodontal disease and chronic infectious disease reduces postoperative infection and accelerates healing. Therefore, perioperative (preoperative, intraoperative, postoperative) intraoral control is important. In addition to surgical therapy, radiotherapy and pharmacotherapy are used in cancer therapy. Intraoperative and postoperative complications are likely to occur, and dental care is required. Information sharing and cooperation between physicians and dentists are essential for cancer therapy.

1）Oral function control before surgery（treatment）

Periodontal disease with inflammatory conditions causes bacteremia, resulting in oral bacteria including periodontopathic bacteria spreading in the body. This is a risk for postoperative infection after major surgery. Before any major surgery, antibiotics combined with appropriate oral hygiene procedures are necessary for oral bacterial infection. Caries prevention requires fluoride application before radiotherapy, removal of overhang of restoration stimulating soft tissue and scaling. Cancer-related ONJ（osteomyelitis of the jaw after radiotherapy in craniocervical regions, and ONJ related with osteonecrosis and BMA administration）is a severe adverse event. It is important to perform periodontal therapy before treatment and reduce as many risk factors as possible.

2）Oral function control during and after surgery（treatment）

Oral hygiene conditions in the perioperative period of major surgery are always exacerbated. Oral hygiene control before surgery is significant and leads to reduced risks for intraoperative and postoperative aspiration pneumonia and postoperative complications after oral and pharyngoesophageal surgery. In radiotherapy for craniocervical regions, the gingiva is highly sensitive to radiation and gingival recession sometimes occurs without indication of inflammation. In chemotherapy, invasive procedures should be performed with consideration of thrombocytopenia and leukopenia induced by myelosuppression. In cancer radiotherapy and pharmacotherapy, it is important to perform continuous oral hygiene control during and after therapy and prevent oral adverse events.

3）Aspiration and infection in oral hygiene control

Perioperative oral function control（herein oral hygiene control as narrow-sense oral care）reduces risks for aspiration pneumonia and improves the postoperative course in the oral cavity and ascending regions. In contrast, patients who undergo oral care are frequently compromised hosts after invasive surgery, before and after chemotherapy or radiotherapy, or are immunosuppressed and elderly. Therefore, inappropriate procedures for oral care and hygiene control with oral care devices induce aspiration pneumonia. To prevent aspiration during oral care, it is important to assess patients in cooperation with other healthcare professionals and choose appropriate surgical procedures. Cross infection via oral care has risks for nosocomial infection. There are studies that show outbreak of nosocomial infection by multidrug-resistant strains via oral care. Cross infection can be prevented by appropriate hygiene control（cleaning disinfection, sterilization）of devices used for oral care, and introduction and appropriate use of disposable devices（particularly vacuum hoses and tips）.

6 Emergency procedures

1. Identification of cause of pain

Improvement of pain is the highest priority in patients with a chief complaint induced by periodontal disease. Local factors are acute symptom of gingival abscess and periodontal abscess and combined periodontal-endodontic lesions. Abnormal bleeding and pain not related with local factors are considered to be systemic factors. Leukemia-related gingivitis, necrotizing ulcerative gingivitis, periodontitis, aphthous stomatitis and hemorrhagic exfoliative gingivitis with lichen planus in the marginal gingiva are particularly related to systemic resistance reduction. Treatment requires cooperation with physicians.

2. Treatment of acute inflammation (see Figure 6 [3])

Patients who visit with a chief complaint of pain frequently have localized acute inflammation. A subgingival mechanical approach alone does not always have a sufficient effect on acute inflammation. Antibiotic use is effective for suppressing inflammation and facilitating periodontitis healing. In an acute symptom of gingival abscess and periodontal abscess, occlusal conditions are confirmed and occlusion is adjusted as required. Furthermore, periodontal pockets, which are possible causes, are thoroughly irrigated and an abscess with marked fluctuation is incised. A local drug delivery system (LDDS) using depots can be combined with subgingival pocket irrigation[1]. A LDDS is convenient due to its prompt effect and easy-to-use procedures (see Japanese Society of Periodontology : Guidelines for antibiotic therapy in patients with periodontal disease). If an abscess moves in a combined periodontal-endodontic lesion, the abscess is incised to make drainage roots. Antibiotics are administered as required and the priority is early endodontic therapy. Early non-chronic combined periodontal-endodontic lesions are likely to improve, while prolonged combined periodontal-endodontic lesions with remaining periodontal pockets are treated by subgingival SRP. Patients with marked tooth movement are treated with a temporary splint.

7 Preventive treatment

1. Prevention of transition from plaque-induced gingivitis to periodontitis

The 2011 dental disease survey showed that the number of 15- to 25-year-old patients with periodontal pockets ≥4 mm has rapidly increased[1)]. Since plaque-induced gingivitis transfers to periodontitis in these patients, appropriate preventive procedures for periodontal disease inhibits transfer from gingivitis to periodontitis. Appropriate preventive procedures for periodontal disease in people aged 15-25 years are expected to decrease patients with periodontal disease because more than 80% of people aged 40 years or older have periodontal disease. Periodontal disease is bacterial infection; therefore, both self and professional care are important. Furthermore, it is life style disease and community care for local groups, students and personnel is also important. Preventive procedures during this period include periodontal tissue examination, oral hygiene instruction, mechanical tooth cleaning and scaling. Prevention of periodontal disease is closely related to treatment; therefore, routine primary and secondary prevention is necessary to prevent progression to periodontitis.

2. Preventive treatment for pregnant women 〔see Page 48 "2) Periodontal therapy for pregnant women"〕

Pregnant women are likely to have poor oral hygiene control due to the changed oral environment caused by hormone imbalance and hyperemesis gravidarum, resulting in pregnancy-associated gingivitis and onset or deterioration of periodontitis. A study indicated the possibility that chronic inflammatory conditions in the oral cavity release various chemical mediators in blood, leading to increased preterm delivery and preterm low weight birth. At present, municipalities conduct dental examinations alone for pregnant women. Early detection and treatment is important, but preventive treatments are more important. Routine preventive procedures for pregnant women include periodontal examination, oral hygiene instructions, mechanical tooth cleaning, scaling, scaling-root planing and occlusal adjustment, and health guidance. Active preventive treatments are also recommended for women planning pregnancy.

8 Basic periodontal therapy

1. Concepts of basic periodontal therapy (Figure 5)

Basic periodontal therapy is treatment to eliminate basic etiological and risk factors for periodontal disease, improve inflammation in periodontal tissues, and enhance the effect of periodontal therapy, leading to successful therapy. Therefore, etiological and risk factors for periodontal disease require clarification, and systemic problems and patient background and lifestyle should be considered. A medical interview and cooperation with physicians are important and medical test data should be fully understood. Based on these results, pathology including sensitivity is considered and a therapeutic strategy is planned. Sensitivity to periodontal disease affects the progression rate of long-term periodontal therapy, and understanding systemic conditions is important to predict reactivity to periodontal therapy and the influence of periodontal disease on the whole body.

2. Therapeutic strategy for basic periodontal therapy

1) Therapeutic strategy and process of basic periodontal therapy

It is important to plan a comprehensive therapeutic strategy based on patient background and systemic conditions. The severity of etiological and risk factors should be identified and the major items in basic periodontal therapy determined. Generally, destruction of periodontal tissues and plaque control conditions are the focus; consequently, brushing instructions and SRP take priority. However, the effect of basic periodontal therapy increases according to the above-mentioned flow.

2) Therapeutic strategy focusing on bacterial infection and inflammation

Detailed treatment contents (Figure 6) include [1] bacterial plaque-accumulating conditions; [2] plaque retention factors; [3] acute inflammation and probing depth; and [4] periodontopathic bacteria tests and antibody titer tests.

3. Treatment of bacterial infection

1) Plaque control is a high priority in all therapies

The major causes of plaque-induced gingivitis and periodontitis are supragingival and subgingival bacterial

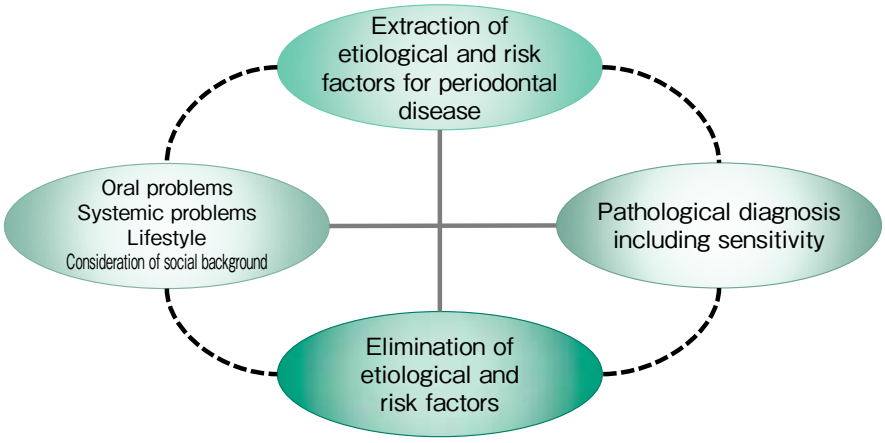

Figure 5. Concept of basic periodontal therapy

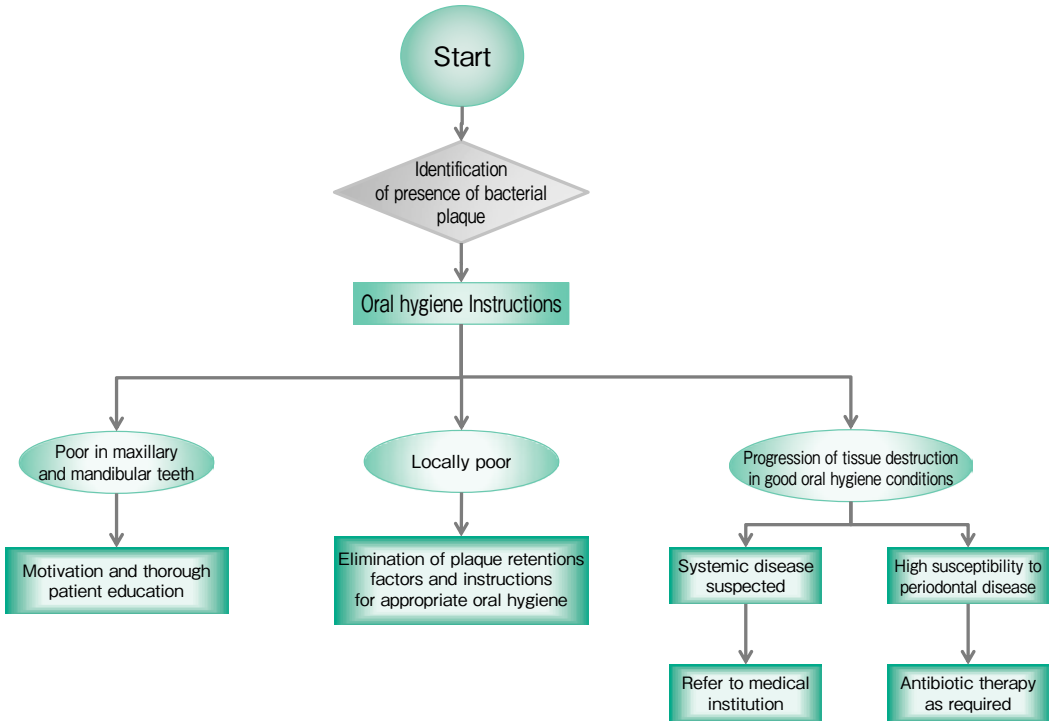

Figure 6 [1]. Basic therapy according to the level of plaque control

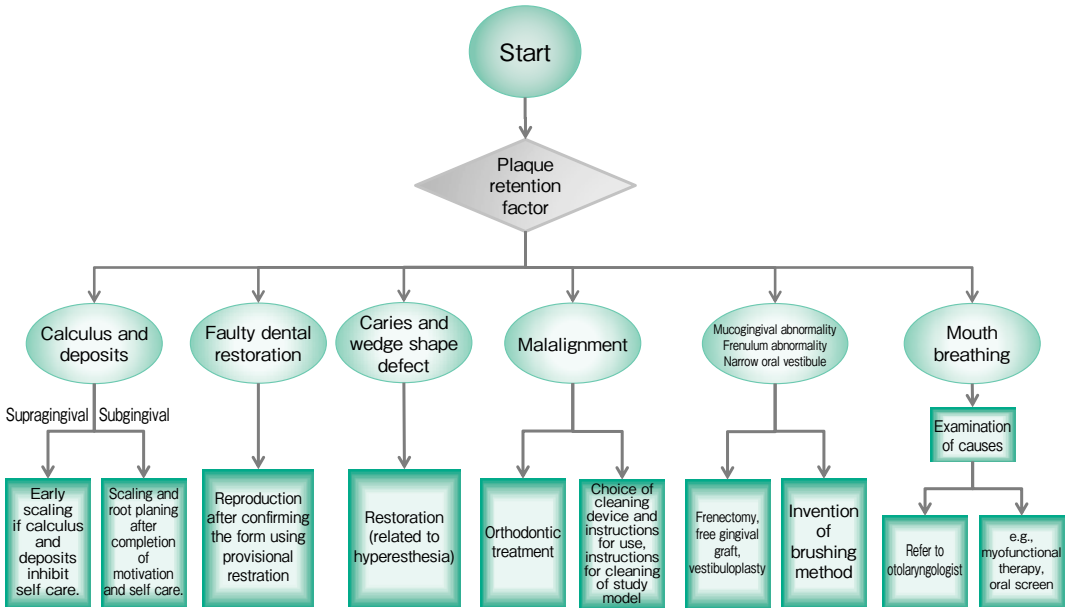

Figure 6 [2]. Basic therapy for plaque retention factors

plaques[1]. Elimination of bacterial plaques, the main causes of plaque-induced gingivitis and periodontitis, is the basis of treatment and prevention of periodontal disease. Insufficient plaque control in periodontal therapy substantially decreases effects of dental therapy, including SRP, temporary splint and periodontal surgery, resulting in failure of periodontal therapy itself.

Specifically, good plaque control is useful for healing after periodontal surgery and prevention of tissue inflammation[2], and desirable clinical results are obtained in tissue regenerative therapy[3]. Furthermore, self care of oral hygiene control (not including routine control) does not frequently include cause-related therapy, which is not an effective periodontal therapy system[4,5].

