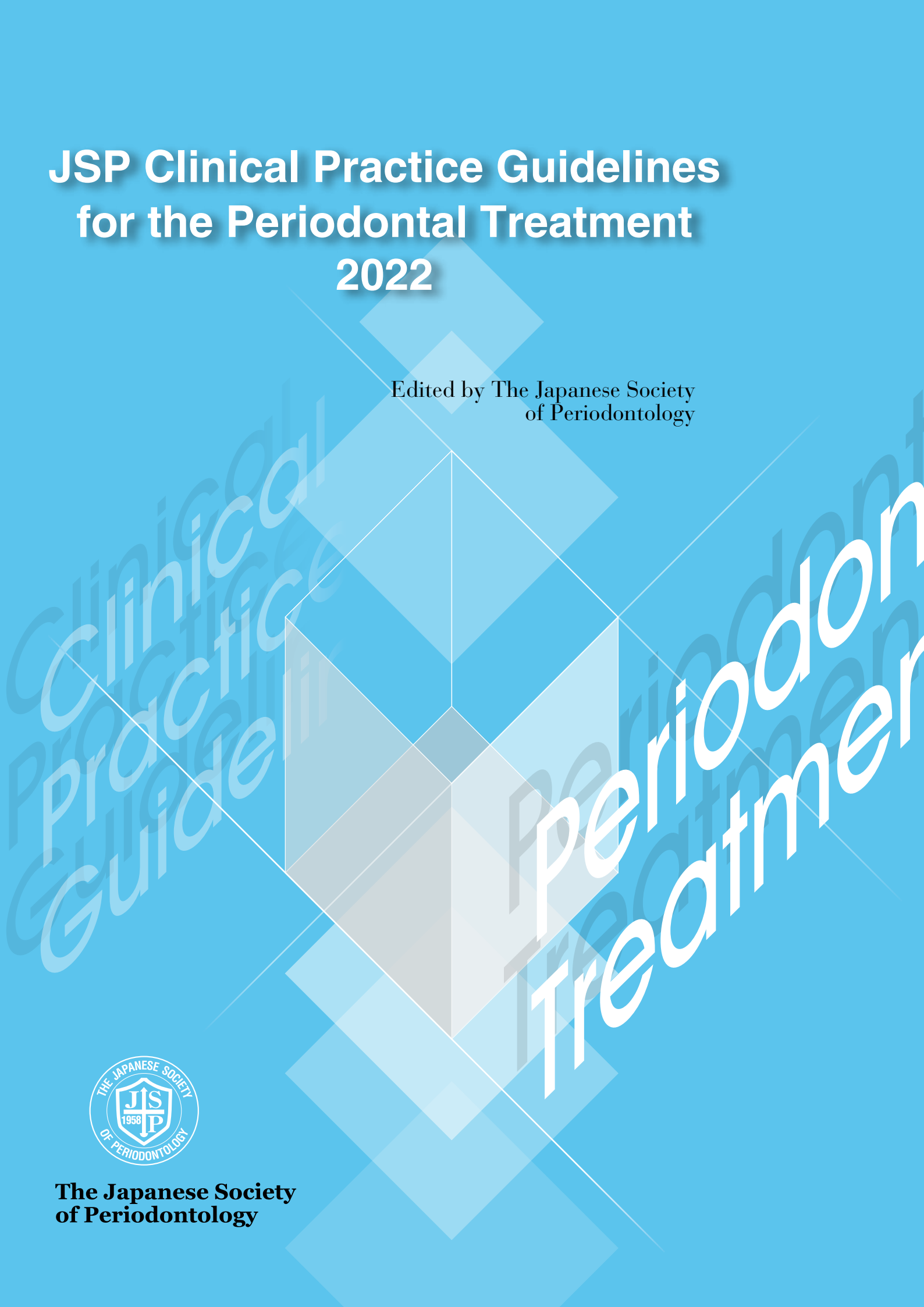
JSP Clinical Practice Guidelines for the Periodontal Treatment 2022

Edited by The Japanese Society of Periodontology



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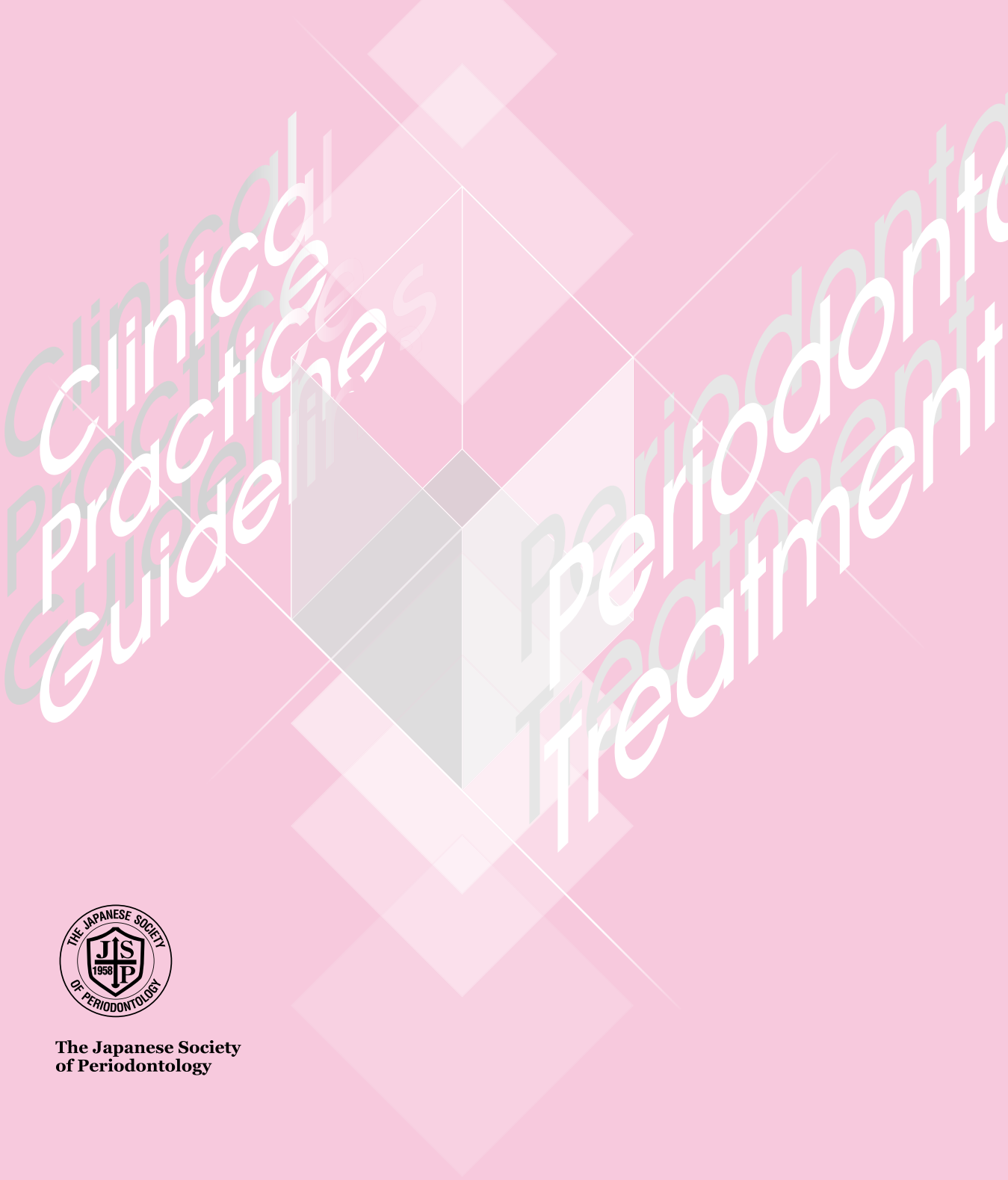

The Japanese Society of Periodontology

Foreword to the "2022 Guidelines for Periodontal Therapy"

In Japan, elderly people accounted for more than 23% of the population in 2010, resulting in a super-aged society. In 1989, when the "80-20 Campaign" started, less than 10% of people aged 75 years or older achieved the 80-20 goal (age over 80 with 20 teeth). Achievement of this goal has increased year by year and the 2016 Survey of Dental Diseases showed that 51% of people aged 75 to 84 years accomplished the 80-20 goal. However, there is an increasing number of elderly patients with periodontal disease and other diseases. Periodontal therapy is important to maintain oral health care and control general health because periodontal disease is a risk factor for systemic health. Therefore, guidelines for periodontal therapy including prevention of periodontal disease are required.

The 2015 Guidelines for Periodontal Therapy were revised more than 6 years after publication based on changes in social conditions, leading to publication of the 2022 Guidelines for Periodontal Therapy. Since guidelines proposed by major academic societies have a great influence on medical care, the JSP discussed future periodontal therapy strategies in detail.

These guidelines were compiled based on the following concepts.

1. The guidelines are integrated with the 2007 Guidelines for Diagnosis and Treatment of Periodontal Disease, which was the first general statement of periodontal therapy published by the JSP, and the detailed exposition 2008 Guidelines for Examination, Diagnosis and Treatment Planning for Periodontal Disease.
2. JSP Clinical Practice Guidelines for Periodontal Treatment, 2015 combined and revised the above two guidelines. The JSP Clinical Practice Guidelines for Periodontal Treatment, 2022 is published as a further revised version.
3. The guidelines were developed based on evidence and classification of periodontal disease, consideration of systemic diseases, examination, diagnosis, treatment planning, oral biofilm infection, peri-implant disease, and continued management.
4. We focused on issues such as, cooperation with medical staff in performing periodontal treatment for the elderly, sick or home care patients, perioperative patients, and disabled people.
5. The aim of the guidelines is to provide objective criteria for periodontal treatment that can be used by many dentists, including clinical dental residents.
6. The guidelines refer to lectures and clinical teaching on periodontology and periodontal therapeutics at educational institutions and questions in the national dentist examination.

We expect that the guidelines will contribute to maintenance and promotion of oral and systemic health by providing a correct understanding of periodontal disease, periodontal therapeutics and delivery of appropriate treatment and high-quality periodontal treatment to the public, including elderly persons, sick persons, perioperative patients and disabled persons.

We gratefully acknowledge the chairperson, Dr. Kazuhiro Gomi, and members of the Guidelines Development Subcommittee (JSP Medicine Committee), the JSP Board members, and Ishiyaku Publishers, Inc.

March 2022

Yorimasa Ogata

President of the Japanese Society of Periodontology

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“2022 Guidelines for Periodontal Therapy”

Members of the Guidelines Development Subcommittee (JSP Medicine Committee)

(April 2021 to March 2023)

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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. Maintenance of 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[3] and 51.2% in 2016[4]. The mean number of remaining teeth was 15.3. 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 achieved, but the number of elderly people with periodontal pockets ≥4 mm is increasing.

Japan is among countries with the highest longevity, but Japanese people aged around 80 years have few remaining teeth. As shown in the data of "number of existing teeth by age group" and "Survey of Dental Diseases", 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 lesions, is an inflammatory and infectious disorder caused by periodontopathic bacteria that develop in the periodontium, which consists of the gingiva, cementum, periodontal ligament and alveolar bone. Periodontal disease also includes necrotizing periodontal disease, periodontal abscess, combined periodontic-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[5]. Recently, periodontal disease has also been viewed as 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 in this goal by healthcare professionals (systemic disease).

2) Morbidity of periodontal disease

The 2016 Survey of Dental Diseases showed that the population with periodontal pockets ≥4 mm increased with age and accounted for 50% of persons aged 45-49 years and 57% of those aged 65-74 years[4]. The more remaining teeth elderly people have, the more periodontal pockets ≥4 mm they have. Those with gingival bleeding accounted for >30% in the age group of 15 to 29 years, and >40% in that of 30 years or older. Therefore, further prevention of periodontal disease and severe conditions is required in younger patients.

3) Trend in the rate of patients receiving periodontal therapy

The municipal screening rate for periodontal disease was 4.3% in 2015 based on the Report on Regional Public Health Services and Health Promotion Services[6] and the Basic Resident Register[7] and there is a need for increased

screening rates. The 2016 Survey of Dental Diseases estimated that 3.983 million patients had gingivitis and periodontitis disease (under treatment), which was higher than patients in the 2011 survey by 660,000. The 2016 Survey of Dental Diseases also estimated that approximately 70 million patients had periodontal disease. However, approximately 4 million patients are actually treated at dental clinics, which is many fewer patients than the estimated total cases. This difference suggests that there are many people who are not aware of periodontal disease and those who are aware of it are often not treated. It is preferable for these patients to undergo screening and to visit clinics and hospitals.

❷ Types of periodontal disease

The JPS classification system of periodontal disease (2006)[8] is shown in Table 1.

1) Gingival lesions

(1) Plaque-induced gingivitis

Plaque-induced gingivitis is gingival inflammation caused by bacteria around the gingival margin. 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 hyperplasia

Gingival hyperplasia 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 hyperplasia

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 margin, interdental papilla and attached gingiva. This disease develops in infants and swelling is found in the buccolingual side of the maxillary and mandibular teeth, but disappears after extraction. Clinical cases with inheritable traits have been reported both in forms of autosomal-dominant and -recessive inheritance.

(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 the gingival margin 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 margin 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 host defense mechanism. A classification of periodontitis by risk factor is shown in Table 4.

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 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 periodontic–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 Periodontal Disease Classification System of the American Academy of Periodontology (1999). Other diseases are defined by the JSP.

(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 old. Symptoms include periodontal pocket formation, drainage, bleeding, alveolar bone resorption, and tooth movement. This disease has a chronic course, but results in acute symptoms due to compromised 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 the age of patients ranges from 10 to the 30s. Some patients have large colonies of *Aggregatibacter actinomycetemcomitans*, and secondary characteristics are an 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[9].

(3) Periodontitis associated with genetic disorders

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

Table 2. Classification of plaque-induced gingivitis

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

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

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

Table 4. Classification of periodontitis by risk factor

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

Table 5. Genetic disorders associated 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 (Type IV and VIII)
11) Hypophosphatasia
12) Other

3) Necrotizing periodontal diseases

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

(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*, spirochaetes and *Prevotella intermedia*. The pathogenesis includes poor oral hygiene, stress, smoking, and immunodeficiency. The disorders are also oral findings in HIV-infected patients.

4) Abscesses of the 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 periodontic-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 accessory canal (lateral canal) and apical foramen, whereas lesions in pulp cavities have effects on periodontal tissues via the lateral canal, medullary tube and apical foramen.

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 hypersensitivity 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 radiolucency surrounding the tooth root. Disruption of the periodontium is expanded by excessive occlusal force to tissues with periodontitis (see Page 18, "❻ **Characteristics of occlusal trauma**").

❸ New classification of periodontal disease
(2018 American Academy of Periodontology/European Federation of Periodontology)

The World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions was held in Chicago in November 2017 jointly by the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) to discuss a new classification of periodontal diseases. The results were compiled into a consensus report and the new classification of periodontal diseases was published by the AAP and EFP during EuroPerio9 in Amsterdam in June 2018 (Table 6 and 7). The new classification markedly revised the types of periodontitis. In the 1999 classification, periodontitis was categorized into two groups: aggressive periodontitis and chronic periodontitis. On the other hand, in the new classification, periodontitis is grouped under a single category and is further characterized based on a multi-dimensional staging and grading system. Severity and complexity have 4 stages (Stage I: mild, Stage IV: severe) and progression risks have 3 grades (Grade A: lowest risk, Grade C: highest risk). Risk factors including smoking and diabetes are considered in the grade determination[10].