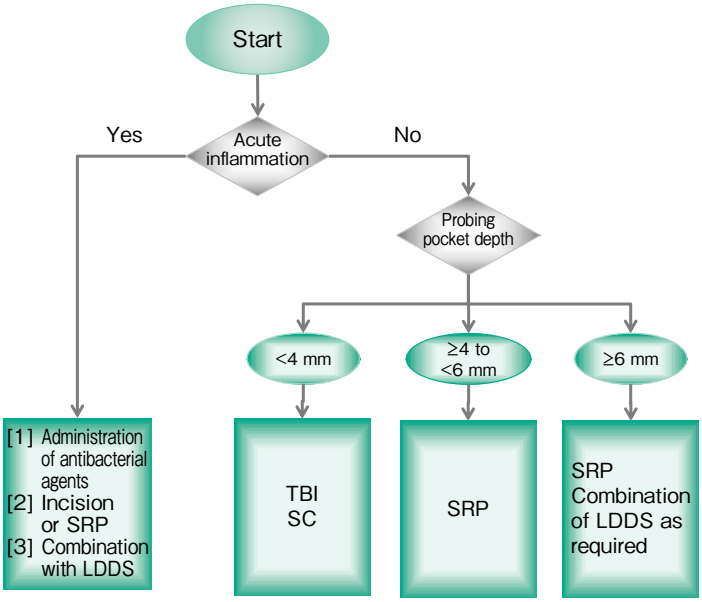

Figure 6[3]. Basic periodontal therapy for acute inflammation and probing pocket depth
(LDDS: local drug delivery system, TBI: tooth brushing instruction, SC: scaling; SRP: scaling-root planing)

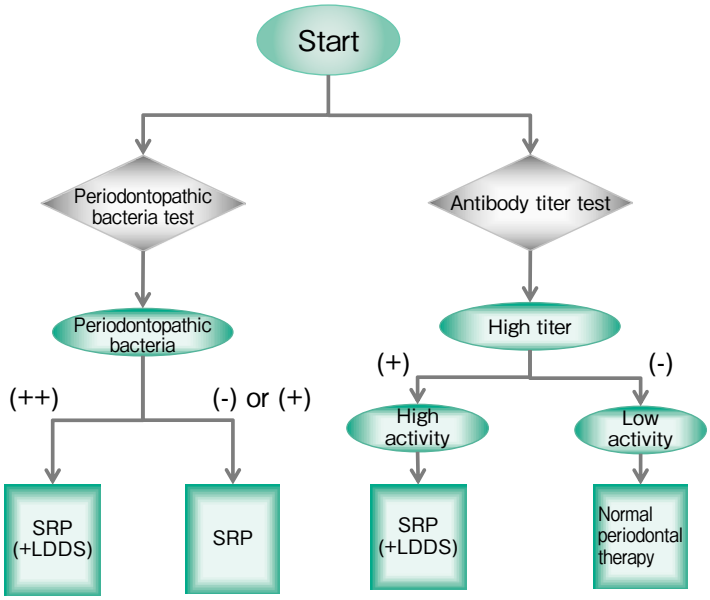

Figure 6[4]. Basic periodontal therapy using a periodontopathic bacteria test and antibody titer test
(SRP: scaling and root planing; LDDS: local drug delivery system)

Periodontal therapy maintains good oral hygiene conditions and inhibits progression of periodontitis[6,7]. Therefore, periodontal therapy depends on plaque control and instructions are given throughout periodontal therapy (from the beginning to SPT). Plaque control is successfully completed by cooperation among dental staff and patients. Plaque control is roughly classified into self care by patients and professional care by dental specialists. Bacterial plaque is likely to adhere in the current dietary environment; therefore, health guidance including improvement in dietary habit is needed. If a patient has difficult sites for elimination of bacterial plaque (e.g., inside a periodontal pocket) or cannot eliminate plaque, dental staff take the initiative to eliminate supragingival and subgingival bacterial plaques. If plaque retention factors including supragingival and subgingival calculus and faulty dental restoration are found, they should be improved.

(1) Motivation

Motivation is essential to make patients complete plaque control and perform periodontal therapy successfully. Therefore, credibility with patients is necessary to promote understanding of the importance of oral health and the effect of periodontal disease on the whole body. It is necessary for patients to understand that plaque removal is indispensable for recovery and maintenance of oral health. Specifically, it is important to inform patients of their oral conditions (pathology) based on the results of periodontal tissue examination, bacteria tests and others, explain the relationship between bacterial plaque and periodontal disease, and show them that bacterial plaque is a microorganism using a phase-contrast microscope. In addition, patients should be shown the effect of plaque control on changes in gingival inflammation and periodontal pockets visually. Motivation generally decreases over time; therefore, repeated motivation sessions are necessary and effective.

(2) Self-care (supragingival plaque control)

Plaque control is classified into mechanical and chemical control. In general, basic procedures are mechanical plaque control using cleaning devices such as a toothbrush (including interdental brush and dental floss), and a combination of mainly mechanical plaque control with chemical control is effective. Chemical plaque control is used for regions in which mechanical control cannot be used immediately after periodontal surgery, and is useful for regions in which mechanical procedures cannot be used. Instructions for improving lifestyle are given as required to decrease soft food that increases bacterial plaque and to eat self-cleaning high-fiber foods. Patient education, oral hygiene and health instructions are required to make such plaque control procedures successful. Specifically, it is necessary to make patients understand the importance of plaque control by themselves (motivation) and give them practical cleaning procedures (brushing). Self care by patients is the basis of periodontal therapy, and has a great effect on the success of this therapy and is important for maintaining stable periodontal tissues after therapy.

(3) Instructions for brushing

Instructions for brushing should be repeated, similarly to motivation, and these are combined for most patients. Toothbrushes suitable for a patient's oral conditions (e.g. dentition size, teeth alignment, gingival condition, regions difficult to clean, type and shape of defects, and dental restoration) and technical level are chosen and instructions on effective brushing are given.

Practitioners must fully understand the characteristics of various brushing methods, understand a patient's conventional brushing method and oral conditions, and give brushing instructions. An appropriate and effective cleaning instrument (interdental brush, dental floss, electric, sonic and ultrasonic toothbrush) must be recommended. Instructions are given gradually in order and changed according to the patient's motivation and technical level. Instructions should not be stereotypical, and should be patient-oriented. The effect of instructions is improved by showing and explaining changes in a plaque chart and improved gingival conditions to patients. For patients with periodontal disease, oral hygiene control using a cleaning instrument including a interdental brush and dental floss are effective; therefore, it is important to give instructions for appropriate use[8].

(4) Professional care (supragingival and subgingival plaque control)

Self care is most important, but when patients have regions with insufficient oral hygiene control due to oral conditions and technical brushing problems, practioners eliminate bacterial plaque from the tooth surface and prostheses and simultaneously remotivate and reinstruct for oral hygiene control at the patient's visit[9]. Professional care is referred to as professional tooth cleaning (PTC) or professional mechanical tooth cleaning (PMTC).

2) Scaling-root planing

Scaling-root planing are extremely important procedures, in addition to plaque control, for periodontal therapy, and are performed during basic periodontal therapy and periodontal surgery and SPT. Scaling mechanically eliminates supragingival and subgingival bacterial plaque adhered to teeth, calculus and other prostheses using various scalers. Calculus is calcified bacterial plaque. It has a crude surface on which many bacterial plaques accumulate.

Therefore, calculus is the most important local plaque retention factor. The objectives of scaling are to eliminate factors attached to bacterial plaques and build an environment in which bacterial plaque is easily eliminated by practitioners and patients. Root planing eliminates pathologic tooth substances (mainly cementum) including bacteria on root surfaces and other metabolites using various scalers, produces lubricant tooth roots without biological hazard, and enhances attachment between the gingiva and roots. Scaling-root planing is performed in series as SRP.

(1) Significance and objective of scaling-root planing (SRP)

SRP decreases bacteria and their metabolites. Subgingival SRP using a curette type scaler is performed for the tooth surface facing periodontal pockets. The deeper the periodontal pocket, the more complicated the process, requiring appropriate techniques, time and effort. Root planing is unnecessary for gingival lesions because lesions do not affect the tooth root.

(2) Precautions for SRP

Before starting SRP, bacterial plaque attached to teeth and suspended in periodontal pockets should be eliminated. Although less than preparation for periodontal surgery, infection control including thorough sterilization and disinfection of instruments is necessary considering systemic pain and past history because SRP involves invasive procedures. Patients with systemic disease are given antibiotics and antiinflammatory agents, as required by bacteremia. After SRP, debridement* including calculus and residual contaminants are cleaned out. There are studies concluding that excessive cementum elimination is not desirable for periodontal therapy[10-12].

(3) Importance of sharpening

Use of the blunt edge of a hand scaler is difficult for effective SRP. Such scalers make it difficult to eliminate calculus sufficiently and also cause operator fatigue, resulting in poor efficiency. Therefore, sharpening (grinding) of the hand scaler is important for successful SRP.

(4) Sonic and ultrasonic scalers

Bacterial plaque, calculus and other deposits can be mechanically eliminated using sonic and ultrasonic scalers. These scalers are effective for elimination of supragingival calculus, and recently improved scaler tips are also available for subgingival scaling, with high elimination effects for certain regions[13]. Studies have shown clinical effects similar to those of hand scalers[14,15].

(5) Dentin hypersensitivity after SRP

Elimination of calculus, deposits and infected tooth substances sometimes cause transient hypersensitivity after SRP. This should be explained to patients in advance. Patients with hyperesthesia should be appropriately treated.

3) Improved plaque retention factors (see Figure 6[2])

Plaque retention factors that are improved by basic periodontal therapy include calculus, faulty dental restoration, caries, wedge shape defects, and mouth breathing. Malalignment, abnormal gingiva and alveolar mucosa, abnormality of frenulum, and narrow oral vestibule are treated after basic periodontal therapy.

4) Periodontal pocket curettage

If SRP provides no improvement, periodontal tissues can be improved and periodontal pockets shortened by eliminating bacterial plaque and calculus on roots facing periodontal pockets and cementum on the surface of contaminated roots, together with periodontal curettage of epithelia and inflammatory connective tissues in periodontal pockets containing junctional epithelia in the inner walls of periodontal pockets, using a curette type scaler.

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* Debridement: procedure for elimination of foreign stimuli and denatured tissues. In periodontal therapy, elimination of bacterial plaque, calculus, contaminated roots, and inflammatory granulation tissue.

5) Extraction of hopeless tooth

Teeth that cannot be saved are extracted in basic periodontal therapy. However, such a tooth that maintains occlusal relation or plays an important role in oral function may be extracted after teeth in other regions are treated to maintain occlusal relation and oral function. If a tooth cannot be evaluated in the initial examination, it is not extracted in basic periodontal therapy and is reassessed after completion of this therapy. In particular, teeth with acute inflammation are likely to have increased mobility as periodontal pockets become deeper. Therefore, these teeth are evaluated after elimination of acute inflammation to diagnose the condition correctly. When extraction is performed or scheduled, but teeth in other regions are treated before extraction in basic periodontal therapy, or extraction is indicated in reassessment, it is important to explain to patients and obtain informed consent, because most patients who undergo periodontal therapy desire to keep as many teeth as possible. Even for teeth that clearly require extraction dentally and medically, informed consent is required for extraction.

4. Current treatment of bacterial infection (Table 6)

1) Mechanical supragingival plaque control

The major oral hygiene control is brushing by patients using a toothbrush. Use of a cleaning instruments including an interdental brush, dental floss, and electric/sonic/ultrasonic toothbrushes is necessary considering the periodontal severity, treatment period, and patient's technique and lifestyle. Scaling and mechanical tooth cleaning by medical staff are likely to help plaque control and enhance and maintain a patient's motivation[1]. Adjustment and removal of faulty dental restoration disturbing supragingival plaque control and occlusal reshaping are performed as required. Subgingival plaque control is combined for periodontal pockets ≥4 mm. Supragingival plaque control is essential to maintain the effect of subgingival procedures[2].

2) Mechanical subgingival plaque control

SRP is standard treatment for periodontal therapy, but has less therapeutic effect on advanced furcation involvement and complicated or deep infrabony pockets. SRP also has risks of causing attachment loss in periodontal pockets <3 mm. It is more difficult to eliminate subgingival plaque and calculus as periodontal pockets become deeper[3]. Decreases of periodontal pockets with depth of 5-7 mm were 1-2 mm and attachment gain was 0.5-1

Table 6. Basic periodontal therapy chosen by diagnostic classification

Diagnostic classification	Systemic control* (liaison with physicians)	Mechanical plaque control		Chemical plaque control			
				Supragingival	Subgingival		
				Application of antimicrobial and antiseptic agents		Antibiotic therapy	
		Supragingival (brushing, scaling)	Subgingival (scaling-root planing)	Mouthwash	subgingival pocket irrigation	Administration to periodontal pockets	Oral administration
Plaque-induced gingivitis	▲	●	▲	▲	▲		
Chronic periodontitis (mild)	▲	●	●	▲	▲	▲	
Chronic periodontitis (severe)	●	●	●	●	●	▲	▲
Aggressive periodontitis	●	●	●	●	●	▲	▲

●: Necessary or recommended treatment

▲: Treatment as required

* Control of systemic disease, improved psychosocial stress, dietary modification, instruction for smoking cessation

Table 7. Major drugs used for chemical plaque control

Antibiotics	Product type	Concentrations of antibiotics used in Europe and the United States	Inhibitory effect of the drug at this concentration on plaque	Inhibitory effect of the drug at this concentration in periodontitis	Upper limit of the concentration in the Japan pharmaceutical affairs guidelines (as a quasi drug)	Reference	
						Presentation type/ analysis method/ selected RCTs (study period)	Reference
Chlorhexidine gluconate	Mouth-wash	0.12～0.20%	−0.67 in QHI	−0.32 in GI	0.05%	systematic review Meta-analysis 30 RCTs (≥4W)	J Clin Periodontol, 39: 1042-1055, 2012.
Essential oil	Mouth-wash	0.063% Thymol 0.091% Eucalyptol 0.042% Menthol 0.055% Methyl salicylate	−0.83 in QHI	−0.32 in GI	1% Menthol 0.1% Methyl salicylate No other criteria	systematic review Meta-analysis 7 RCTs (≥6W)	J Periodontol, 78: 1218-1228, 2007.
Triclosan/ copolymer	Denti-frice	0.3%／2%	−0.48 in QHI	−0.26 in GI	0.1%／NL	systematic review Meta-analysis 15 RCTs (≥6W)	J Clin Periodontol, 31: 1029-1033, 2004.
Triclosan/ Zinc citrate	Denti-frice	0.2～0.3%／ 0.5～1.0%	+6～ −37% in QHI	+4～ −52% in GI	0.1%／NL	systematic review 6 RCTs (≥6W)	Periodontol 2000, 48: 23-30, 2008.
Triclosan/Sulfuric acid pyrophosphate	Denti-frice	0.28～0.3%／ 5.0%	+2.5～ −14%	+4～ −24%	0.1%／NL	systematic review 5 RCTs (≥6W)	Periodontol 2000, 48: 23-30, 2008.
Cetylpyridinium chloride	Mouth-wash/ Denti-frice	0.05～0.1%	−0.42 in QHI	−0.15 in GI	0.01%	systematic review Meta-analysis 4 RCTs (≥6W)	Int J Dent Hyg, 6: 290-303, 2008.
Tin fluoride	Denti-frice	0.45%	−3～ −33%	+1～ −40%	NL	systematic review 10 RCTs (≥6W)	Int J Dent Hyg, 3: 162-78, 2005.
Amine fluoride/ Tin fluoride	Denti-frice	1,400 PPMF-／ 250 PPMF-	−3.5～ −11.8%	−4.3～ 29.9%	1,000 PPMF-	systematic review 4 RCTs (≥6W)	Int J Dent Hyg, 3: 162-78, 2005.
Sanguinarine	Mouth-wash	0.01%	+4～ −33.9%	+5～ −33.8%	NL	systematic review 6 RCTs (≥6W)	Int J Dent Hyg, 3: 162-78, 2005.
Delmopinol	Mouth-wash	0.1～0.2%	−9.3～ −35%	+1～ −18%	NL	systematic review 3 RCTs (≥6W)	Int J Dent Hyg, 3: 162-78, 2005.

RCT: randomized controlled trial; QHI: Quigley & Hein Plaque Index, GI: Gingival Index; NL: not listed in the quasi drug additives list PFSB/ELD 0327004, March 27, 2008. Cited from reference 5]

$mm^{2)}$.

3) Chemical supragingival plaque control

After mechanical plaque control, chemical plaque control is performed using a mouthwash. Effective mouthwashes includes low-concentration chlorhexidine solution, which inhibits bacterial plaque formation and deposition on the tooth surface. Phenols, povidone-iodine, cetylpyridinium chloride, and essential oils are also used[4]. In basic periodontal therapy, continuous use for 2-4 weeks after scaling prevents regrowth of periodontopathic bacteria (Table 7)[5].

4) Chemical subgingival plaque control

Precautions for chemical subgingival plaque control are [1] complete supragingival plaque control in advance, [2] give priority to mechanical plaque control, and [3] understand that chemical plaque control is not needed in most cases of chronic periodontitis and in regions with a good response to SRP.

(1) Subgingival pocket irrigation

The inside of a periodontal pocket is irrigated with drug solution using a syringe. Drugs available for subgingival pocket irrigation are povidone-iodine, benzethonium chloride, oxydol and acrinol. A combination of these drugs with SRP has clinical effects, whereas the effect of subgingival pocket irrigation alone is limited.

(2) Administration of antibacterial agents into periodontal pockets

Drugs for periodontal pockets include sustained-release tetracycline antibiotic ointment[6-8], which is used for local drug delivery. The indications and usage are once per 1-2 weeks, continuously 3-4 times for [1] periodontal abscess (acute symptom of periodontitis), [2] immunocompromised patients with periodontitis (including diabetes), [3] combination with SRP for moderate or severe periodontitis and [4] periodontal pockets not improved after basic periodontal therapy. However, irresponsible administration may induce microbial substitution and drug resistance, and there is no validation of repeated administration of antibiotics in SPT.