<Periodontal health, gingival diseases/conditions>
1) Periodontal health and gingival health
(1) Clinical gingival health on an intact periodontium
(2) Clinical gingival health on a reduced periodontium
a) Stable periodontitis patient
b) Non-periodontitis patient

2) Gingivitis – dental biofilm-induced
(1) Associated with dental biofilm alone
(2) Mediated by systemic or local risk factors
(3) Drug-influenced gingival enlargement

3) Gingival diseases – non-dental biofilm-induced
(1) Genetic/developmental disorders
(2) Specific infections
(3) Inflammatory and immune conditions

(4) Reactive processes
(5) Neoplasms
(6) Endocrine, nutritional & metabolic diseases
(7) Traumatic lesions
(8) Gingival pigmentation

<Forms of periodontitis>

1) Necrotizing periodontal diseases

(1) Necrotizing gingivitis
(2) Necrotizing periodontitis
(3) Necrotizing stomatitis

2) Periodontitis as a manifestation of systemic diseases

3) Periodontitis

(1) Stage: Based on severity and complexity of management (Table 6)

Stage I: Initial peiodontitis
Stage II: Moderate periodontitis
Stage III: Severe periodontitis with potential for additional tooth loss
Stage IV: Severe periodontitis with potential for loss of dentition

(2) Extent and distribution: Localized; generalized; molar-incisor distribution
(3) Grade: Evidence or risk of rapid progression, anticipated treatment response (Table 7)

Grade A: Slow progression
Grade B: Moderate progression
Grade C: Rapid progression

<Periodontal manifestations of systemic diseases and developmental and acquired conditions>

1) Systemic diseases or conditions affecting periodontal supporting tissues

2) Other periodontal conditions

(1) Periodontal abscesses
(2) Endodontic-periodontal lesions

3) Mucogingival deformities and conditions around teeth

(1) Gingival phenotype
(2) Gingival/soft tissue recession
(3) Lack of gingiva
(4) Decreased vestibular depth
(5) Aberrant frenum/muscle position
(6) Gingival excess
(7) Abnormal color
(8) Condition of the exposed root surface

Table 6. Periodontitis stage

Periodontitis stage		Stage I	Stage II	Stage III	Stage IV
Severity	Interdental CAL at site of greatest loss	1 to 2 mm	3 to 4 mm	≥5 mm	≥5 mm
	Radiographic bone loss	Coronal third (<15%)	Coronal third (15 to 33%)	Extending to middle or apical third of the root	Extending to middle or apical third of the root
	Tooth loss	No tooth loss due to periodontitis		Tooth loss due to periodontitis of ≤4 teeth	Tooth loss due to periodontitis of ≥5 teeth
Complexity	Local	Maximum probing depth ≤4 mm Mostly horizontal bone loss	Maximum probing depth ≤5 mm Mostly horizontal bone loss	In addition to Stage II complexity: Probing depth ≥6 mm Vertical bone loss ≥3 mm Furcation involvement Class II or III Moderate ridge defect	In addition to Stage III complexity: Need for complex rehabilitation due to: Masticatory dysfunction Secondary occlusal trauma (tooth mobility degree ≥2) Severe ridge defect Bite collapse, drifting, flaring Less than 20 remaining teeth (10 opposing pairs)
Extent and distribution	Add to stage as descriptor	For each stage, describe extent as localized (<30% of teeth involved), generalized, or molar/incisor pattern			

CAL: clinical attachment loss

Table 7. Grade of periodontitis

Periodontitis grade			Grade A: Slow rate of progression	Grade B: Moderate rate of progression	Grade C: Rapid rate of progression
Primary criteria	Direct evidence of progression	Longitudinal data (radiographic bone loss or CAL)	Evidence of no loss over 5 year	<2 mm over 5 years	≥2 mm over 5 years
	Indirect evidence of progression	% bone loss/age	<0.25	0.25 to 1.0	>1.0
		Case phenotype	Heavy biofilm deposits with low levels of destruction	Destruction commensurate with biofilm deposits	Destruction exceeds expectation given biofilm deposits; specific clinical patterns suggestive of periods of rapid progression and/or early onset disease (e.g., molar/incisor pattern; lack of expected response to standard bacterial control therapies)
Grade modifiers	Risk factor	Smoking	Non-smoker	Smoker <10 cigarettes/day	Smoker ≥10 cigarettes/day
		Diabetes	Normoglycemic / no diagnosis of diabetes	HbA1c <7.0% in patients with diabetes	HbA1c ≥7.0% in patients with diabetes
Risk of systemic impact of periodontitis	Inflammatory burden	High sensitivity CRP (hsCRP)	<1 mg/L	1 to 3 mg/L	>3 mg/L
Biomarkers	Indicators of CAL/bone loss	Saliva, gingival crevicular fluid, serum	?	?	?

CAL: clinical attachment loss

4) Traumatic occlusal forces

(1) Primary occlusal trauma

(2) Secondary occlusal trauma

(3) Orthodontic forces

5) Prostheses and tooth-related factors that modify or predispose to plaque-induced gingival diseases/periodontitis

(1) Localized tooth-related factors

(2) Localized dental prostheses-related factors

*** Correspondence of the JSP with the new classification**

The JSP uses the conventional classification describing the new classification collectively as a temporary basis for continued use of clinical and research findings accumulated over the years. That is, the definition "localized or generalized" is described first, and "chronic or aggressive" periodontitis second, followed by the stages and grades.

4 Characteristics of gingival lesions (plaque-induced gingivitis)

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

(1) Bacterial plaque is pathogenic

Bacteria attached to teeth grow due to poor oral hygiene control and bacterial plaque is developed, resulting in gingival inflammation. The inflammation grade depends on factors such as host resistance. Bacterial plaque is constructed with numerous bacteria on teeth, gingiva, and restorative and prosthesis products and their metabolites. As a result of plaque maturation, there is coaggregation of different bacterial species and coverage with extracellular polymeric substances (EPS) including glycocalyx.

(2) Inflammation is localized to the gingiva

No inflammation affects the cementum, periodontal ligament or alveolar bone.

(3) Gingival pockets are formed with no periodontal attachment loss

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

(4) Gingival lesions are exacerbated by plaque retention factors

Plaque retention factors (factors that make plaque control difficult and accelerate bacterial plaque retention: see Page 28 "(10) Plaque retention factors" and Figure 6-2) cause bacterial plaque accumulation and progression to periodontitis.

(5) Gingival lesions are improved by plaque control

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

(6) Gingival lesions are considered to be the precursor of 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 untreated gingivitis is the cause of subsequent of periodontitis.

5 Characteristics of periodontitis

Periodontitis is inflammation that initially develops in the gingiva and spreads to deep periodontal 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 induce accumulation of bacterial plaque and

make it difficult to remove this plaque. The progression rate of periodontitis is relatively slow and takes several years. However, sustained traumatic occlusion rapidly destroys the periodontal tissue. Furthermore, the host defense response has effects on the initiation and progression of 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 defects of the 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) Development of attachment loss leads to periodontal pocket formation

Destruction of the attachment between teeth and periodontal tissues leads to attachment loss. The site of gingival junctional epithelium (attached epithelium) and connective tissue attachment extend from the CEJ to root apex and the gingiva detaches from the root. Consequently, a periodontal pocket (true pocket) is formed.

(3) The number of periodontopathic bacteria are increased in deep periodontal pockets and inflammation is sustained

The inside of the periodontal pocket is under anaerobic conditions, in which periodontopathic bacteria are likely to grow. Consequently, bacteria and metabolites invade the gingiva through the epithelium 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 retention factors

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

(2) Complication with traumatic occlusion induces the progression of periodontitis

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

(3) Region-specificity in progression rate

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

(4) Resting and active stage

Periodontitis is generally considered to be a chronic disorder; however, disruption of the periodontium does not always proceed at a constant rate, but rapidly progresses in active stages. There is no diagnostic procedure for identifying the resting and active stages in a single test. Increased BOP ratio, rapid progression of attachment loss and alveolar bone resorption are assessed as the active stage and their region of occurrence is referred to as the active region.

(5) Advanced periodontitis produces a vicious cycle and is likely to progress 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 periodontal support due to alveolar bone resorption induces secondary occlusal trauma, which is complicated by bacterial infection, and disruption of periodontal tissues proceeds.

3) Characteristics of periodontal therapy

(1) Cause elimination improves the system or suppresses the progression of periodontitis

Initial periodontal therapy mainly as cause elimination leads to periodontal health in mild periodontitis and stops progression. However, periodontal surgery and oral rehabilitation are frequently needed in 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 tissue regenerative therapy.

(2) Lifelong follow-up [supportive periodontal therapy (SPT), maintenance and preventive periodontal therapy (PPT)] is a prerequisite for periodontal health

Periodontitis has a high risk for recurrence because bacterial plaque (the major cause) and traumatic factors are always present in 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. Therefore, SPT, PPT and maintenance as healthcare are prerequisites as a part of periodontal therapy to maintain periodontal tissues that are "healing" due to basic periodontal therapy, periodontal surgery and oral rehabilitation, or are in a "stable state of disease" or "preventive stage" due to gingival inflammation, although the probing depth is <4 mm. SPT and PPT mainly comprise plaque control, scaling, root planing and occlusal adjustment by dental professionals, whereas maintenance consists of self-care (home care) by patients themselves and professional care (specialist care) by specialists. Since periodontal disease is likely to recur due to insufficient plaque control, SPT and maintenance are essential. Teeth can be preserved by SPT and maintenance for appropriate intervals and can function for a long time.