(3) Oral administration of periodontal antimicrobial therapy

Oral administration of antibiotics are considered for patients with periodontitis that is not improved by basic therapy, patients who cannot undergo invasive treatment, immunocompromised patients with periodontitis, patients with generalized aggressive periodontitis, and severe generalized chronic periodontitis. Antibacterial therapy must be performed after [1] thorough planning, [2] clarified objectives, [3] reconfirmation of adverse reactions, and [4] a bacteria test[9,10].

5) Patient's choice of antibiotic therapy

Antibacterial therapy (intrapocket application and oral administration) may be indicated for the following patients.

[1] Patients with drug-resistant/refractory periodontitis that was not clinically improved by mechanical plaque control

[2] Patients with severe generalized chronic periodontitis or generalized aggressive periodontitis

[3] Immunocompromised patients with diabetes, etc.

[4] Patients with moderate/severe periodontitis complicated with atherosclerotic disease

[5] Patients with periodontitis with a high risk for bacteremia caused by periodontal therapy (e.g. bacterial endocarditis, aortic valve disease, cyanotic congenital disease, prosthetic valve shunt).

The details of antibacterial therapy for patients with periodontal disease are described in the JSP 2010 "Guidelines for antibiotic therapy in patients with periodontal disease".

5. Treatment of occlusal trauma

Occlusal trauma is injury in periodontal tissues caused by traumatic occlusion and is classified into primary and secondary occlusal trauma (see Page 15 "5. Characteristics of occlusal trauma"). Occlusal trauma is associated with degenerative necrosis in the pressed region of periodontal ligament and alveolar bone resorption (see Table 8). Before treatment, occlusal trauma should be accurately diagnosed (see Page 28 "2) Diagnostic procedure for occlusal trauma") and the need of procedures for occlusal trauma confirmed. Therapy for occlusal trauma is performed to eliminate vertical and horizontal traumatic occlusion[1] and establish stable occlusion. The treatment reduces injury in periodontal tissues aggravated by traumatic occlusion and recovers reduced periodontal tissues due to periodontitis. Findings of occlusal trauma are shown in Table 8: "tooth mobility" and "enhanced periodontal ligament space" are important[2].

1) Relationship of occlusal trauma with progression of periodontitis

Traumatic occlusion is not an initial factor for periodontitis, but an important modifier in progression of periodontitis[3]. Treatment for occlusal trauma eliminates traumatic occlusion, establishes stable occlusion, and reduces damage in periodontal tissues aggravated by traumatic occlusion. Occlusal adjustment and splint are performed for marked symptoms and manifestations of occlusal trauma found after completion of procedures for bacterial infection. The specific procedures are below.

[1] Basic periodontal therapy for bacterial infection. If functional impairment is found, occlusal adjustment may

Table 8. Clinical and radiographic findings of occlusal trauma (revised 1999 AAP New Periodontal Disease Classification)

One or more clinical findings are included.
1) Increased tooth mobility
2) Premature contact
3) Marked attrition
4) Deep periodontal pocket formation
5) Pathological tooth migration
6) Abfraction (wedge shape detect)
7) Tooth fracture

One or more radiographic findings are included.
1) Widened PDL space
2) Changed alveolar bone (loss, hyperplasia)
3) Bone loss (furcation, vertical, circumferential)
4) Root resorption
5) Cementum hyperplasia

be a priority.

[2] Occlusal adjustment or splint when basic periodontal therapy for bacterial infection causes inflammation to disappear and reduces tooth mobility in partial regions; however, mobility remains or increases in some teeth.

[3] Occlusal adjustment and splint for teeth without improved mobility.

[4] Occlusal adjustment and splint for teeth with increasing mobility.

For a patient with severe periodontitis and no therapeutic effect on occlusal adjustment limited to one to several teeth, occlusal reshaping and temporary splint, it is necessary to plan a therapeutic strategy using temporary and permanent splints with wide-ranging periodontal therapy devices.

2) Occlusal adjustment and occlusal reshaping

Occlusal adjustment is used to reduce the load bearing of occlusal force on periodontal tissues during dental occlusion and calm inflammation in periodontal tissues by correcting traumatic occlusion. Selective grinding makes occlusal force distribute evenly in multiple teeth and transfers the tooth axis forward; consequently, more corrective tooth contact is maintained and periodontal tissues are stabilized[4], but premature contact is not necessary for all teeth with premature contact if there are no findings, including mobility. The objectives of occlusal adjustment are to improve occlusal trauma in periodontal tissues as a priority, and improve temporomandibular joint disorder and bruxism, stabilize occlusion after tooth crown restoration and orthodontic treatment, improve food impaction, and eliminate premature contact interfering with orthodontic treatment. Occlusal reshaping[5] is performed to revise the ridge and buccolingual diameter of crown or reshape crown morphology, including the cuspal angle and cusp, to eliminate and distribute traumatic occlusion caused by a poor crown shape. Occlusal reshaping is performed regardless of premature contact; however, occlusal force is reduced by reserving the contact site of the intercuspal position and grinding lateral pressure-induced regions and broad contact area. However, tooth grinding is an irreversible process; therefore, it is necessary to examine the detailed occlusal status, and give patients a thorough explanation on the need to perform appropriate grinding after obtaining informed consent. Teeth with inflammatory periodontal tissues due to poor oral hygiene sometimes transfer, and these teeth are likely to return to the original normal site due to improved inflammation. Therefore, if inflammation is found, severe traumatic occlusion alone is adjusted and then precise occlusal adjustment is performed after inflammation disappears due to plaque control.

3) Temporary splint

Temporary splint is performed when occlusal trauma cannot be improved by occlusal adjustment alone, severe tooth mobility is detected, or periodontal tissues are destructed, resulting in secondary occlusal trauma[6]. Temporary splint is performed to distribute and stabilize occlusal pressure to periodontal tissues, improve occlusal

trauma, and prevent destructive stress with connection of the relevant teeth with surrounding teeth. Temporary splint is performed to observe changes in periodontal tissues after splinting for a certain period. If tooth mobility is severe and occlusal and masticatory dysfunction is found, temporary splint should be performed earlier to improve masticatory function. Temporary splint is generally performed when occlusion is not stabilized by improved gingival inflammation with plaque control and occlusal adjustment. If tooth mobility is temporally increased by invasion after periodontal surgery and may affect healing, temporary splint is performed before surgery and the splint is removed after periodontal tissues stabilize and movement is improved after surgery. As described above, the decision on timing, period and procedures for temporary splint should take into account the severity and range of destruction of periodontal tissues, movement on the dental arch, and teeth position.

[Precautions for temporary splint]

［1］ Perform occlusal adjustment fully before and after temporary splint.

［2］ Do not let a temporary splint device inhibit oral hygiene control.

［3］ Check plaque control conditions, premature contact and damage of the splint device because routine observation and management is necessary.

［4］ Remove temporary splint if periodontal tissues are sufficiently stabilized and consider transfer to a permanent splint if possible.

Choose a temporary splint method that is sufficiently durable for the occlusal force on the splint site.

4） Devices for periodontal therapy （provisional restoration）

For patients with a tooth defect who require extraction or elimination of a faulty dental restoration, temporary prosthetic treatment is performed to recover occlusal function and dental esthetics during periodontal therapy. These devices improve masticatory and esthetic dysfunction and reduce load bearing of the occlusal force to remaining teeth, and are referred to as devices for periodontal therapy and denture base and crown type devices[7]. If faulty dental restoration is deeply involved in the onset of periodontal disease, periodontal tissues are stabilized by eliminating the restoration and installing devices for periodontal therapy during basic periodontal therapy. In cases of masticatory dysfunction caused by a tooth defect or secondary occlusal trauma caused by decreased remaining teeth, periodontal tissues should be stabilized by installing devices for periodontal therapy during basic periodontal therapy and improving mastication and occlusion. For patients who are likely to undergo long-term periodontal therapy, it is particularly important to use devices for periodontal therapy and to install these devices in advance of periodontal surgery[8].

[Precautions for periodontal therapy devices]

［1］ Design a structure for easy control of oral hygiene, as well as improvement of occlusion and esthetics. A crown type device is preferable on the supragingival margin due to periodontal control. Prevention of overcontour of the tooth crown and maintenance of the size of the interdental embrasure are important for use of the interdental brush.

［2］ Observe periodontal tissue conditions during installation of devices for periodontal therapy, confirm regions with possible recurrence, consider appropriate forms, and incorporate these results into the final prosthesis design.

［3］ Perform routine control（adjustment and repair）of devices for periodontal therapy and oral hygiene instructions.

5） Treatment of bruxism

Bruxism is a habit of grinding upper and lower teeth, clenching or continuously tapping by masticatory muscle hypertonia, which is unrelated to normal function such as biting, swallowing and talking. Specifically, upper and lower teeth are connected without food and strong occlusal force, and lateral force is particularly applied to teeth, leading to risks for inducing occlusal trauma in periodontal tissues. If periodontitis is complicated with occlusal

trauma due to bruxism, the disease is likely to progress rapidly to severe periodontitis. Basic treatment is performed to eliminate causes of bruxism, local factors（abnormal occlusal contact including premature contact）and systemic factors（e.g., emotional stress）[9]. However, the causes and mechanism of bruxism are not fully understood and individual differences are significant; consequently, it is currently difficult to treat bruxism. First, occlusion of small ranges is adjusted by grinding the premature contact site alone, which is a cause, and an occlusal splint（occlusal base for bruxism） is installed, followed by observation. It is not recommended to adjust wide occlusion and make an irreversible process including oral rehabilitation. Treatment for sleep bruxism is bedtime autosuggestion to remind oneself not to grind the teeth; however, many factors are involved in sleep bruxism and there is no established therapy to improve sleep bruxism.

6）Orthodontic treatment

If an abnormal tooth position inhibits plaque control or occlusal trauma due to malalignment is found, the effect of periodontal therapy can be enhanced by orthodontic treatment[10]. However, this treatment may be difficult in patients with extremely advanced alveolar bone resorption, which makes it necessary to choose indications. Orthodontic treatment should be performed after gingival inflammation is improved and periodontal tissues are stable, and it is preferable to conduct treatment after eliminating periodontal pockets. If orthodontic treatment starts before periodontal therapy is sufficient, although malalignment is a cause of bacterial plaque accumulation, periodontal tissues result in destruction. Occlusal adjustment after orthodontic treatment is essential and it is important to obtain finally balanced occlusal conditions and continue to follow up. An improved dental arch by orthodontic treatment makes oral hygiene control easier and stabilizes periodontal tissues.

9 Risk factors for periodontal disease and risk control during treatment

Factors defining the onset and progression of periodontal disease and those useful for prediction are defined as risk factors. The cause of periodontal disease is bacterial plaque, and plaque control is the most important treatment. However, onset, progression and reaction to treatment are influenced by risk factors. In this chapter, risk factors are classified as systemic and environmental, and an overview of risk factor control in periodontal disease is provided. For plaque retention factors as local factor, see "Page 25. Characteristics and procedures for the elderly, ill persons, women and smokers".

1) Systemic risk factors (see Page 16 "6. Systemic conditions and periodontal disease")

Systemic risk factors include age, sex, ethnic differences, genetics, systemic disease, and individual susceptibility of periodontal disease. For patients with systemic risk factors, including systemic disease such as metabolic syndrome (diabetes, hypertension), cardiovascular disease[1] and medication, information on the effects of systemic factors on periodontal disease should be provided to allow an understanding of these factors. Instructions are given to allow patients to understand why higher level plaque control is necessary for them in comparison with people without systemic risk factors, and thorough plaque control should be performed. Following positive periodontal therapy, routine control at appropriate intervals is necessary to maintain healthy periodontal tissues.

2) Environmental risk factors

Environmental risk factors include social factors such as psychological and social stress and lifestyle factors such as dietary habit, smoking and alchol. In particular, smoking is an important risk factor for progression of periodontal disease[2], and the necessity of smoking cessation for periodontal therapy should be explained to smokers and they should be referred to a smoking cessation clinic. The effect of social stress on progression of periodontal disease is not fully understood; however, stress is strongly related to onset of necrotizing periodontal disease. Instructions are given to patients to have sufficient rest, sleep and relaxation. Some patients unconsciously develop awake bruxism due to stress. It is important to make patients understand that avoidance of bruxism prevents disruption in periodontal tissues due to occlusal trauma.

1. Periodontal therapy for the elderly

The elderly population in Japan has been increasing; however, individual differences in health are significant and health conditions depend on the quality of earlier dental therapy. Elderly people generally have decreased cardiopulmonary and immune function and restorative performance, and have significantly less secondary memory and psychological functions, in comparison with those in late middle age. Maintenance of masticatory function is extremely important for elderly people, both physically and mentally. In periodontal therapy for the elderly, it is necessary to consider the general characteristics of the elderly, mental and physical conditions, the level of finger function, and limitation of secondary memory[3]. Elderly people have less residual function to maintain homeostasis in response to physical stress[4] and are likely to develop water and electrolyte imbalance. If it is difficult to perform long-term periodontal therapy, including flap surgery, in an elderly patient, nonsurgical treatment should be repeated: mainly debridement in periodontal pockets including plaque control, SRP, periodontal pocket curettage as required, and supplemental combined chemical plaque control. Elderly people also often develop new systemic disease during maintenance and SPT; consequently, medication is changed or increased. Therefore, it is required to ask about new disease or medication at every visit. Cognitive decline may also occur. If a patient's fingers or brush-

ing actions during maintenance and SPT pose a problem for the first time, it is necessary to contact their family and provide the assistance according to cognitive function and brushing actions. More attention is given to physical, mental and environmental changes in periodontal therapy for elderly people, compared to therapy for those in late middle age.

2. Periodontal therapy for patients with other diseases

Patients with periodontal disease often also have diseases such as hypertension, cardiovascular disease, diabetes and osteoporosis.[5,6]. Many kinds of systemic diseases are closely related to periodontal disease; therefore, periodontal therapy is also important to control systemic diseases. Furthermore, these patients are frequently given many different drugs, and periodontal surgery is severely invasive in these cases, similarly to elderly patients. It is important to conduct a lengthy medical interview before the start of periodontal therapy, refer to attending physicians for symptoms, and establish appropriate medical cooperation. In elderly and diseased individuals, prevention of complications requires determination of resting blood pressure, heart rate and arterial oxygen saturation before surgery and monitoring of vital signs during therapy, even if treatment has no problems. Periodontal and dental therapy may be difficult in some patients, depending on the type and symptoms of systemic disease. In such a case, communication with advanced care facilities for systemic disease is recommended, with a request for information on risk factors for therapeutic strategies and control of systemic disease. Medical information on the effects of systemic risk factors on periodontal disease should be provided to patients. Instructions are given to allow an understanding of why higher level plaque control is necessary in comparison with people without systemic risk factors, with performance of thorough plaque control and improved recognition of the need for routine control of periodontal tissues. Patients should understand the effect of periodontal disease on the whole body（e.g. metabolic syndrome including diabetes, and hypertension, cardiovascular disease, osteoporosis）and should be given appropriate advice from the periodontal perspective[7]. Patients who particularly require monitoring are described below.

1）Metabolic syndrome

Metabolic syndrome is a combined risk syndrome in which obesity increases the risk for atherosclerotic disease. Diagnostic criteria are visceral fat accumulation and two or more of serum dyslipidemia, elevated blood pressure and hyperglycemia. In the United States, periodontal disease is a basic disease of metabolic syndrome, as well as obesity, diabetes, hypertension and hyperlipidemia. In particular, obesity and diabetes have been shown to be related to periodontal disease in many studies, and procedures for preventing periodontal disease that include lifestyle factors are required.

2）Obesity

Obese individuals are likely to have periodontal disease and the causes are considered to be related to hyperlipidemia and insulin resistance.

3）Diabetes

Periodontitis complicated with diabetes is not induced by diabetes, but by immune system disorder and peripheral circulatory disturbance due to diabetes modulating the pathology of periodontitis. See “2014 Guidelines for periodontal therapy in diabetic patients, second revision”（Japanese Society of Periodontology）.

（1）Type 1 diabetes

Avoidance of development of hypoglycemia is a concern if eating is limited by long-term treatment, including extraction and periodontal surgery.

（2）Type 2 diabetes

It is generally preferable not to perform SRP until patients achieve plaque control by themselves; however, peri-

odontopathic bacteria in periodontal pockets are related to diabetes. Therefore, debridement in these pockets should be conducted earlier than usual. For patients with generalized chronic periodontitis complicated with diabetes and those with severe diabetes-related periodontitis, combination with antibacterial therapy is recommended to reduce adverse reactions in other organs.

4) Hypertensive patients

If blood pressure is not fully controlled, the priority is stabilization of blood pressure. Before treatment, the patient's conditions are discussed with the attending physician and treatment is performed with cooperation between the physician and dentist. Local anesthetics without epinephrine are used and vital signs are monitored during periodontal surgery.

5) Patients with cardiovascular disease (particularly those taking antithrombotic agents)

A correlation between periodontal disease and onset of cardiovascular disease is found after known confounding factors are adjusted. In addition, functional improvement in vascular endothelial cells occurs after improvement of periodontal disease, which suggests that periodontal disease has an effect on the cardiovascular system. There are two hypotheses for the mechanism connecting periodontal disease with cardiovascular disease: [1] bacteria directly enhance onset and progression of cardiovascular disease; and [2] an inflammatory response evoked by periodontal disease increases C-reactive protein in blood and periodontal disease is indirectly related to onset of cardiovascular disease[7]. Antithrombotic agents (antiplatelet drugs, anticoagulants) affect cardiovascular disease and various underlying diseases, such as prevention of complications of diabetes. Periodontal therapy in a patient treated with antithrombotic agents should be performed after discussing underlying disease and current systemic conditions to an attending physician and understanding these conditions. Invasive dental procedures, including extraction, are commonly performed without withdrawal of antithrombotic agents when possible. To perform such invasive procedures, it is important to pay attention to hemostasis and drug administration after completion of procedures. For administration of antibiotics, see the "Guidelines for antibiotic therapy in patients with periodontal disease" (Japanese Society of Periodontology)

6) Dialysis

Some antibiotics affect excretion rates from the body and consultation with an attending physician is necessary to choose appropriate antibiotics for periodontal therapy. Since anticoagulants are often administered on dialysis day, invasive periodontal therapy should not be performed.

7) Respiratory disease

Oral bacteria, including periodontopathic bacteria, pass through the trachea and invade the lung with the saliva, resulting in aspiration pneumonia.

3. Female-specific periodontal disease

1) General precautions

Female hormones including estrogen and progesterone increase and decrease during menstruation and pregnancy. These hormones are secreted into the gingival sulcus via blood and induce proliferation of periodontopathic bacteria (e.g., *P. Intermedia*) and induce gingival inflammation[8]. Thus, women are more susceptible to periodontal disease in comparison with men throughout life.

2) Periodontal therapy for pregnant women

During early pregnancy, brushing instructions are mainly given and therapy without stress is performed in as short a time as possible. SRP is performed during stable pregnancy (4 to 5 months gestation)[9]. Administration during pregnancy is avoided as much as possible and it is desirable to combine professional care, including mechanical plaque control, with self care. If extraction is required due to periodontal disease during pregnancy, debridement in periodontal pockets is conducted and a tooth is extracted during stable pregnancy; however, invasive procedures should be performed after delivery. Periodontal disease is a risk factor for preterm and low weight birth; therefore, appropriate periodontal therapy is required for pregnant women. However, procedures are limited during pregnancy and it is desirable to perform oral hygiene control daily. (See Page 33 "2. Preventive treatment for pregnant women").

3) Patients with osteoporosis (particularly those taking BP products and anti-RANKL antibodies)

Osteoporosis develops frequently in postmenopausal women and the elderly, and BP products are the first choice for osteoporosis. Anti-RANKL antibodies inhibit bone resorption through a mechanism that differs from that of BP products and are used as therapeutic agents for osteoporosis. BP products and anti-RANKL antibodies are also administered to cancer patients. (See Page 22 "3. Liaison with medicine"). Patients taking BP products and anti-RANKL antibodies can develop ONJ after invasive dental therapy, and this is suggested to be related to these agents[10-12]. Treatment should be discussed and planned with cooperation between the physician and dentist.

4. Periodontal therapy for smokers

Smoking is a cause of lung cancer and other diseases. Many epidemiologic studies have shown that smoking is the highest risk factor for periodontal disease, regardless of race, and smokers develop periodontal disease at 2-8 times higher a rate than non-smokers. Nicotine in blood constricts capillaries and the clinical characteristics of smokers include less BOP and mild redness, which are unlikely to present as symptoms[13]. Since smoking delays healing of periodontal disease, smokers are less responsive to periodontal therapy than non-smokers. However, patients who were a heavy smoker, but then abstained from smoking, have a decreased risk for periodontal disease[14]. Therefore, it is necessary to explain to patients that smoking cessation is essential for periodontal therapy and to support their abstention from smoking in cooperation with medical facilities.

10 Periodontal surgery

The indications for periodontal surgery are [1] remaining a deep periodontal pocket after basic periodontal therapy, [2] poor plaque control and relapse of periodontitis due to soft tissue morphological abnormality, and [3] esthetic dysfunction and anatomical morphological abnormality preventing installation of appropriate dental restoration[1]. A patient should also meet the following conditions before periodontal surgery: [1] provision of informed consent after a full explanation, [2] good systemic conditions, [3] good oral hygiene, and [4] current non-smoker. Periodontal surgery is classified into four types: tissue attachment therapy, resective therapy, periodontal regenerative therapy, and periodontal plastic surgery. The type of surgery is determined based on the bone defect type, oral hygiene, periodontal pocket depth, BOP, and radiographic findings (Table 9 and Figure 7). The indications for periodontal surgery are periodontal pocket depth ≥4 mm in reassessment and BOP; however, surgery is conducted to improve poor gingival forms in cases with a lower periodontal pocket depth and no BOP. Bone defect conditions are important criteria in the choice of the surgical procedure (Figure 8).

Definition of flap surgery

Flap surgery is periodontal surgery to detach the gingiva from a mucoperiosteal flap containing the periosteum or a mucosal flap with the periosteum remaining on the bone surface, curette plaque, calculus and inflammatory gran-

Table 9. Bone defect type and periodontal surgical procedures

Vertical osseous defect	Tissue attachment therapy	・Flap curettage (access flap surgery) ・Modified Widman flap surgery
	Resective therapy	・Apically-positioned flap procedure + ostectomy and osteoplasty
	Periodontal regenerative therapy	・Bone transplantation ・Guided tissue regeneration (GTR) ・Enamel matrix derivative (EMD) applied surgical procedure ・Surgical procedure using other biologically active substances
Horizontal osseous defect	Tissue attachment therapy	・Periodontal pocket curettage ・Excisional new attachment procedure (ENAP) ・Flap curettage (access flap surgery) ・Modified Widman flap surgery
	Resection	・Apically-positioned flap procedure (+ osteoplasty) ・Gingivectomy

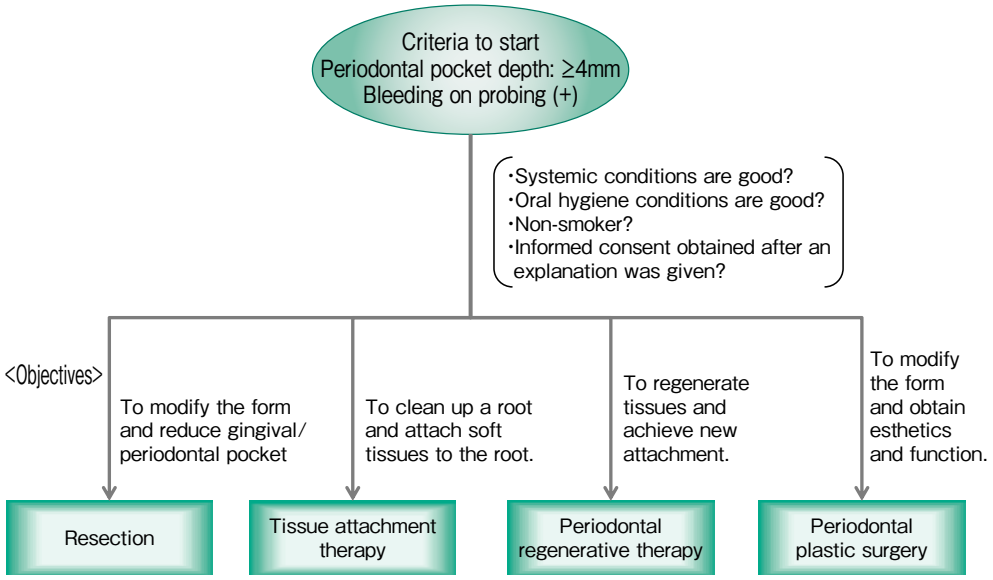

Figure 7. Selection criteria of periodontal surgery by purpose

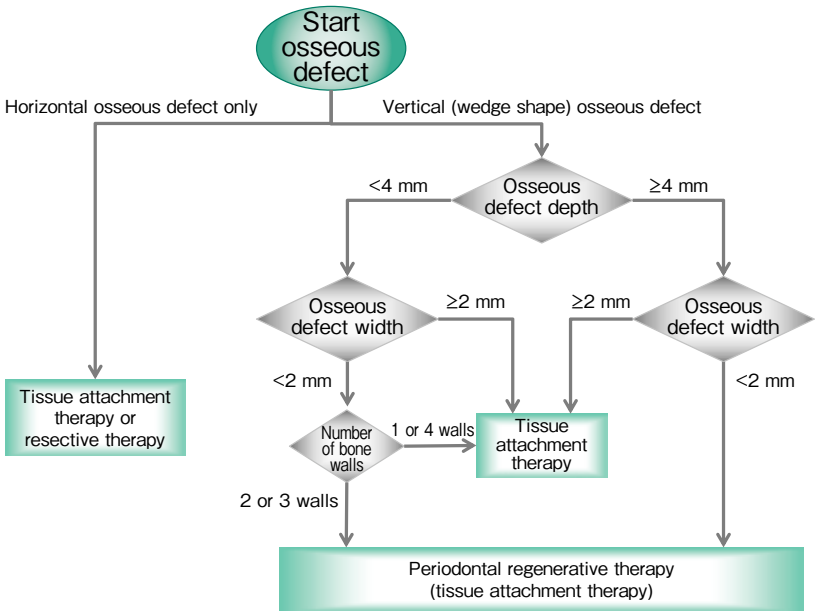

Figure 8. Selection criteria for periodontal surgery by bone defect type
* The depth and width of the bone defect are radiographic findings.

ulation tissues with clear visibility, and eliminate or decrease periodontal pockets.

1. Tissue attachment therapy

Tissue attachment therapy is a surgical procedure to eliminate bacteria and bacteria-derived contaminants on roots and inside periodontal pockets, and facilitate attachment of gingival soft tissues on roots[3]. Tissue attachment therapy does not include positive ostectomy, osteoplasty or apically positioned flap surgery, but includes periodontal pocket curettage, excisional new attachment procedure (ENAP), flap curettage (access flap surgery), and modified Widman flap surgery. The major inclusion criteria for tissue attachment therapy, surgical characteristics and indications are shown in Figure 9. In patients with fully controlled oral hygiene, tissue attachment therapy results in better attachment than resective therapy[3].

1) Periodontal pocket curettage

Periodontal pocket curettage treats roots (e.g., elimination of bacterial biofilm, calculus and pathological cementum) with simultaneous curettage of inflammatory lesions (periodontal pocket epithelium, inflammatory gingival tissue) on the inner walls of periodontal pockets. This is a procedure for promoting attachment of the gingiva and root surfaces and decreasing periodontal pockets. This procedure is performed to relieve inflammation in the tissues surrounding periodontal pockets and stabilize the pathology even for deep periodontal pockets difficult to eliminate.

Characteristics: Shorter operative time and less invasive than flap surgery, but clear visible surgery cannot be performed on roots and curettage of inflammatory lesions is likely to be insufficient.

2) Excisional new attachment procedure (ENAP)

ENAP is a periodontal pocket curettage using a surgical scalpel. Inner walls of periodontal pockets are eliminated by internal bevel incision from the gingival margin to the bottom of a periodontal pocket, the root surface is treated with SRP, and the gingiva is pressed and attached to the root, followed by suturing.

Characteristics: Similarly to periodontal pocket curettage, ENAP is less invasive and results in less gingival

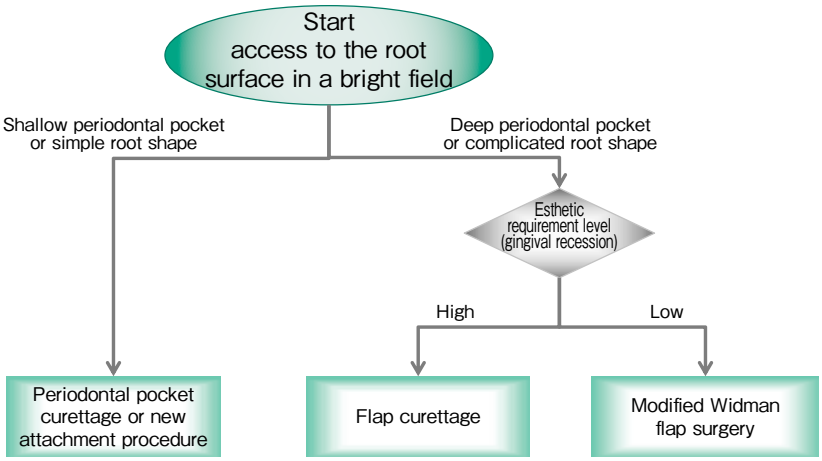

Figure 9. Selection criteria for tissue attachment therapy

recession than flap surgery. However, new attachment is seldom gained and outcomes result in cure with long epithelial attachment.

3) Flap curettage (access flap surgery)

Flap curettage has objectives and procedures that are close to modified Widman flap surgery (see below). The differences from modified Widman flap surgery are addition of intracrevicular incision and removal of gingival flaps from the mucoperiosteal flap to allow access to the root surface and further remove the gingival flap to expose the bone tip slightly.

Characteristics: Root cleaning with clear visibility, less surgical invasion, and low gingival recession.

4) Modified Widman flap surgery

This is a surgical procedure for eliminating periodontal pocket epithelium and removing the mucoperiosteal flap accessible to the root surface to eliminate contaminants on roots and give clear visibility. The original procedure introduced by Ramfjörd[4] specifies steps of incision from outside 1-2 mm from the gingival margin and removal of the mucoperiosteal flap by 2-3 mm from the alveolar crest, but no ostectomy or osteoplasty. However, the procedure used for ostectomy and periodontal pocket elimination associated with modified Widman flap surgery is not strictly classified as tissue attachment therapy.

Characteristics: Periodontal pocket depth decreased by gingival attachment and resection during healing, and usually it will be attachment between the gingiva and root surface is long epithelial attachment[4].

2. Resective therapy

Resective therapy includes gingivectomy, apically-positioned flap surgery, ostectomy and osteoplasty. Flap surgery is usually classified as tissue attachment therapy; however, a procedure using gingival collars rather than gingival margins in the incision process is close to resective therapy. Inclusion criteria for resective therapy, including flap surgery, are shown in Figure 10. Since resective therapy causes gingival resection after surgery, detailed instructions and management for oral cleaning and hypersensitivity are needed.

1) Gingivectomy

Gingivectomy is a procedure for gingivectomizing with external bevel incision to decrease or eliminate gingival (false) pockets or shallow suprabony periodontal (true) pockets.