6 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 findings. 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, premature contact, cuspal interference, bruxism, excessive bite force, lateral pressure, abnormal habits in the tongue and lips, and food impaction.

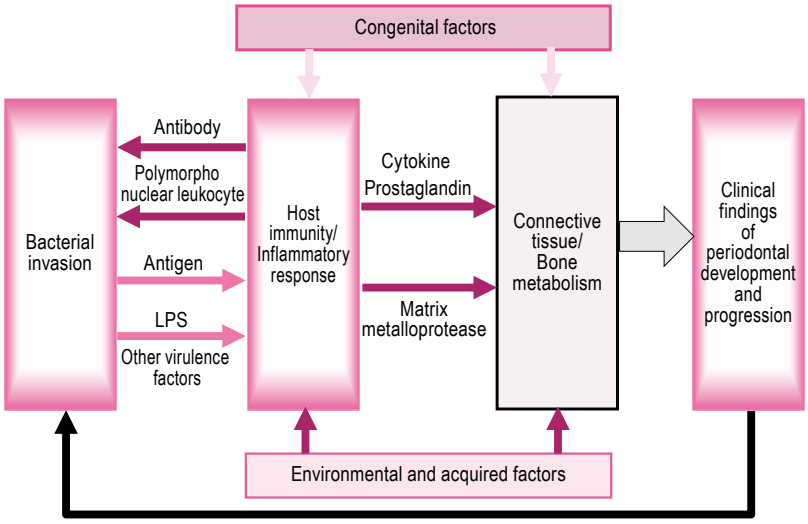

Figure 1. Etiology of periodontal disease (ref 11, revised)

7 Systemic conditions and periodontal disease

Patients with periodontal disease who have or are suspected to have systemic disease should undergo a medical interview before the start of periodontal therapy, with immediate referral to attending physicians for 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 polymorphism in inflammatory immune related genes 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-associated/pubertal gingivitis. 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[12].

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 factors

a) Smoking

Smoking is the strongest risk factor among environmental factors. Smokers are likely to have periodontal 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

Stress is related to aggravation of periodontal disease and stress-induced mental tension (stress response) has effects on the 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) are routine medications that cause 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 low weight birth

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

(4) Diabetes

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

(5) Rheumatoid arthritis

Patients with rheumatoid arthritis have large attachment loss and dental loss. Periodontal disease has many causes and pathological conditions similar to those in rheumatoid arthritis. Enhanced production of inflammatory cytokines and prostaglandin E_2 (PGE_2) is involved in tissue disruption.

(6) Other diseases

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

2 Process of periodontal therapy (see Figure 2)

❶ 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 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 a medical interview is required before the start of periodontal therapy, with referral to attending physicians 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 antimicrobial therapy is recommended to improve the response of periodontal therapy and reduce adverse effects on the body and organs[2, 3].

3) Elderly patients

Elderly patients are likely to have decreased resistance to periodontal disease due to age-related impaired immune functions and may develop aspiration pneumonia because of decreased oral functions. There are no 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 to perform 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. To prevent aspiration pneumonia, it is important to examine oral contamination using an oral biofilm test for diagnosis of biofilm infection and to keep the oral cavity clean.

❷ Examination-based diagnosis, therapeutic strategy and informed consent

For appropriate periodontal therapy, correct testing and diagnosis of the current symptoms of periodontal disease are required (see Page 27 "❶ **Periodontal disease examination**"). The first step is to conduct a periodontal tissue examination to confirm gingival inflammation and tissue disruption, 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 then to 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.

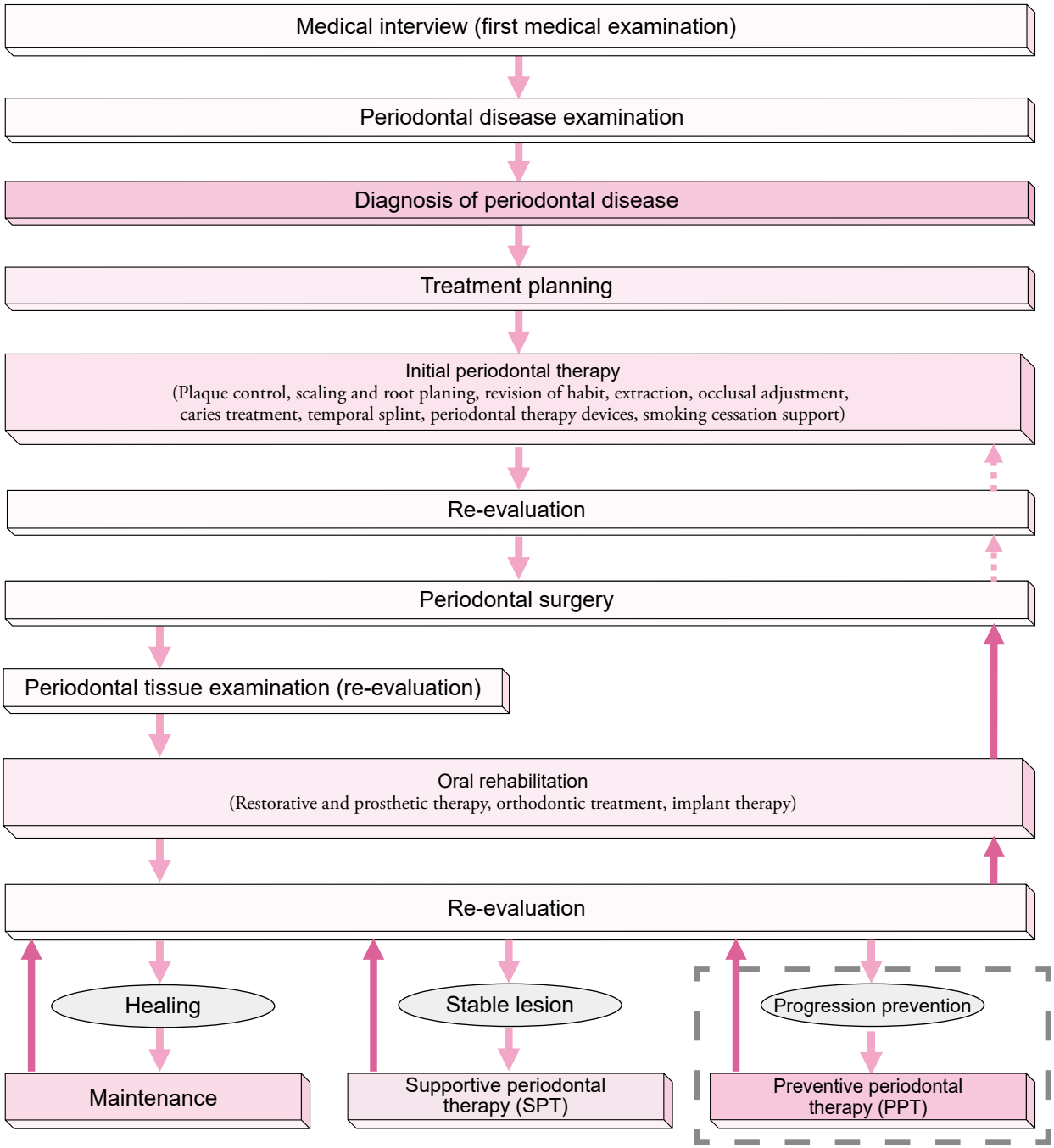

Figure 2. Standard procedures for periodontal therapy

* Therapy considered unnecessary in a test can be skipped. ⋯ A new concept in health insurance.

❸ Initial periodontal therapy

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

1) Proactive participation of patients in treatment

Daily plaque control (self-care) by patients is important in periodontal therapy[4]. 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 bacterial 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 initial 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 basic 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[5].

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 movement due to periodontal disruption after traumatic factors are eliminated, it is important to splint and install devices for periodontal therapy temporarily for occlusal stabilization and recovery of masticatory function[6].