Characteristics: This is a simple procedure for definite elimination of gingival and periodontal pockets, and

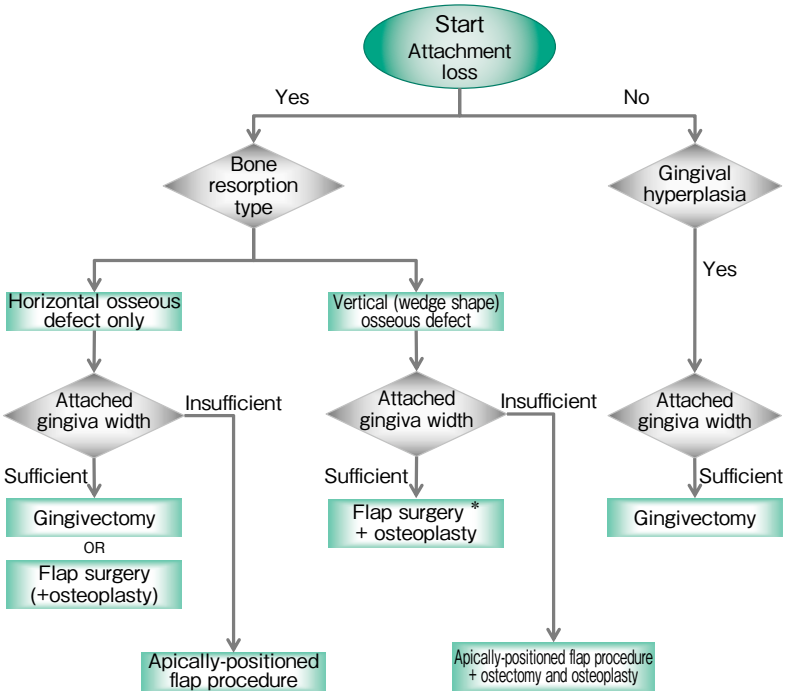

Figure 10. Selection criteria for resective therapy
* Incise further outside of the gingival margin.

outcomes after surgery are easily predictable. However, gingivectomy sometimes causes postoperative bleeding, pain, decreased attached gingiva width, and esthetic dysfunction due to gingival resection. Vertical bone resorption inhibits visual confirmation of the root and bone during gingivectomy; consequently, such cases are excluded from the indication.

2) Apically-positioned flap procedure

This procedure is periodontal plastic surgery that eliminates periodontal pockets and is included in resective therapy. The gingival flap over the mucogingival junction is removed, and the soft tissue flap is transferred to the apical side before suture. Simultaneously with elimination of periodontal pockets, the attached gingiva width is allowed to increase. However, the gingival flap of the maxillary palate cannot be transferred to the apical root and the gingival thickness and height are adjusted by scallop-shaped incision. The gingival flap can be removed on the mucoperiosteal and mucosal flaps, respectively. For removal on the mucoperiosteal flap, the gingival flap is tightly in contact with the alveolar bone after suture and a periodontal pack is used as required. For removal on the mucosal flap, a periosteal suture is applied. In the longitudinal incision site, the gingival flap can be transferred to the apical root and sutured. In apically positioned flap surgery, ostectomy and osteoplasty are usually combined to eliminate vertical osseous defects and bone torus because periodontal pockets remain or the postoperative gingival form worsens if the bone margin is not smooth when transferring the gingival flap to the apical root.

Characteristics: Reduction of periodontal pockets, but the root exposed area increases; therefore, it is necessary to give instructions on careful oral hygiene control. This procedure is also used as a clinical crown lengthening procedure.

3. Periodontal regenerative therapy (see "2012 Guidelines for regenerative therapy in patients with periodontal disease" (Japanese Society of Periodontology[5]))

Several periodontal regenerative therapies are based on recent studies of periodontal generation. There is a long

history of bone transplantation and guided tissue regeneration（GTR）as regenerative therapy. Recent clinical applications include use of biologically active substances. The main procedure is enamel matrix derivative(EMD)-applied surgery, which was approved as "highly advanced medical technology for periodontal surgery" in 2007 by the Ministry of Health, Labour and Welfare in Japan and is currently used in clinical practice in several university hospitals. This therapy is aimed at regenerating periodontal tissues, and it is important to assess the amount of regenerated bone and the attachment level gain accurately for a certain period after surgery using standardized radiography measurements. Several other materials for regeneration have not been approved in Japan. These guidelines describe these materials to allow an understanding of the current conditions of periodontal regenerative therapy, but do not recommend surgical procedures using the materials. Many regenerative materials are approved in Japan and are currently used off-label; therefore, particular attention including medical ethics is required in use of this therapy.

1）Bone graft

Bone graft is performed to stabilize periodontal tissues with regeneration of bone defects and maintain dental function and esthetics by supporting or enhancing teeth. Bone graft also includes heterogenous bone grafts and xenografts, but mainly uses autogenous grafts and artificial bone grafts(e.g. hydroxyapatite, tricalcium phosphate) as bone graft materials for safety.

Characteristics: Indications are various bone defects and furcation. Good outcomes of bone regeneration is expected when many bone walls support graft materials. Bone graft is clinically applied in combination with GTR and EMD; however, there is no clear evidence of an additional effect. Therefore, careful consideration should be given to application.

2）Guided tissue regeneration（GTR）

GTR is a surgical procedure for preventing extension and contact of gingival epithelia and connective tissues to roots during healing and regeneration of periodontal tissues with new connective tissue attachment on roots using gingiva and an absorbable or nonabsorbable GTR membrane.

Characteristics: Indications are vertical bone loss in 2 or 3 walls and class Ⅱ furcation involvement. In such cases, GTR provides significant attachment gain and improved horizontal bone loss in comparison with flap surgery. For class Ⅲ furcation involvement, there is no definite evidence for regeneration.

3）Enamel matrix derivative（EMD）-applied surgery

This is a surgical procedure for introducing cementum and facilitating regeneration of periodontal tissues by applying EMD extracted and purified from tooth germs of juvenile pigs to roots with attachment loss.

Characteristics: The indications are vertical bone loss in 2 or 3 walls. EMD is considered to have outcomes similar to those of GTR（nonabsorbable membrane）for periodontal pocket depth and attachment gain one year after surgery. For furcation involvement, there are studies showing that EMD provides significantly improved attachment gain and improved horizontal bone loss in comparison with flap surgery; however, furcation involvement is not currently included in indications of EMD in Japan and its use requires careful consideration.

4）Surgical procedure using other biologically active substances

Regenerative materials combined with tricalcium phosphate, as bone graft materials, and platelet-derived growth factor（PDGF）are produced in the United States are used for periodontal regenerative therapy. A surgical procedure using basic fibroblast growth factor has completed clinical trials in Japan and is scheduled to be used for periodontal regenerative therapy. Platelet-rich plasma（PRP）therapy for regenerating periodontal tissues using biological substances such as PDGF is also applied clinically. The Law on Safety of Regenerative Medicine, was enforced on December 25, 2014 and PRP is classified as a Regenerative Medicine Class Ⅲ.

4. Periodontal plastic surgery（including gingival/alveolar mucosaplasty）

Periodontal plastic surgery is a collective term for surgical procedures for improving anatomical problems, including lack and loss of attached gingiva, shallow oral vestibule and frenulum, and muscle attachment, which inhibit the marginal gingiva, to treat and prevent periodontal disease, confirm the oral environment facilitating plaque control, and improve esthetics[6].

1）Frenectomy

The objective of this surgery is to incise an abnormal frenulum, increase the width of attached gingiva, and stabilize periodontal teeth and tissues. The procedure incises the transfer site of the frenulum and gingiva, removes the attached frenulum from the bone, and resects the frenulum.

Characteristics: Abnormality in the frenulum is likely to cause periodontal pocket formation and deepening due to traction of the marginal gingiva, and is also the cause of median and interdental diastema, leading to injury in brushing. This surgery establishes an oral environment suitable for plaque control, and may also stabilize dentures.

2）Laterally positioned flap surgery

In this procedure for localized gingival recession, keratinized gingiva in adjacent teeth is transferred laterally as a pedicle flap to cover an exposed root. The supply regions are required to have sufficient thickness and width（approx. 1-2 teeth）of keratinized gingiva.

Characteristics: This is a standard procedure that has been used for many years to cover a solitary exposed root of mild（≤4 mm）gingival recession or a severe case with a narrow width. A marked osseous defect in the region to be covered, a large area of the exposed root, and a shallow oral vestibule are excluded from indications. The disadvantages are the complicated operation because a pedicle flap is produced by combination of mucoperiosteal and mucosal flaps, and a high possibility that new gingival recession will develop in teeth adjacent to the transplanted marginal gingiva.

3）Coronally positioned flap surgery

This procedure is surgery to produce a pedicle flap by removing the gingiva beneath the gingival recession, transfer the flap to the crown side, and cover an exposed root.

Characteristics: The indication is exposed roots of 1-2 teeth with sufficient attached gingiva width. The procedure is also used to cover a bone graft and GTR membrane in periodontal regenerative therapy. However, force pressing on a gingival flap sometimes causes recurrence and necrosis. Semilunar coronally positioned flap surgery covers an exposed root of 2-3 mm.

4）Apically positioned flap surgery

This is a surgical procedure for increasing the attached gingiva width and eliminating periodontal pockets in patients with a narrow attached gingiva width or a periodontal pocket bottom beyond the mucogingival junction. For details, see the resective therapy described above.

5）Free gingival graft

A free gingival graft is a procedure for transplanting grafts containing epithelium and connective tissues collected from the donor site（e.g., palate）to the recipient site. The objectives include covering of exposed roots, definite acquisition of attached gingiva, expanded oral vestibules, and increased attached gingiva. Grafting is performed for regions with narrow attached gingiva width and a shallow oral vestibule that are difficult to clean.

Characteristics: A graft meeting the size of the recipient site can be collected, but the graft requires two surgical sites. Laterally positioned and coronally positioned flap surgery are sometimes combined with grafting. A disadvantage is that grafted gingiva forms a keloid. Miller classified gingival recession into Class Ⅰ and Ⅱ and proposed therapeutic guidelines: Class Ⅰ root coverage can be achieved with a free gingival graft, whereas Class Ⅱ root coverage requires GTR.

6) Connective tissue graft

Connective tissue graft is a procedure for transplanting subepithelial connective tissues collected from the palate. The objectives include expanded oral vestibules and alveolar ridge augmentation in a region requiring coverage and esthetics of exposed roots, and protection of GTR membranes and newly formed tissues on the GTR membrane. The indications are gingival recession in wide ranges and exposed roots of many teeth.

Characteristics: A graft in the recipient site is supplied with blood from the periosteal and epithelial sides; consequently, the graft is likely to engraft in comparison with a free gingival graft. This grafting is superior to free gingival graft in esthetics and is currently the best method.

7) Other periodontal plastic surgery

Besides the periodontal plastic surgery mentioned above, double papilla laterally positioned flap surgery and vestibular extension procedures are included in periodontal plastic surgery.

5. Laser application in periodontal surgery

Debridement to the root in periodontal surgery is usually performed mechanically with a hand scaler and ultrasonic scaler. However, use of lasers for periodontal therapy has increased and an Erbium (Er): YAG laser with high water-absorbability has particularly been used in debridement of pathologic roots, including calculus elimination. The Er: YAG laser output is absorbed by water in calculus and the internal pressure increases as vaporization is produced, with contaminants including calculus are transpired by "micro-explosion". The laser is likely to have bactericidal action on the irradiated area and effects on endotoxin degradation and removal. However, a laser is light therapy with a noncontact action and is completely different from conventional mechanical instrument. Therefore, dentists must be familiar with laser procedures. A laser beam has orientation and may cause mis-irradiation at untreated sites due to reflection from a mirror used for treatment and a metal crown. The safety of patients is a concern and staff should wear protective goggles. A position paper on lasers for periodontal therapy "Calculus removal by laser" was developed by the Japanese Society of Periodontology and Japanese Society for Laser Dentistry[7].

11 Treatment of furcation involvement (Figure 11)

Furcation involvement occurs in a lesion of periodontal tissues in the interradicular septum of double-rooted teeth. The furcation is a region with complicated anatomical morphology and it is frequently difficult to perform definitive debridement using common periodontal instruments. Consequently, a laser is currently used to treat the furcation. Furcation involvement is caused by inflammation spreading from marginal periodontal tissues, traumatic occlusion and periodontal-endodontic lesions. A lesion spreading to the furcation and its severity depend on root form and divergence, root trunk length and local anatomical factors, including enamel projection in the tooth cervix. Therapeutic procedures and outcomes vary based on causes, severity and affected tooth conditions; however, periodontal lesions spreading from margins require more complicated therapeutic procedures and it is important to make an appropriate diagnosis in accordance with the Lindhe and Nyman furcation classification or Glickman furcation classification[1].

1. Examination

In the examination of furcation involvement, the cause and lesion range should be identified; therefore, precise probing using a furcation probe and examination by dental x-ray film are essential. This examination is conducted using eccentric projection and an instrument with contrast media as required. CBCT is effective because it gives three-dimensional images of the lesion range. Radiographic interpretation includes [1] conditions of the root trunk, [2] crown root ratio, and [3] root conditions (length, form, curvature, separation, and divergence).

2. Treatment

In determining the therapeutic strategy, it is necessary to carefully consider whether the teeth after removal of periodontal pockets are ready to be maintained by the patient and appropriate restorative and prosthetic therapy are performed.

Therapy is generally decided using the Lindhe and Nyman furcation classification.

[1] Class Ⅰ or mild Class Ⅱ lesion: treated with basic periodontal therapy, selective grinding and removal of

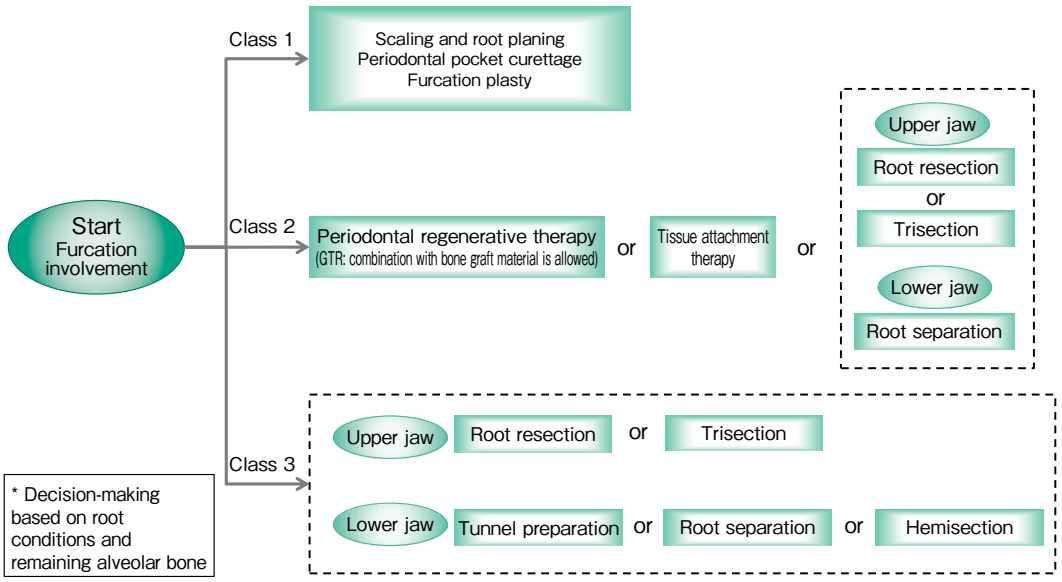

Figure 11. Selection criteria for therapy for furcation involvement

enamel projection and pearl, furcation plasty, and a local drug delivery system (LDDS).

[2] Class Ⅱ lesion: an indication for tissue attachment therapy and periodontal regenerative therapy.

[3] Class Ⅲ lesion: an indication for tunnel preparation and root separation. A lesion localized in the surrounding area of a specific root is treated with root resection (maxillary), trisection (maxillary), and hemisection (mandibular).

In all cases, detailed instructions and management, including postoperative plaque control, are important.

12 Treatment of combined periodontic-endodontic lesions

The root canal and periodontal tissues communicate with each other via the apical pore, accessory root canal and collateral (medullary canal), and infection in either can affect the other. Therefore, in advance of therapy, a definite diagnosis is required based on pulp viability, periodontal pocket depth and radiographic findings, and a decision is made to prioritize endodontic therapy or simultaneously perform endodontic and periodontal therapies. In a case with deeper periodontal pockets due to progression of periodontitis, bacterial infection in a root adjacent to the pockets can spread to the pulp via the dentinal tubule, accessory root canal, collateral (medullary canal), and apical pore. Most accessory roots exist in the periapical region (2-3 mm from the root apex); therefore, the deeper a periodontal pocket, the higher the incidence of combined periodontic-endodontic lesions. Ascending pulpitis is not caused by caries in the crown or root, but via the apical pore or accessory root.

1. Classification of combined periodontic-endodontic lesions

Classifications of combined periodontic-endodontic lesions include the Simon classification[1] and Weine classification[2] and consist of three types of pathogenesis.