5) Abstention from symptomatic treatment

It is inappropriate to administer antibacterial and antiinflammatory agents alone, conduct incisional drainage for the swollen gingiva, and just fix tooth movement in patients with gingival inflammation and gingival and periodontal abscess. Such procedures are referred to as symptomatic treatment, and do not remove bacterial plaques causing periodontal disease. Bacterial plaques temporarily decrease and seem to be relieved by symptomatic treatment; however, plaques soon increase again, resulting in recurrence of periodontal disease. Therefore, periodontal therapy should be conducted to eliminate causes.

4 Periodontal surgery

After completion of initial periodontal therapy, appropriate surgery is conducted to repair and regenerate lost periodontal tissues in regions requiring this procedure, based on the patients' 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 initial 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, prevention of progression, and stabilization of periodontal disease

Patients with a probing depth <4 mm without gingival inflammation are considered to be “healing” after initial periodontal therapy and periodontal surgery or occlusal function restoration, and can undergo maintenance. Patients with a probing depth <4 mm, but with gingival inflammation are considered to be in the “preventive stage”.

In this stage, periodontal disease is likely to be in progression; therefore, routine PPT should be used for these patients. Patients with a periodontal pocket ≥4 mm, slight tooth movement and furcation involvement without gingival inflammation are considered to be clinically stable and to have a "stable lesion". However, periodontal disease is likely to recur in this stage; therefore, patients with a "stable lesion" should be encouraged to visit a clinic at appropriate intervals and undergo SPT. It is important for patients in this stage to receive maintenance, PPT and SPT and maintain oral health[7]. Determination of the "healing", "preventive stage" or "stable lesion" stage depends on the state of periodontal disease progression.

1) Plaque-induced gingivitis

Plaque-induced gingivitis is cured by initial periodontal therapy and diagnosed by re-evaluation after therapy in a case with "healing" or in the "preventive stage". Periodontal therapy is not discontinued, but maintenance or PPT is performed at appropriate intervals.

2) Periodontitis

Slight periodontitis is often determined as "healing" or in the "preventive stage" in basic periodontal therapy. Moderate or severe periodontitis depends on lesions, and periodontal surgery is performed for lesions as required. Furthermore, after completion of this surgery, re-evaluation (including partial re-evaluation) is conducted to evaluate the effect of periodontal therapy and the state of periodontal tissues. Patients who are determined to be in a "preventive stage", "stable lesion" or "healing" at the completion of oral rehabilitation can transfer to PPT, SPT or maintenance.

3) Progression prevention

"Progression prevention" is a new concept in health insurance that was introduced in the 2020 revision of medical service fees. When re-evaluation shows that a patient has gingival inflammation in some regions, but recovery in all regions with probing depth <4 mm, PPT is used due to the high possibility of periodontal disease progression. Risks should be assessed in the patient, and re-evaluation and PPT should be performed.

4) Stable lesion

Patients who have healthy periodontal conditions, but a periodontal pocket ≥4 mm, slight tooth movement and furcation involvement without gingival inflammation in a re-evaluation are considered to be have a "stable lesion". 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 re-evaluation and SPT. Patients who have bruxism and abnormal habit, decrease tooth-supporting volume due to severe alveolar bone resorption resulting in occlusal trauma even with physiological bite force, or have systemic disease (e.g. diabetes), should also frequently undergo a re-evaluation and SPT.

5) Pathological progression

Patients who have a periodontal pocket >4 mm and BOP during follow-up (maintenance, SPT and PPT) are considered to be in a state of progression of periodontal disease and are assessed as in a "preventive stage". Patients who have attachment loss >2 mm, continuous BOP, X-ray findings of progressive bone resorption, and increased tooth movement should undergo periodontal therapy again.

6) Treatment after healing

Patients with a probing depth <4 mm, but gingival recession and exposed furcation are sometimes determined to be "healing". However, these patients with an exposed root who were determined to be "healing" are likely to develop root caries and require careful maintenance.

3 Medical interview, patient referral, and liaison with medicine

❶ Medical interview

The major reason (chief complaint) for the patient's visit, and particularly their wish for periodontal therapy, should be determined by asking the patient. This is important for good communication with patients and performance of 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 assess 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 mellitus, obesity, ischemic heart disease, aspiration pneumonia, preterm low weight birth, osteoporosis, and immune/allergic disease, as well as environmental factors (smoking, stress, etc.) and genetic factors.

❷ Referral of patients to periodontal specialists and advanced care facilities

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

❸ Liaison with medicine

Aging patients with periodontal disease complicated with different systemic diseases have begun to visit 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 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 prescription drugs, and should refer patients to appropriate facilities with appropriate timing. With regard to diseases including diabetes mellitus that are deeply involved in onset and progression of periodontal disease (see Page 52 "❷ **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), nifedipine (antihypertensive, calcium antagonist) or cyclosporine (immunosuppressant, calcineurin inhibitor), the patient is informed of this possibility and the effect of the prescription drugs is communicated to the attending physician. Close coordination with the attending physician is important to allow a decision on possible drug replacement based on a mutual understanding of the patient. Bisphosphonate (BP) drugs and anti-receptor activator of nuclear factor kappa-B ligand (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. 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 initial periodontal therapy. The type and dose of local anesthetics scheduled, use of adrenaline 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 disease 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 examinations systematically for patients, analyze the results, and plan or revise the therapeutic strategy based on these results. Examinations are also necessary to evaluate the conditions of periodontal tissues in SPT and maintenance. Examination results should always be described in medical records to facilitate planning of the therapeutic strategy and compare with re-evaluated results.

1) Periodontal tissue examination

A periodontal tissue examination includes the following items.

(1) Gingival inflammation

Gingival inflammation is evaluated 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 points method), with the number of measurement points increased or decreased as required.

(3) Attachment level (AL)

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

(4) Periodontal epithelial surface area (PESA) and periodontal inflamed surface area (PISA)

Quantitative evaluation of the periodontal epithelial surface area (PESA) and periodontal inflamed surface area (PISA) gives values for the severity of periodontal disease and inflammatory expansion. The clinical attachment level (CAL) of periodontal pockets, gingival recession volume and BOP are used for estimation (http://www.perio.jp/member/news/file/info_200210_pisa_format.xls). These values are effective as indicators to investigate relationships between periodontal and systemic diseases.

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

Bacterial plaque-attachment conditions are recorded and evaluated using plaque charts. A tooth is divided into four regions, mesial, distal, labiobuccal and lingopalatal sides, and a plaque-sensing agent is used to determine if bacterial plaque is present in the tooth cervix of each side[4].

(6) Tooth mobility

Tooth mobility is measured using the Miller classification of tooth mobility: Grade 0 (physiological movement <0.2 mm), Grade 1 (slight: labiolingual 0.2-1 mm), Grade 2 (moderate: labiolingual/mesiodistal 1-2 mm), and Grade 3 (high: labiolingual/mesiodistal >2 mm or vertically choreatic movement).

(7) X-ray images

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

(8) Occlusion

The occlusal relation in whole tooth alignment (e.g. malocclusion) and traumatic occlusion due to premature con-

tact and cuspal interference are examined (see Page 29 "❷ **Diagnosis of periodontal disease**").

(9) Furcation involvement

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

a) Lindhe & Nyman's furcation classification[5)]

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

b) Glickman's furcation classification[6)]

Grade I: Early bone resorption in the furcation area. Grade II: Disruption and resorption of the alveolar bone in the partial furcation area, but no penetration of the periodontal probe through the furcation area. Grade III: Resorption of bone beneath the furcation area and buccolingual or mesiodistal penetration of the periodontal probe, but the furcation area covers the gingiva. Grade IV: Exposed furcation area in the oral cavity and complete penetration of the periodontal probe.

(10) Plaque retention factors

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

(11) Oral photography

Oral photography provides a record of the oral status that is difficult to record in words or as a figure. Photography is performed at 5 points: frontal, right and left molars, and maxillary and mandibular occlusions. Four lingopalatal sides of the molar are sometimes added, giving 9 points in total.

(12) Study model

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

2) Microbiological assays

(1) Bacterial 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 the PCR invader method are used in bacterial tests. The procedure for determining bacterial enzymes, a chair-side test, does not identify bacterial species, but is used as a convenient method. Bacterial test kits using a monoclonal antibody for *P. gingivalis* are also under development.

(2) Serum bacteria-specific antibody titer test

An enzyme-linked immunoassay (ELISA) is used to determine serum antibodies 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) Quantitative measurements of oral bacteria

Samples collected from the saliva or upper tongue are used to count oral bacteria to understand contamination of the entire oral cavity, using a chair-side instrument.

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.

(2) Saliva test

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

(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 quality of life (QOL) scales are used[8-10].

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] systemic factors, [2] traumatic occlusion, and [3] lifestyle. Next, each tooth unit is diagnosed with plaque-induced gingivitis or periodontitis. Based on these diagnoses, a patient is identified as having plaque-induced gingivitis or periodontitis. Periodontitis is further diagnosed as 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 slight, 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 disruption and inflammation is also considered in diagnosis.

a) Periodontitis classification by degree of tissue disruption

- Slight periodontitis has a bone resorption level (bone level: BL) <15% or an attachment level (AL) <3 mm and no furcation involvement (Stage I).
- Moderate periodontitis has BL ≥15% or AL ≥3 mm to <5 mm and furcation involvement (Stage II).
- Severe periodontitis has BL ≥33% or AL >5 mm and furcation of grade 2 (Stage III, IV).

b) Periodontitis classification by inflammation severity

- Slight periodontitis has a probing depth <4 mm (Stage I)
- Moderate periodontitis has a probing depth ≥4 mm to <6 mm (Stage II)
- Severe periodontitis has a probing depth ≥6 mm (Stage III, IV)

c) Diagnosis of periodontitis by tooth unit

The diagnostic classification is based on the degree of tissue disruption 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 assessed based on the presence of systemic disease, familial onset, smoking and stress.
- Disruption of periodontal tissues that is slower than that in the same age group is diagnosed as chronic peri-

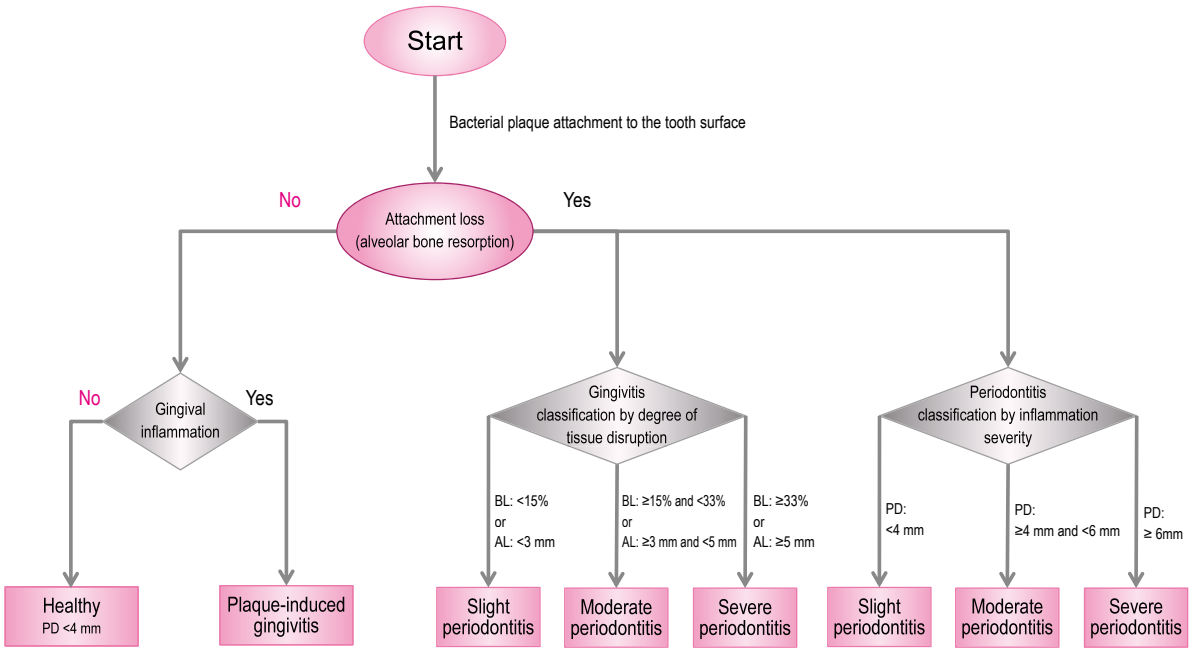

Figure 3. Diagnosis of plaque, induced gingivitis and periodontitis by tooth unit
PD: probing depth; BL: bone level; AL: attachment level

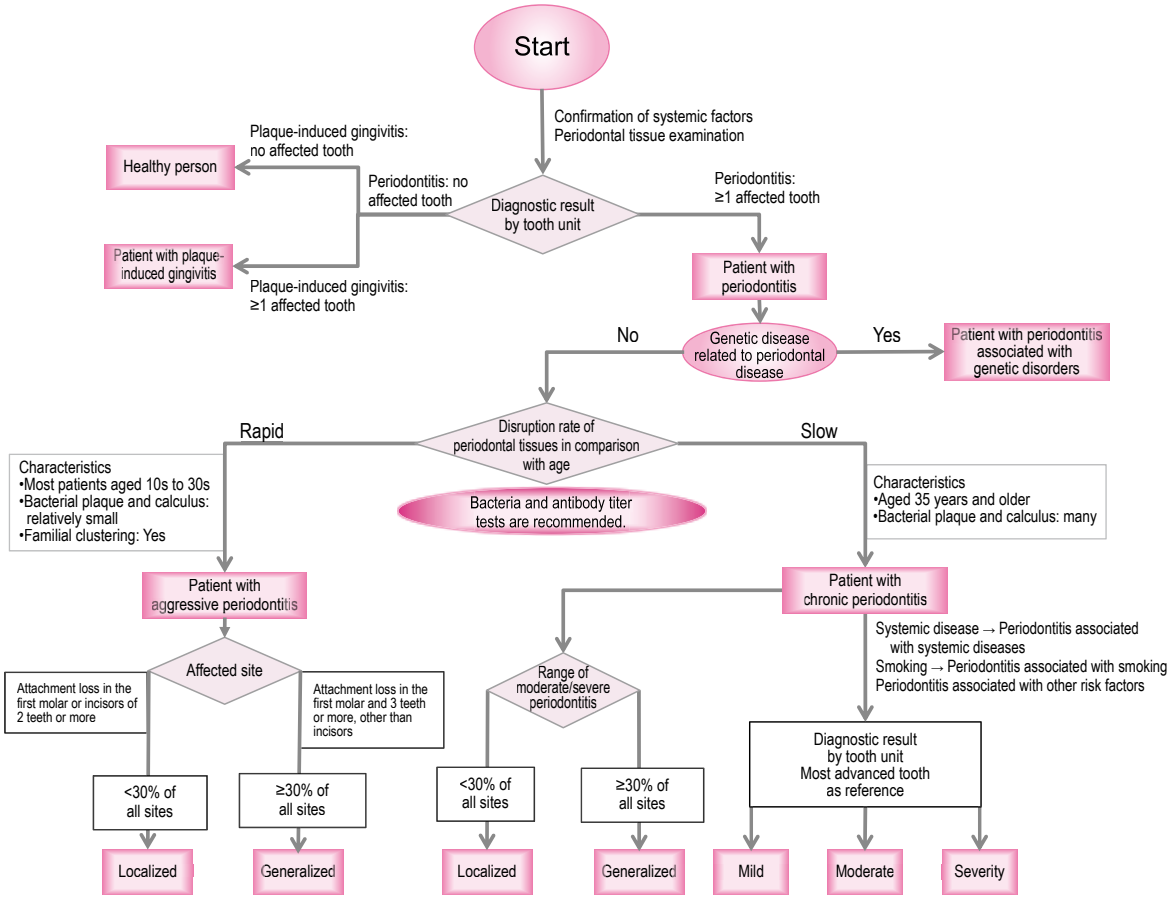

Figure 4. Diagnosis of plaque-induced gingivitis and periodontitis at individual levels

odontitis and that with a more rapid rate is diagnosed as aggressive periodontitis.

b) Progression of periodontitis

- A patient with slight, 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 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 teeth involved is <30% and ≥30%, respectively. However, the AAP Consensus Report[11] 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 has generalized periodontitis. It is important to classify patients based on 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 of the 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 bite force to healthy periodontal tissues and secondary occlusal trauma caused by decreased supporting alveolar bone due to periodontal-induced periodontal disruption. 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.

❸ 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 surgeon's technical capability. After planning this strategy, it is necessary to give a 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 dental 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 particular, it is important to examine gingival inflammation, depth of periodontal pocket, 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 lesions 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, no inflammation including gingival redness, and no smoking are recommended.