(1) Class I (endodontic lesion-derived): Radiographic findings show bone resorption of advanced periodontitis, but the cause is pulp inflammation and necrosis. The pulp is devitalized. Endodontic therapy is performed.

(2) Class II (endodontic lesion-derived): Severe bone resorption due to periodontitis is found and the pulp is infected from the accessory root or apical pore in periodontal pockets. The pulp is usually vital tooth. In multi-(double-) rooted teeth, only one root is devitalized.

(3) Class III (combined periodontic-endodontic lesion-derived): Lesions that are due to apical periodontitis-induced periapical bone resorption and periodontitis-induced bone resorption connect with each other and combine. The pulp is devitalized. Endodontic therapy is the first treatment and is combined with periodontal therapy.

2. Examination

If combined periodontic-endodontic lesions are suspected, the following items are examined: [1] pulp viability, [2] periodontal pocket depth (position of pocket bottom) and probing of furcation, [3] X-ray (form and number of the root or root canal; CBCT definitively shows the range of bone defect and the relation with the root canal and is considered to be effective), [4] severity of gingival inflammation, [5] pain type, [6] occlusal condition, and [7] root fracture.

3. Treatment

Treatment is begun after examination of the above items and diagnosis of the class of periodontal-endodontic lesion. In a case with severe pain, the first therapy is for pain relief. The patient conditions are examined to determine whether treatment of the pulp (pulpectomy) or that of acute symptom of periodontitis (e.g. abscess incision) is necessary. After acute symptoms disappear, endodontic therapy is usually given as a priority, followed by periodontal therapy. For devitalized teeth, attention should be given to root fracture. In a case in which traumatic occlusion is found in the intercuspal position (centric occlusion) or lateral movement, occlusal adjustment is first performed. A Class Ⅰ lesion is treated with endodontic therapy. Affected cementum and periodontal ligament

fibers are likely to recur, therefore, SRP should not be performed early. A Class Ⅱ lesion with suspected irreversible pulpitis or partially devitalized roots is treated with pulpectomy (root canal therapy). Single-rooted teeth sometimes induce asymptomatic pulp necrosis and gangrene. In such a case, both endodontic and periodontal therapies are necessary. Lesions in molars are treated with root resection, including hemisection. A Class Ⅲ lesion is initially treated with endodontical therapy, followed by a combination with periodontal therapy.

13 Oral rehabilitation
—Choice of splint, bridge, denture and implant—

Oral rehabilitation is a collective term for treatment after periodontal surgery to recover oral function lost by periodontal disease, and includes occlusal treatment, restorative and prosthetic therapy, orthodontic treatment, and implant therapy. Oral rehabilitation for patients with periodontal disease is required for dentin defect, tooth defect, tooth movement, decreased occlusal and masticatory function, and esthetics. This treatment is important to recover appropriate occlusal and masticatory function and esthetics, and for long-term stabilization of periodontal tissues for functional maintenance and avoidance of induction of inflammation or occlusal trauma in periodontal tissues. For moderate or severe advanced periodontitis with decreased support of periodontal tissues, bacterial infection and occlusal trauma are concerns (Figures 12 and 13). Joint splint with extensive prosthesis to fix mobile teeth during basic periodontal therapy and removal partial denture are often performed; consequently, restorative and prosthetic therapy for patients with advanced periodontal disease is likely to be more difficult than that for patients who are healthy. Periodontal therapy is completed by solving these problems and performing oral rehabilitation, an objective of dental treatment[1]. In this chapter, the concepts and choices of procedures for oral rehabilitation are described.

1. Choice of therapeutic procedures

1) Test items

It is important for oral rehabilitation to avoid induction of inflammation or occlusal trauma in periodontal tissues and build an oral environment to stabilize these tissues. Therefore, it is important to examine bacterial infection and inflammation, including oral hygiene (O'Leary plaque control record), periodontal pocket depth and BOP; and occlusal trauma based on roentgenograms (bone resorption, root length, enhanced periodontal ligament space), tooth mobility and fremitus (slight vibration in occlusal contact), and number, placement of remaining teeth and occlusion (e.g., bruxism, bite force). For patients with lateral differences in jaw movement or clicks on mouth opening and closing, it is necessary to examine the temporomandibular joint. Jaw dysfunction may be diagnosed in patients with periodontitis complicated with occlusal trauma due to load bearing of the force originally on the jaw joint on teeth and periodontal tissues due to articular disc dislocation.

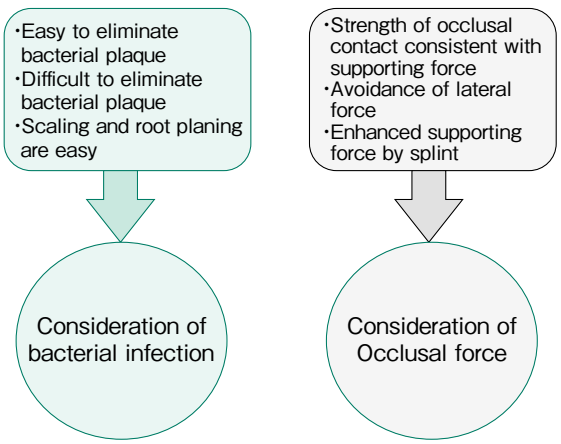

Figure 12. Bacterial infection and bite force in oral rehabilitation in patients with periodontal disease[1-4]

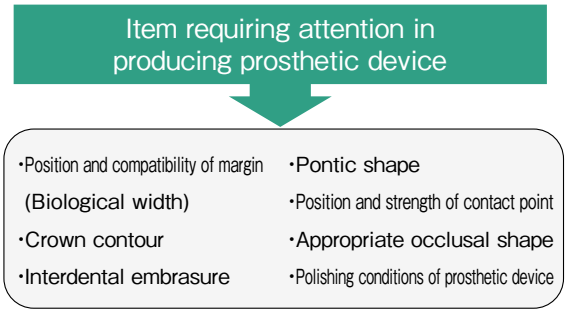

Figure 13. Precautions in production of a prosthetic device for oral rehabilitation

2）Treatment of mobile teeth[2,3]

For oral rehabilitation for patients with periodontal disease, it is particularly important to examine and treat the cause of a mobile tooth, after determining whether mobility is due to inflammation or traumatic occlusion, including early contact and bruxism. Sleep bruxism can exceed the maximum bite force[4] and it is important to treat excessive traumatic force, including sleep bruxism[5,6]. If tooth mobility is significant, priority should be given to therapy for infected bacteria, although occlusal adjustment and temporary splint are sometimes necessary during basic periodontal therapy. For patients with dysfunction due to remaining mobility after treatment of infected bacteria, changes in periodontal tissues including tooth mobility are assessed after occlusal adjustment and temporary splint, the necessity and range of a permanent splint are determined, and an occlusal splint is used.

3）Temporary splint and splint with provisional restoration

If tooth movement is found after therapy for bacterial infection, a temporary splint is used and the splint procedures and range are examined. In using a permanent splint, patients with advanced periodontal tissue disruption have decreased support from remaining teeth and are likely to have recurrent inflammation. Consequently, it is often necessary to determine whether dental restoration is a cause of bacterial infection or occlusal trauma based on chronological data. The process in such a case is to produce provisional restration for periodontal therapy, examine the form of dental restoration and the split range, and assess whether a less predictable tooth or a tooth with wide movement is also maintained. Specifically, a splint with devices for periodontal therapy is used for temporal restoration of occlusion and esthetics and also for assessment of occlusion, cleaning and occlusal trauma.

2. Choice of procedures for prosthesis and precautions

1）Tooth crown restoration（permanent splint）

Permanent splint is performed when a temporary splint cannot provide sufficient intensity because masticatory dysfunction or failure in comfortable masticatory function is caused by tooth movement, or occlusal trauma remains. There are various problems with performance of tooth crown restoration for permanent splint, including abutment tooth preparation, impressive accuracy, model production, restoration compatibility, and type of cementum for attachment. ne produced to make it easy to perform plaque control. If these are not appropriate, the risk for caries increases[7]. If bite force is strong, a permanent splint should be carefully established using devices for periodontal therapy（provisional restoration）and a temporary splint is used considering the splint range. Incorrect splint range may induce new or advanced periodontal disease in a splint tooth or other remaining teeth. Furthermore, insufficient consideration about traumatic occlusion causes restoration avulsion and fracture[6]. For long-term maintenance of restoration, it is necessary to decrease restoration avulsion and fracture[8], and particularly for patients with a strong bite force, it is important to consider occlusive trauma for long-term maintenance of restoration（Figure 13）[5,6].

2）Treatment of dentition with tooth defect

For a tooth defect, prosthetic therapy is performed with a fixed bridge, removable denture, tooth transplantation, and implanting. Prosthesis for defects is important to secure a continuous dental arch and occlusion and prevent remaining teeth from occlusal trauma. Understanding the cause of a defect is important to obtain good outcomes. It is necessary to understand whether the cause of tooth loss is caries or periodontal disease, if periodontal disease is the cause of a defect, and whether occlusal trauma is involved in the defect. When traumatic occlusion is involved in a defect, the outcomes are poor if the type of traumatic occlusion, assessment of traumatic force, and prospect of therapy are not definitively determined, regardless of whether the procedure is used at any site. In a distal extension defect of a molar less influenced by occlusal trauma, the molar is not used for prosthetic therapy, but the short dental arch with occlusion to the premolar is used for building（Table 10）[9].

Table 10. Choice of prosthetic devices

Defect level		Support and masticatory and bite force of periodontal tissue	Prosthetic device			
			Crown and bridge	Partial denture	Implant	Complete denture
Several teeth loss		Support of periodontal tissue≧masticatory and bite force	◎	◎	◎	×
		Support of periodontal tissue＜masticatory and bite force	○ (Improved support with connective splint of remaining teeth)	△ (Clasp-anchored teeth bilaterally placed as joint-stabilizing devices)	○ (Attention to fracture of pair teeth)	×
Multiple teeth loss	Number of occlusal support: 9-6	Support of periodontal tissue≧masticatory and bite force	△ (Canine tooth instruction and molar occlusal support are confirmed)	◎ (Connective splint of remaining teeth and bilateral partial denture)	◎	×
		Support of periodontal tissue＜masticatory and bite force	×	○ (Connective splint of remaining teeth and bilateral partial denture)	○ (Attention to fracture of pair teeth)	×
	Number of occlusal support: 6-5	Support of periodontal tissue≧masticatory and bite force	×	◎ (Connective splint of remaining teeth and bilateral partial denture)	○	×
		Support of periodontal tissue＜masticatory and bite force	×	○ (Connective splint of remaining teeth and bilateral partial denture)	○ (Attention to fracture of pair teeth)	○ (Multiple teeth are lost due to root fracture)
Non-vertical stop occlusion		Support of periodontal tissue≧masticatory and bite force	×	×	◎ (Outcomes of remaining teeth have no problems)	◎ (Cross bite, overlay denture)
		Support of periodontal tissue＜masticatory and bite force	×	×	○ (Attention to choice of materials for upper structures)	◎ (Cross bite, overlay denture)
Several teeth remaining		Under any condition	×	×	○ (Conditions of alveolar ridge and mucosa are appropriate)	◎ (Overlay denture)

◎Recommended ○Indicated △Indicated by condition ×Inadequate

(1) Bridge[10-17]

A prosthetic bridge makes abutment teeth receive a bite force; therefore, it is important to examine the defect range, distribution of remaining teeth, and conditions of periodontal tissues of abutment teeth, and design prosthetics to avoid overload on abutment teeth. A properly designed bridge has a fixing effect, leading to prevention of occlusive trauma, whereas an inappropriate design induces new or advanced periodontal disease in abutment teeth.

(2) Removable partial denture

Denture must be designed based on the defect range, number of remaining teeth and position, and number of paired teeth. An inappropriate denture design may cause load bearing of clasp-anchored teeth and induce occlusal trauma; therefore, the load bearing ratio of bite force to remaining teeth and denture mucosa should be carefully determined. Stable retention of partial denture are support (vertical movement), grasp (horizontal movement), and maintenance (prevention of withdrawal). Stable denture reduces the load bearing of clasp-anchored teeth; however, it is important to design denture with full consideration of load bearing capacity of remaining teeth. In a case with many defective teeth, it is important to determine the cause, analyze the patient's background on daily life, and take measures.

(3) Implant[18,19]

An implant gives strong support and usually reduces the load bearing of remaining teeth. An implant can avoid the fixing prosthesis with cutting of neighboring teeth, but may act as a traumatic force on a teeth pair. Therefore, attention should be paid to an implant with a strong bite force. Periodontal therapy for remaining teeth is important because there is a possibility of periodontopathic bacteria infection from natural teeth to peri-implant tissues.

(4) Tooth replantation

Tooth replantation is related to complicated factors for outcomes, including the choice of replanted teeth, replanting site and technology, and occlusal trauma. However, if problems with these respective factors are solved, good long-term outcomes are likely. In evulsion of replanted teeth, as many healthy periodontal ligaments as possible should be kept. The outcomes depend on the surgeon's plan and technique, and further establishment of conditions and approaches is required[20].

3. Orthodontic treatment

1) Malalignment

Malalignment is classified into that existing before onset of periodontal disease and that induced by periodontal disease and habit. For cases in which plaque control is difficult, orthodontic treatment is performed to build an environment in which it is easier to manage oral hygiene. For cases with causes of occlusal trauma, including occlusal interference, treatment is used to improve occlusal abnormality.

2) Remodeling of the periodontium by orthodontic treatment[21,22]

Teeth that have inclination and extrusion, resulting in complication with occlusal trauma, sometimes have an infrabony defect. Osseous defect may be improved by adding orthodontic force (e.g. uprighting, extrusion, intrusion) to this defect after completion of periodontal therapy. Bone leveling is also performed by extruding a tooth with bone resorption. Therefore, orthodontic treatment is significant for improving the environment of periodontal tissues, and not just for moving teeth.

14 Implant therapy

1. Benefit of implant therapy for oral functional restoration in patients with periodontal disease

For oral rehabilitation for patients with periodontal disease associated with a defect, it is important to avoid induction of inflammation or occlusal trauma in periodontal tissues after therapy.

Application of an implant for defect prosthodontics is useful for protecting remaining teeth with decreased supportive ability and building serial alignment. Implant therapy may avoid removable denture, occlusal stabilization, prevent natural teeth cutting associated with restorative and prosthetic therapy, increase masticatory efficacy and improve esthetics. However, this is not a criterion for extracting teeth with periodontal disease. Implant therapy can be used, but teeth on the border of extraction approval should be carefully assessed[1,2]. There are no strict criteria for extracting teeth with periodontal disease or use of implant therapy, and implant therapy should be determined based on a full examination by dental staff and informed consent based on test results.

2. Implant therapy in patients with periodontal disease

1) Importance of periodontal therapy prior to implant therapy

Implants are exposed to infection of oral bacteria in the oral cavity, with no significant difference between the attachment form of the implant and epithelium and that of natural teeth and epithelia. However, the attachment mechanism of epithelia and implants is built only at the deep site of epithelial attachment, and not near the implant pocket base. Consequently, external factors are likely to enter tissues[3] and implants are less resistant to infection than natural teeth. Patients with periodontal disease have a lower rate of implant success than patients without this disease, and also have a significantly high incidence of peri-implantitis[4]. Pathogenic bacteria in peri-implantitis are Gram-negative anaerobic bacteria simultaneous with periodontopathic bacteria, and these bacteria spread and infect from the periodontal site of natural teeth to the peri-implant crevice[5]. Based on these results, periodontal therapy is performed for remaining teeth before implantation. To confirm the effect of periodontal therapy, it is preferable to conduct a periodontal tissue examination and a microbiological assay（bacteria test, serum bactericidal antibody titer test）.

2) Precautions for peri-implant mucositis and peri-implantitis

Indications for implants are wide and include patients with maxillofacial deformity, as well as those with edentulous jaw or partial tooth loss, and implants are also applied as an anchor of orthodontic treatment. Although implants have been applied to various defects in the oral cavity, peri-implant inflammation occurs similarly to that in periodontal tissues after implant therapy for patients with periodontal disease who have poor plaque control. Implant treatment also produces new problems, including peri-implant mucositis and peri-implantitis presenting with clinical and histopathological manifestations[6,7]. The causes of implant failure are classified as traumatic and infectious, and periodontopathic bacteria in periodontal pockets in the implanted oral cavity are detected in areas surrounding implants and result in failure due to bacterial infection.

3) Precautions for implant with trauma

Microflora in implants with disintegrated osseointegration due to trauma are similar to those in a stable implant. When bacterial infection and excessive traumatic force simultaneously act on implants, acute and marked disruption of peri-implant tissues occurs. In prosthetic consideration of tissue disruption, reverse of the crown-to-implant ratio（i.e., implantation of a short implant body and a long upper structure）is caused by widespread

disruption of bone tissues due to periodontal disease, leading to excessive burden to implants[8]. To perform implant therapy for patients with periodontal disease, precautions for both bacterial infection and traumatic force and therapeutic guidelines are required. Therefore, for implant therapy for patients with periodontal disease, both risk factors for periodontal disease and for peri-implantitis should be controlled, in addition to the number of lost teeth and alveolar ridge conditions.

3. Implant therapy and maintenance

In comparison with periodontal tissues, tissues around osseointegration-type implants have markedly different function and structure[9]. Important characteristics of periodontal tissues that differ from peri-implant tissues are periodontal ligaments and suprabony connective tissues. Teeth are supported by alveolar bones and suprabony connective tissues via periodontal ligaments and connective tissue fiber, whereas implants have no connective tissue attachment because there is no cementum in implants[10]. Consequently, no physiological movement occurs in implants. Collagen fibers are not attached to the surface of implants, but form circular fibers running parallel with the implant surface. Implant therapy requires pretreatment including removal of the source of infection in basic periodontal therapy and adjustment of occlusal relations. Implant therapy is generally performed as a two-step procedure: [1] implantation of the implant body into the bone,[2] implant-abutment connection in the transmucosal site in a secondary surgery after osseointegration periods, and [3] production of upper structures. In contrast, in a one-step implant procedure: the transmucosal site is exposed on the oral mucosa simultaneously with implantation of the implant body. To maintain long-term implant function, it is important to conduct routine assessments, control peri-implant plaques, and maintain appropriate occlusal conditions, similar to management of natural teeth. The upper structure of implants is likely to be markedly overcontoured, which is a cause of difficulty in self care. The frequency of visits for maintenance after completion of implant therapy depends on a patient's ability for oral hygiene control and the host response to pathogenic bacteria around implants. Patient recall is generally every 3 months for the first year, followed by every 6 months. For details, see the "2008 Guidelines for implant treatment in patients with periodontal disease" (Japanese Society of Periodontology).

15 Treatment of peri-implantitis

1) Broad definition of peri-implantitis

Implants have been established as a therapeutic option for defect prosthodontics, as a replacement for conventional dentures and bridges. However, various complications after implant therapy occur in the clinical course. In particular, the incidence of peri-implantitis is high and increases with time after implant therapy[1,2]. Therefore, it is important to elucidate the mechanism of peri-implantitis and establish therapeutic procedures in implant therapy.

Peri-implantitis is inflammatory lesions associated with bone disruption in peri-implant tissues that develops due to bacterial infection and the burden on implants under osseointegration. Clinical manifestations include redness, swelling, pus discharge in peri-implant tissues, BOP, increased probing depth and recession, followed by progression to abscess formation and implant movement. To prevent onset of peri-implantitis, early detection of initial inflammatory lesions in peri-implant soft tissues is required. Therefore, it is important to monitor changes in clinical findings around implants routinely and continuously using multiple clinical parameters.

Peri-implant mucositis and peri-implantitis are defined as inflammatory lesions in peri-implant tissues (Table 11). Peri-implant mucositis is a reversible inflammatory process in peri-implant soft tissues, whereas peri-implantitis is an inflammatory process causing supporting bone loss[3]. Marked bone resorption in a radiograph is evidence for advancement of peri-implantitis. There are many studies of inflammatory lesions caused by bacterial plaque formation in peri-implant tissues, including differences between natural teeth and peri-implant tissues[4-6], and the mode of spreading of inflammation in implants differs from that in periodontal tissues. In periodontal tissues, periodontal lesions induced by bacterial plaque are localized in connective tissues, whereas in peri-implant tissues, lesions spread to alveolar bones[6]. Bacterial flora in pockets are similar to each other[7]. Considering this background, if peri-implant tissues are exposed to bacterial plaque for a long period, peri-implant mucositis proceeds to peri-implantitis[8]. However, fracture and crack of the implant body, abutment (screw), upper structure loosening, and inflammation induced by cementum residues after cementation are similar clinical findings that need to be differentiated from clinical findings of peri-implant mucositis and peri-implantitis.

2) Cause of peri-implantitis

Microflora around implants are similar to those around natural teeth and periodontopathic bacteria, with high proportions of *A. actinomycetemcomitans, P. gingivalis, P. intermedia*, and *T. denticola* are present in high proportion[9-11]. When the remaining teeth are affected with periodontal disease and not treated with plaque control, these teeth are reservoirs of periodontopathic bacteria around implants[12], consequently, risks increase in patients with generalized aggressive periodontitis and severe generalized chronic periodontitis.

Other risk factors include systemic disease-related periodontitis (particularly complication with diabetes and rheumatoid arthritis), smoking-related periodontitis, occlusal trauma in remaining teeth due to changed occlusal conditions, and occlusal overloading on implants. Overloading is related to the diameter and length of implants, surface structure, number and direction of implants in defects, and bone mass in implanted sites[8].

Table 11. Peri-implant mucositis and peri-implantitis

	Peri-implant mucositis	Peri-implantitis
Pathology	Reversible inflammatory lesion localized to surrounding mucosa	Irreversible inflammatory lesion associated with bone resorption
BOP	+	+
Drainage	+ or −	+
Bone resorption	−	+ Difficult to detect in early lesions. Different to progression state
Deflection	−	+ In case with progression

3）Examination and diagnosis of peri-implantitis

Systematic and consecutive monitoring of peri-implant tissues based on routine maintenance or SPT is necessary for early diagnosis of lesions in peri-implant tissues. The following clinical parameters are proposed to assess conditions from early onset to advanced lesions and to diagnose lesions.

（1）Plaque（biofilm）control state

Plaque control is closely related with onset of peri-implantitis and peri-implant bone resorption. Biofilms form on the surface of implants, similarly to periodontal disease. Therefore, it is important to perform plaque control, using the modified plaque index（PI）for objective assessment[13].

（2）Bleeding on probing（BOP）

The accuracy of BOP diagnosis is higher than that in natural teeth[14] and BOP is an important index to monitor changes in peri-implant tissues. The modified gingival index（GI）is generally used for assessment of inflammation in peri-implant tissues. In addition, a BOP（－）status under appropriate probing pressure（0.15-0.25 N）[13] shows healthy conditions of peri-implant tissues.

（3）Probing depth（PD）

Probing of a peri-implant crevice requires appropriate pressure based on conditions of keratinized mucosa or alveolar mucosa. The insertion direction is determined considering the type, mode（platform switching）and depth of the implant body. The approach using PD depends on the chronological increase in PD, rather than the absolute value of PD. PD changes are correlated with the conditions of peri-implant inflammation[1,13]. Resistance of tissues in inserting a probe is also helpful to determine whether tissues are healthy.

（4）Pus discharge

Pus discharge is not an appropriate parameter for early peri-implantitis, but suggests that a lesion suspected to be advanced peri-implantitis is associated with bone disruption. Since inflammation of peri-implant tissues is active, it is necessary to treat bacterial infection[1,13].

（5）Radiograph

Radiography is less sensitive for diagnosis of early peri-implantitis and does not show changes in the alveolar bone on the buccolingual（palatal）side. The criterion for implant success is mean resorption in the marginal bone after loading implant function ＜0.2 mm per year; however, this criterion requires reassessment[8,14].

（6）Implant mobility

Diagnosis to peri-implantitis is less sensitive and clinical evidence for the diagnostic accuracy of devices for quantitative evaluation of mobility（Periotest（Siemens, Germany）and Osstell（Integration Diagnostics, Sweden））is insufficient[13]. If movement is detected, osseointegration is considered to be lost,, which is a definitive result for uninstallation of the implant.

（7）Peri-implant keratinized mucosa

There is no clear evidence showing that keratinized mucosa is necessary. However, insufficient keratinized mucosa results in poor plaque control and inappropriate probing depth and BOP[1,13].

（8）Peri-implant crevicular fluid（PICF）

The amount of PICF is correlated with the inflammatory severity and bone resorption in peri-implant tissues; however, the diagnostic accuracy is not always high[13].

（9）Microbiological tests

When antibiotic therapy for peri-implantitis is given in accordance with cumulative interceptive supportive therapy（CIST）, bacterial tests combined with BOP improves diagnostic accuracy[12,15].

（10）Occlusal relation

Peri-implant bone disruption is progresses acutely due to bruxism and occlusal trauma as peri-implantitis advances（perio-implant-load-titis）[16]. Peri-implant bone is lost due to excessive overloading and upper structures are broken and fixation screws fracture.

Table 12. Requirements for surgical therapy

- Control of pathogenic bacteria before surgery（including antibiotic therapy）
- Confirmation of keratinized mucosa（not movable）
- Choice of definite debridement on the implant body surface
- Diagnosis of horizontal and vertical osseous defects and choice of surgical procedures
- Choice of biomaterials used for regenerative therapy

4）Treatment

The priority for treatment of peri-implantitis is to extinguish inflammatory lesions in affected areas due to bacterial infection. It is necessary to diagnose and treat the affected area and simultaneously diagnose and treat periodontitis in remaining teeth. For conservative therapy or surgical treatment, success depends on debridement of bacterial biofilms attached to microstructures on the implant surface. Reassessment should be performed after elimination of inflammation is confirmed, as in periodontal therapy, and surgical procedures should be selected as required.

（1）Treatment process

Therapy for improvement of inflammation includes reinstruction for plaque control, debridement, mechanical cleaning, disinfectant therapy and antibiotic therapy, which are consistent with basic periodontal therapy and are chosen depending on the patient. Bacterial tests are also important parameter in the treatment process. Occlusal adjustment for overloading and bruxism are performed depending on patients. Periodontal tissue examination and periodontal therapy for remaining teeth are essential, and smoking and systemic disease are considered. Reassessment is then performed and use of surgery is determined depending on the patient. Possible surgery includes resective therapy to expose the surface of the contaminated implant body, apically-positioned flap surgery（applied to horizontal bone resorption and not applied to esthetic regions）, periodontal plastic surgery for immobile keratinized mucosa deficit（free gingival graft, connective tissue graft）, and regenerative therapy（e.g. vertical bone defect）. Particularly in regenerative therapy, the success of re-osseointegration depends on the procedure for debridement of contaminated implant surfaces, including curettage with pure titanium curette, laser, air ablation, photodynamic therapy（PDT）, and implant plasty[1,13]. The outcomes of these therapies should improve with time. In regenerative therapy, a combination of autologous bone and membrane is the standard. The requirements shown in Table 12 should be considered in choosing the surgical procedure.

（2）Cumulative interceptive supportive therapy（CIST）（Figure 14）

For patient management after implant therapy, it is important to monitor various clinical parameters continuously and evaluate the results. Lang et al. recommended a CIST protocol（Figure 14）for systematically integrated assessments of peri-implant tissue conditions of plaque index（Pl.I）, probing depth（PD）, BOP, bone resorption in radiography, and bacterial test[17,18]. This protocol includes four categories（A to D）in accordance with the combination of assessment results of clinical parameters. A: mechanical plaque removal, B: application of disinfectants, C: systemic or localized administration of antibiotics, and D: regenerative or resective surgery. With regard to disinfectants［B］, chemical plaque control requires gargling with 0.1-0.2% chlorhexidine or use of 0.2% chlorhexidine gel for topical application. However, these agents are currently unavailable in Japan. In application of antibiotics［C］, the recommended agents are ornidazole（1,000 mg×1）or metronidazole（250 mg×3）for 10 days, or a combination of amoxicillin（375 mg×3）and metronidazole（250 mg×3）for 10 days, as required. These agents are available, but should be used carefully based on the results of bacterial tests and under the responsibility of a clinician. In surgical treatment［D］, even for resective or regenerative surgery, judgment should be made considering wound closure and membrane exposure if no keratinized mucosa is present around implants.

The flowchart of treatment until surgery is shown in Figure 15: A, basic therapy for peri-implantitis: mechanical plaque removal, B: application of disinfectants, and C: systemic or localized administration of antibiotics, for

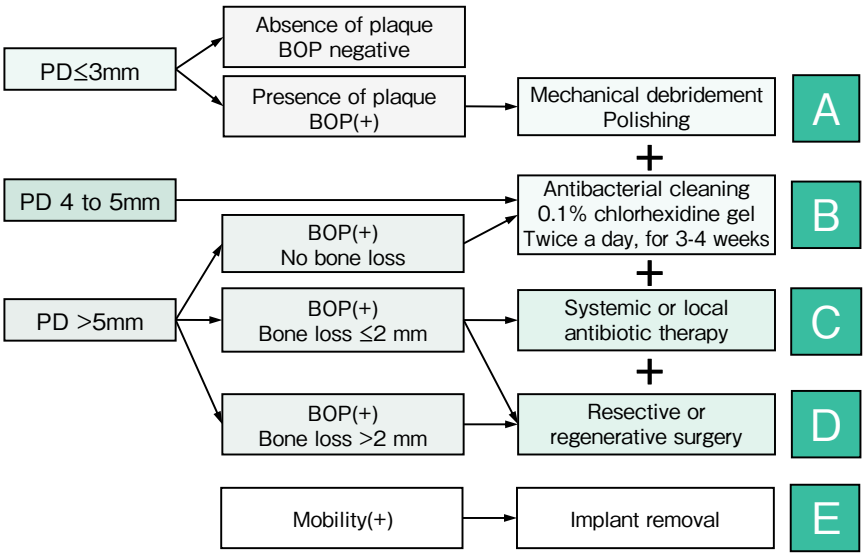

Figure 14. Cumulative interceptive supportive therapy (CIST)

which the priority is thorough removal of pathogenic bacteria. Surgical procedures should be chosen, including the availability of surgery after reassessment. After surgery, it is important to design a routine maintenance program based on the patient's conditions and perform SPT for remaining teeth and implants. Particularly for the high risk group, including generalized aggressive periodontitis, severe generalized chronic periodontitis, systemic disease-related periodontitis (complication with rheumatoid arthritis and diabetes), and smoking-related periodontitis, bacterial tests are required, in addition to conventional clinical parameters[1,12]. In addition, it is necessary to maintain an appropriate occlusal relationship of remaining teeth, including neighboring and pairing teeth, secure occlusal balance against contact with implants and changed occlusal conditions using occlusal adjustment as required, and prevent occlusive trauma in remaining teeth and overloading of occlusion to implants[19,20].