3) Periodontal surgery

If an active periodontal pocket ≥4 mm remains after basic periodontal therapy or periodontal tissues disrupted by periodontal disease are to be regenerated, periodontal surgery is considered. This surgery is roughly classified into tissue attachment therapy, resective therapy, periodontal regenerative therapy, and periodontal plastic surgery. If tissue regeneration is needed, periodontal regenerative therapy is considered, whereas gingival recession and oral vestibule are treated by periodontal plastic surgery. It is preferable to refer a patient to a periodontal specialist if difficulties are encountered with dental 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 recommended. 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, periodontal pocket 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 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 follow-up

This examination is performed as in the first dental examination, in principle. Based on these results, the need for repeated basic periodontal therapy and periodontal surgery is determined. If this is not necessary, the patient is assessed to be in a “stable state”, “preventive stage” or “healing” and transferred to SPT, PPT 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) Preventive periodontal therapy

Preventive periodontal therapy (PPT) is treatment to suppress progression of periodontal disease because patients with a probing depth <4 mm but slight gingival inflammation in reassessment after completion of periodontal therapy are likely to be under progression. PPT includes maintenance of motivation, enhanced plaque control, scaling, root planing and professional mechanical tooth cleaning.

9) Maintenance

Periodontal disease is likely to recur and routine maintenance, including plaque control, scaling, root planing and occlusal adjustment, is necessary, even in patients with “healing”. 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 Periodontal therapy and oral biofilm infection in home care, perioperative patients and disabled persons

1 Home care and periodontal therapy

Many bedridden patients at home, who cannot visit a dental clinic or hospital, have functional impairments such as cerebral infarction sequelae, heart disease and lower hemiparesis. A long-term bed-ridden status causes joint contracture, muscular atrophy and dementia, often resulting in reduced mental and physical performance. Therefore, it is important for patients with normal 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 periodontal tissue examination and radiography, inquiry and inspection play a role in planning the therapeutic strategy. Oral contamination level is assessed by bacterial count with quantitative measurements of oral bacteria or tongue coating index (TCI). Periodontal tissue examination includes inspection of gingival inflammation and soft tissues, tooth mobility and probing depth, if possible. In all cases, dentists need 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 the mobility of the fingers 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 can be 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. Initial periodontal therapy is also performed, depending on the 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 probably reduces postoperative complications. 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 maintenance of the oral environment 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 often causes bacteremia, resulting in oral bacteria including periodontopathic bacteria spreading to the whole body. This is a particular risk for infective endocarditis after heart valve replacement. Before any major surgery, antibiotics combined with appropriate oral hygiene procedures are necessary as measures against oral bacterial infection. In radiotherapy for craniocervical regions, it is necessary to apply fluoride before radiotherapy to prevent dental caries, and is also necessary to remove restoration overhangs or dental calculus that may irritate soft tissue. Cancer-related osteonecrosis of the jaw (ONJ) after radiotherapy in the craniocervical region, and ONJ related to Bone-Modifying Agent (BMA) administration is a severe adverse event. It is important to perform periodontal therapy before treatment and reduce as many inflammatory risk factors as possible. Patients who undergo hematopoietic stem cell transplantation sometimes develop bacteremia caused by oral bacteria. Dental disease control including periodontal therapy before surgery reduces severe oral mucositis and decreases the disease duration of febrile neutropenia.

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 the craniocervical region, worsening of periodontal disease is a concern, as well as salivation disorder, oral mucositis and trismus. 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 and progression of periodontal disease after therapy.

3) Aspiration and infection in oral hygiene control

Perioperative oral function control (herein oral hygiene control is referred to 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 evaluate oral contamination conditions using quantitative measurements of oral bacteria (bacterial count) and tongue coating index and to assess patients in cooperation with other healthcare professionals and choose appropriate surgical procedures. Cross infection via oral care has risks for causing nosocomial infection. Studies have shown 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).

3 Disabled persons and periodontal therapy

The Japanese Basic Act for Persons with Disabilities defines the term “persons with disabilities” in this Law to mean individuals whose daily life or social life is substantially and continuously limited due to physical, intellectual or mental disability (hereinafter referred to as “disability”) in Section 2. Disabled persons often have difficulty with oral care and their morbidity rates are high because they have various risk factors for periodontal disease, in-

cluding the influence of systemic disease and oral drugs. Furthermore, they have little interest in or understanding of oral care and are sometimes not willing to receive this care. Treatment and care should be performed based on the disability level and the needs of the patients. Basic periodontal therapy including plaque control and scaling is performed similarly to that for general patients with periodontal disease. If periodontal tissue examination is difficult, oral care is planned based on the results of quantitative measurements of oral bacteria for oral biofilm infection. If normal treatment is difficult, there may be a need for behavior adjustment procedures (behavior modification, body movement control, sedation, general anesthesia). Disabled persons have limitations of self-care due to characteristics of their disabilities and physical handicaps. Professional care by dentists and dental hygienists and oral care by caregivers including their family are important to treat periodontal disease. Periodontal therapy facilitates behavior modification and emotional stability, leading to improved QOL[3]. The details of each step of periodontal therapy are described below.

1) Therapeutic strategy planning

It is important for disabled persons themselves and caregivers to plan a reasonable therapeutic strategy. A feasible strategy should be planned from the viewpoint of "prevention of exacerbation" rather than "complete remission" considering the characteristics of the disabled person.

2) Initial periodontal therapy

Brushing instructions and initial periodontal therapy should be appropriately performed after analyzing and assessing the patient's level of disabilities (cognitive, motor and affective functions required for tooth brushing). However, self-care alone is insufficient and it is important to control inflammation by supragingival/subgingival plaque control by professionals and brushing by a caregiver. A combination of full-mouth scaling, root planing and oral antibiotic therapy has been reported to give clinical and bacteriological improvement in patients with intellectual disabilities and severe periodontitis[4]. These patients may have systemic disease, which depends on the disability level, and adverse reactions of oral drugs and infection should be considered.

3) Periodontal surgery

Periodontal surgery requires good oral hygiene conditions; therefore, a patient without sufficient oral cleansing cannot undergo surgery due to recurrence. Periodontal surgery should be carefully conducted because plaque control can sometimes become more difficult with this surgery.

4) Oral rehabilitation

Although treatment depends on the disability level, easy-to-clean fixed prosthetic devices are preferable because denture is difficult to manage by oneself.

5) Maintenance, preventive periodontal therapy (PPT) and supportive periodontal therapy (SPT)

Bacterial flora in pockets return to previous conditions for 1-2 months if plaque control is poor. Therefore, a short interval is preferable to restart maintenance, PPT and SPT. Professional care should be performed continuously to prevent progression or recurrence of periodontal disease. It is important to make patients and their caregivers understand the necessity of continuous oral care.

4 Oral biofilm infection

Patients in home care, perioperative patients, disabled persons and elderly people described above require control of oral function and hygiene, but some have difficulties with periodontal tissue examination. These patients are evaluated by quantitative measurements of oral bacteria (count of oral bacteria using a chair-side instrument) or assessment of oral contamination using the tongue coating index[5] for oral biofilm infection. These results are used for diagnosis of oral biofilm infection (general term for disease caused by biofilms in the oral cavity and influencing the oral cavity or whole body) and to prevent severe oral biofilm infection and onset of systemic disease[6] (Table 8).

Table 8. Assessment criteria for oral biofilm infection

	Tongue coating: TCI (%)	Count of oral bacteria (CFU/mL)	Gingival inflammation status	Risk
Oral biofilm infection	≥50%	$\geq 10^8$	+++	Critical region
Poor	≥40%	$\geq 10^7$	++	Attention region
Stable	<40%	$< 10^7$	±	Normal range

6 Emergency procedures

1 Identification of cause of pain

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

2 Treatment of acute inflammation (see Page 42, Figure 6 [3])

Patients who visit a clinic 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 attack 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 cleaned and an abscess with marked fluctuation is incised. A local drug delivery system (LDDS) using slow-release drug can be combined with periodontal pocket cleaning[1]. A LDDS is convenient due to its prompt effect and easy-to-use procedures. Refer to “Guidelines for appropriate use of antibiotics in patients with periodontal disease 2020” (edited by the JSP). If an abscess with fluctuation is in a combined periodontic-endodontic lesion, the abscess is incised for drainage. Antibiotics are administered and endodontic treatment is performed early as required. Early non-chronic combined periodontic-endodontic lesions are likely to be improved, while prolonged periodontal-endodontic lesions with remaining periodontal pockets are treated by subgingival SRP. Patients with marked tooth mobility are treated with a temporary splint.