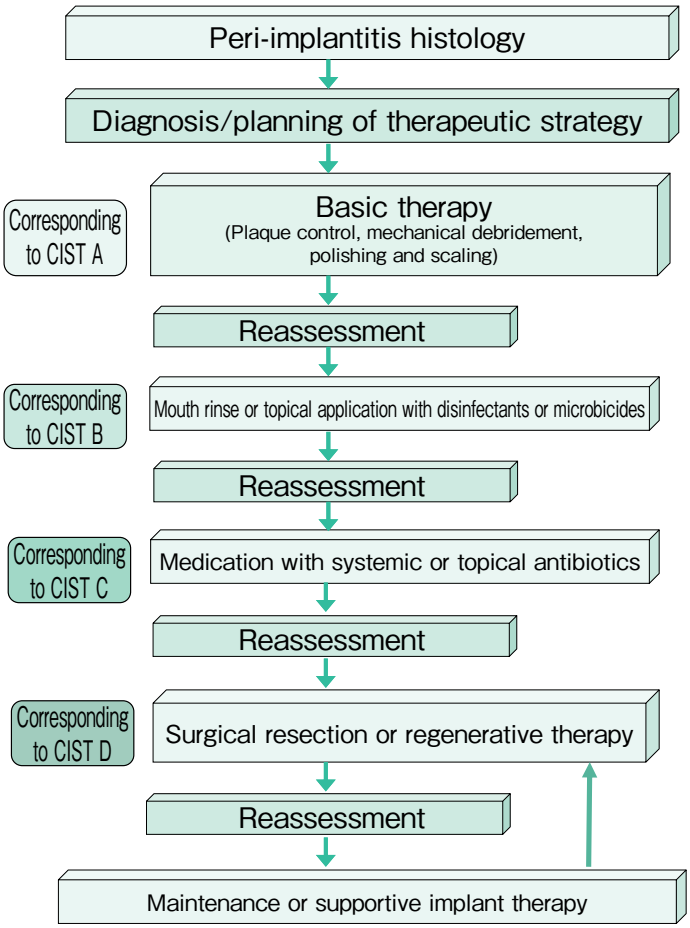

Figure 15. Flowchart of treatment for peri-implantitis

16 Supportive periodontal therapy（SPT）and Maintenance

Bacterial plaque, the main factor for periodontal disease, always exists in the oral cavity. Since traumatic factors are also resident, periodontal pockets of ≥4 mm and furcation involvement sometimes remain after completion of appropriate periodontal therapy. The motivation of patients with periodontal disease decreases with time and the environment in the oral cavity, including changes in position and form of the marginal gingiva over time, and systemic factors have effects and periodontal disease is highly likely to recur[1]. Therefore, it is important to improve patient motivation to maintain periodontal tissues that are cured or stabilized by periodontal therapy, with performance of plaque control in SPT or maintenance based on instructions in daily life, and view point of odontology[2,3]. As described above, family dentists should consider a patient self care permanently for patients getting back the healthy periodontal tissues. Such management prevents recurrence, tooth loss and disruption of periodontal tissues, maintains long term masticatory performance, improve quality of life（QOL）, and increases the healthy lifespan.

1. Term definitions

1）Supportive periodontal therapy（SPT）

After basic periodontal therapy, periodontal surgery and oral rehabilitation, most periodontal tissues are cured, but periodontal pockets remain in a progression-resting stage, SPT is performed to stabilize the disease stage of periodontal tissues for a long period. SPT is comprehensive therapy consisting of plaque control, PMTC, periodontal pocket cleaning, scaling and root cleaning and occlusal adjustment, with the goal of removing causal factors and giving oral hygiene instructions and remotivation.

2）Maintenance

Maintenance is long-term health management to maintain periodontal tissues cured by basic periodontal therapy, periodontal surgery and oral rehabilitation. Periodontitis is likely to recur due to insufficient plaque control; therefore, routine maintenance is essential. Maintenance consists of self care（home care）by patients, motivation to make patients undergo therapy, and professional care by dentists and dental hygienist.

3）Stable state

Patients who have healthy periodontal conditions, but periodontal pocket(s) ≥4 mm without BOP, furcation involvement and tooth movement without inflammation in the reassessment test are clinically stable and determined to be in a stable state. These patients undergo SPT. Some of these patients who cannot undergo periodontal surgery due to systemic disease or other risk factors should frequently have a reassessment test and SPT. Patients who have tooth movement, bruxism and parafunctional habit, decrease tooth-supporting volume due to severe alveolar bone resorption resulting in occlusal trauma even with physiological bite force, or systemic disease（e.g. diabetes）should also have SPT[4].

4）Healing

Healing is a clinically healthy condition recovered in periodontal tissues. The conditions are no gingival inflammation or BOP, periodontal pocket depth ＜4 mm and tooth movement within physiological ranges. Patients with periodontal pocket(s) of depth ＜4 mm, but gingival recession and exposed furcation, might be determined to be cured. Dentine reinforcement with fluorine is necessary in maintenance.

5）Professional tooth cleaning（PTC）

Plaque removal, SRP, and polishing of the tooth surface by a dentist or dental hygienist.

6）Professional mechanical tooth cleaning（PMTC）

PMTC is mechanical removal of plaque from teeth by a dentist or dental hygienists using cleaning instruments. SRP is not included, in principle. PMTC is defined as mechanical tooth cleaning by specialists, or procedures for mechanically choosing and removing supragingival and subgingival（from 1 to 3 mm） plaque on all the tooth surface, including the interdental adjacent area[3)].

2. Examination and diagnosis

Reassessment before SPT is performed similarly to the first dental examination, in principle. After review of examination results and risk factors, the effect of periodontal therapy is assessed and the disease is diagnosed. If no repeated basic periodontal therapy or periodontal surgery is necessary, a patient is defined to be in a stable state or cured, and is transferred to SPT or maintenance. Even during SPT as part of periodontal therapy or maintenance as health management, reassessment is conducted at an appropriate period and the disease process is evaluated. If disease has advanced, the causes are found and therapy including periodontal surgery is performed. Flowcharts in SPT and the maintenance stage after reassessment and criteria are shown in Figures 16 and 17, respectively.

1）Decision-making point

The determination of cure or stable state depends on the progression state.

（1）Plaque-induced gingivitis

Plaque-induced gingivitis is cured by basic periodontal therapy and diagnosed by reassessment after therapy. Periodontal therapy is not completed at this point, but maintenance is performed at appropriate intervals（e.g. recall, reassessment, oral hygiene instructions, SRP, and PMTC once every 3 to 6 months）.

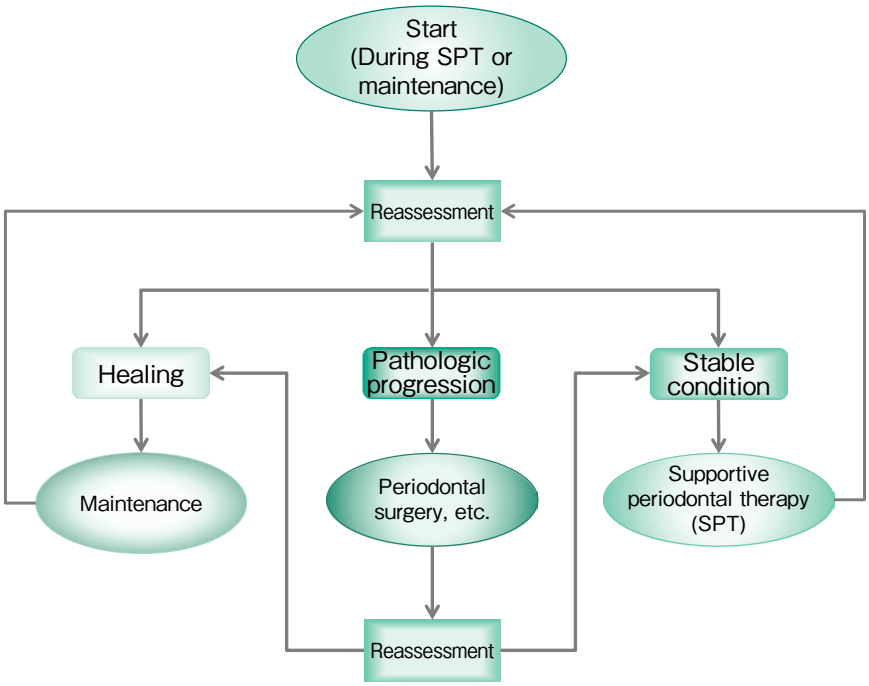

Figure 16. Flowchart in SPT and maintenance stage

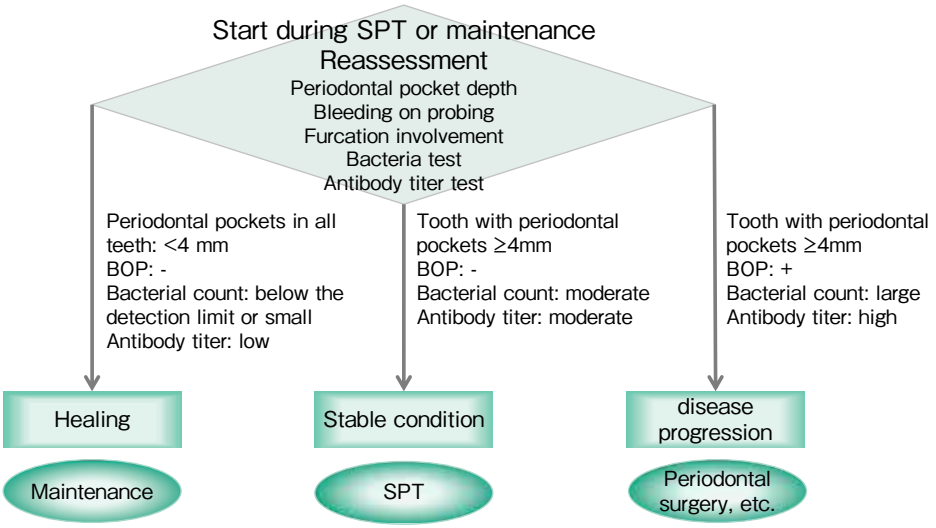

Figure 17. Diagnoses by tooth unit and individual levels
Comprehensive diagnosis is made based on reassessment, periodontal pocket depth, bleeding on probing, bacteria test, and antibody titer test

(2) Periodontitis

Slight periodontitis is often diagnosed with cure in basic periodontal therapy. Moderate or severe periodontitis depends on lesions. Surgical periodontal therapy is performed in lesions as required. Furthermore, after completion of surgical periodontal therapy, reassessment (including partial reassessment) is conducted to evaluate the effect of periodontal therapy and the state of periodontal tissues. Patients who are determined to be in a stable state or cured at completion of oral rehabilitation transfer to SPT or maintenance.

2) Test items

(1) Periodontal examination

The requirements for stepping to SPT or maintenance are reassessment of oral hygiene conditions, periodontal pocket depth, BOP, tooth mobility, radiograph, occlusion and furcation involvement.

(2) Microbiological assays

Bacterial tests to monitor periodontopathic bacteria in subgingival plaque, including *P. gingivalis* and *A. actinomycetemcomitans*, and antibody titer (infection marker) tests are useful to assess therapeutic effects and define the contents of SPT.

(3) Other examinations

A gingival crevicular fluid (GCF) test is also useful to assess therapeutic effects and determine the details of SPT.

(4) Risk assessment in SPT (revised Lang & Tonetti[6], Figure 18)

It is important to classify patients into low- to high-risk levels based on conditions in the oral cavity, to design a care program according to these conditions, and perform patient management.

Lang and Tonetti[5] proposed the following risk assessment.

[1] PD ≥5 mm: low risk ≤4 sites, high risk of recurrence ≥8 sites.

[2] BOP ratio: low risk ≤9%, high risk ≥25%. The cutoff between a stable state and recurrence or advancement is 25%.

[3] Bone loss depending on age, using % maximum loss of molar alveolar bone divided by age: low risk ≤0.5%, high risk ≥1.0%.

[4] Number of lost teeth per 28 teeth: low risk ≤4 teeth, high risk of recurrence ≥8 teeth.

[5] Systemic disease/genetic factor: diabetes and IL-1 genotype-positive are high risk, unknown and IL-1 genotype-negative are no risk.

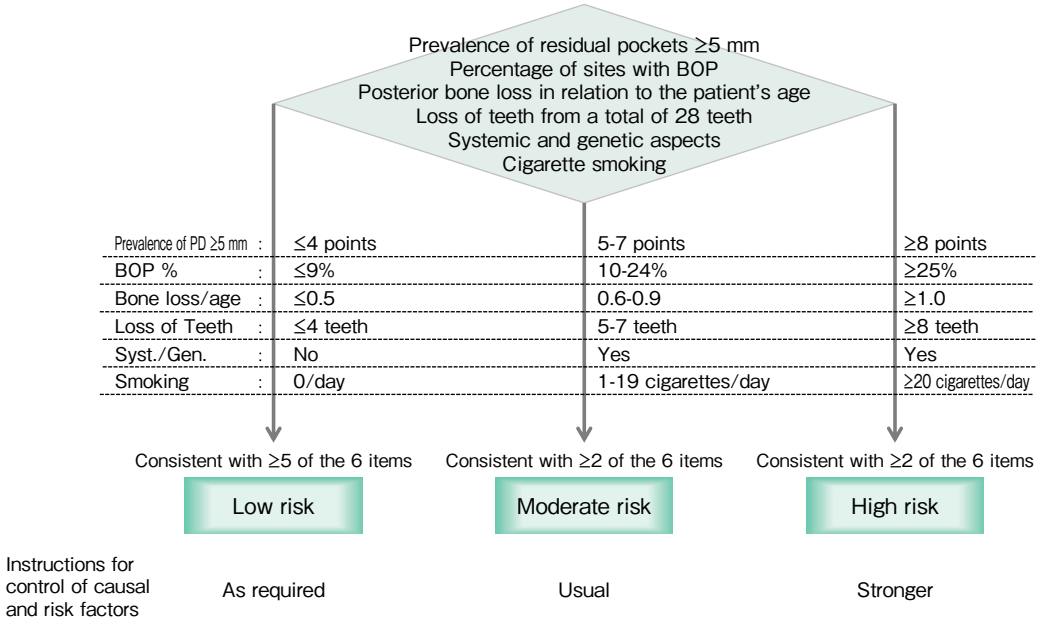

Figure 18. Risk assessment in SPT[5]

［6］ Environment （lifestyle）: non-smoking and smoking cessation ≥5 years are low risk, smoking ≥20 cigarettes/day is high risk.

The risk for periodontal disease is assessed using the above 6 parameters:

* Low periodontal risk: all 6 parameters are low risk or one parameter is moderate risk.
* Moderate periodontal risk: at least 2 parameters are moderate risk and one at most is high risk.
* High periodontal risk: at least 2 parameters are high risk.

3. Therapeutic planning

The contents of therapy after reassessment examination are roughly divided into maintenance[7-9] and SPT[10] and the following therapies are chosen.

1） Maintenance[6-9]

Maintenance is used to prevent recurrence in patients who are cured in reassessment. The objectives of maintenance are［1］prevention of recurrence of periodontal disease,［2］early detection of new sites of periodontal onset, and ［3］ long-term maintenance of a good environment of periodontal tissues. After confirming whether motivation is maintained or appropriate self care is being performed, PMTC and SRP are performed to eliminate causal factors. PTC and PMTC are important procedures and dentine reinforcement by application of fluoride and plaque removal by professional care provide a good oral hygiene environment. Furthermore, it is necessary to understand the patient's living environment, oral conditions and risk factors, and give instructions for improving lifestyle. For patients who have lifestyle factors such as smoking, dietary habit and drinking and systemic diseases including diabetes, it is necessary to perform management focusing on oral hygiene instructions to maintain good plaque control and give instructions on these environmental factors and systemic risk factors. It is important for maintenance to schedule the next visit. Recall intervals are determined based on information from various tests and therapy.

2） Supportive periodontal therapy （SPT）[10,11]

If disease conditions are determined as stable in reassessment, the therapeutic stage moves to SPT. The objectives

Table 13. Therapeutic contents of healing, stable state and progression state

Healing	Maintenance	Based on recall at appropriate intervals Oral hygiene instructions（plaque control） Professional mechanical tooth cleaning（PMTC） Scaling and root planing
Stable state	Supportive periodontal therapy (SPT)	Based on SPT at appropriate intervals Oral hygiene instructions（plaque control） Professional mechanical tooth cleaning（PMTC） Scaling-root planing Periodontal pocket cleaning Administration of antibacterial agents into periodontal pockets Elimination of traumatic factors（occlusal adjustment, splint）
Pathologic progression	Periodontal surgery, etc.	Periodontal surgery Flap surgery Gingivectomy, etc. Oral rehabilitation

of SPT are［1］to provide therapy to maintain or cure lesions in a stable state,［2］to detect new lesions of periodontal disease at an early stage, and［3］to maintain a good environment for periodontal tissues. Therapeutic contents include enforced plaque control（instructions for oral hygiene）, professional mechanical tooth cleaning and SRP, and pocket irrigation and occlusal adjustment as required, as well as administration of antibacterial agents into periodontal pockets (Table 13). However, when the disease is advanced (periodontal pocket depth ≧ 4 mm, BOP（+）, many bacteria, high antibody titer), periodontal surgery may be performed. Recall intervals of SPT depend on periodontal tissue conditions and plaque control level in each patient, and recall every 1 to 3 months is generally recommended. Recall intervals can increase or decrease based on condition changes, e.g. every one month initially, then every 3 months or every 6 months

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