7 Preventive treatment

1 Prevention of transition from plaque-induced gingivitis to periodontitis

The 2016 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 is transferred to periodontitis in these patients, appropriate preventive procedures for periodontal disease inhibits transfer from gingivitis to periodontitis. Persons aged 40 years or more often have periodontal disease. Therefore, appropriate preventive care from age 15 to 25 years is significant for substantial reduction of patients with periodontal disease. Periodontal disease is a bacterial infection; therefore, both self and professional care are important. Furthermore, it is lifestyle-related 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 54 "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. Chronic inflammatory conditions in the oral cavity may result in release of various chemical mediators in blood, leading to increased preterm delivery and low birth weight infants. At present, municipalities conduct dental examinations for pregnant women and those who are found to have periodontal disease are advised to visit a dental clinic. Early detection and treatment are important, but preventive procedures are more important. Routine preventive procedures for pregnant women include periodontal tissue examination, oral hygiene instructions, mechanical tooth cleaning, scaling, scaling root planing and occlusal adjustment, and health guidance. These procedures are also recommended for women planning pregnancy. Refer to pages 28-37 of "Periodontal disease and general health" (edited by the JSP).

8 Initial periodontal therapy

1 Concepts of initial periodontal therapy (Figure 5)

Initial periodontal therapy is treatment to eliminate 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, the pathology is diagnosed and a therapeutic strategy to eliminate causes is planned. Sensitivity to periodontal disease affects the duration of periodontal therapy, and understanding systemic conditions is important to predict the reaction to periodontal therapy and the effects of periodontal disease on the whole body.

2 Strategy for initial periodontal therapy

1) Therapeutic strategy and process of initial 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 initial periodontal therapy determined. Generally, disruption of periodontal tissues and plaque control conditions are the focus; consequently, brushing instructions and SRP take priority. However, efficient initial periodontal therapy can be performed by prioritizing etiologic and risk factors.

2) Therapeutic strategy focusing on bacterial infection and inflammation

Detailed treatment contents (Figure 6) include [1] bacterial plaque-attached 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 plaques[1]. Elimination of bacterial plaques, the main causes of plaque-induced gingivitis and periodontitis, is the

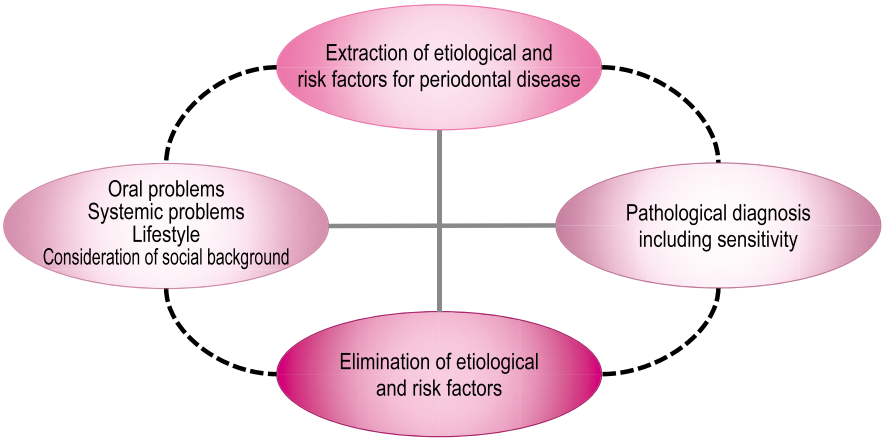

Figure 5. Concept of initial periodontal therapy

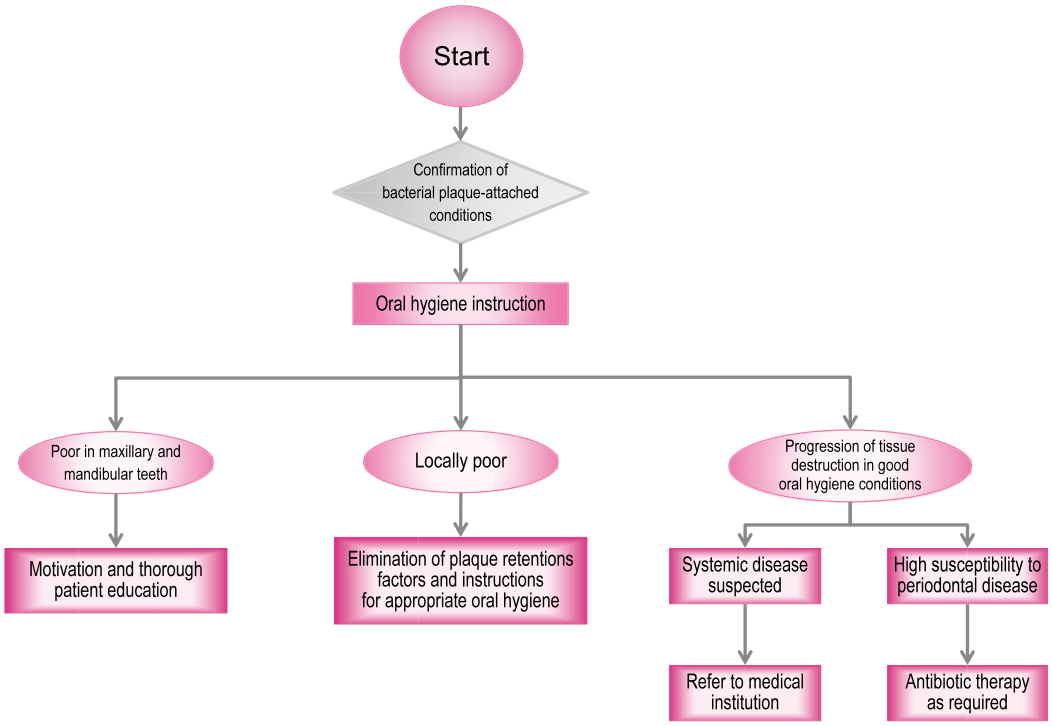

Figure 6 [1]. Initial periodontal therapy for bacterial plaque-attached conditions

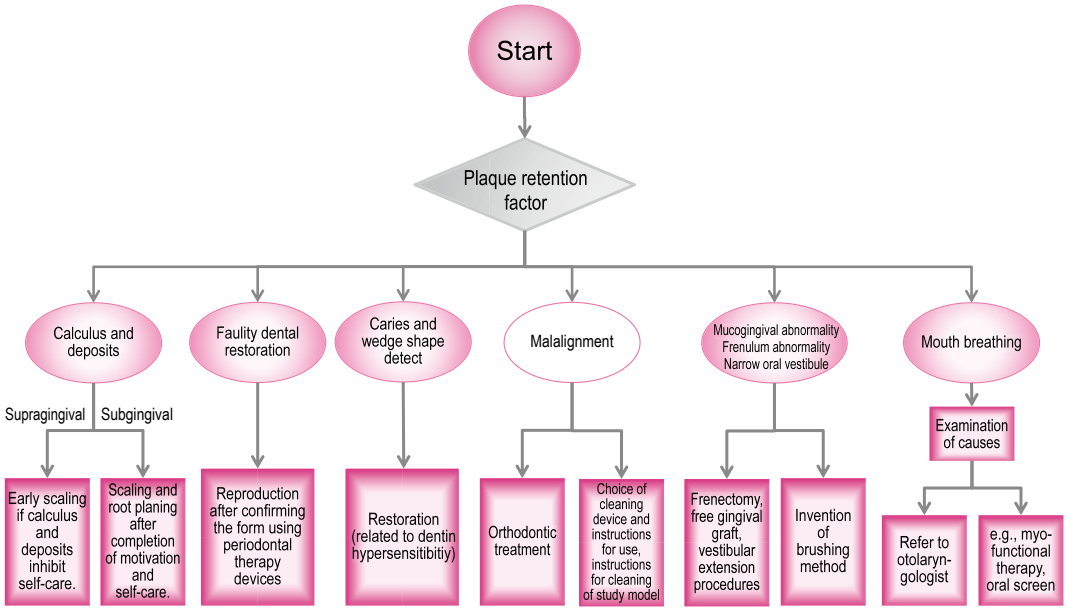

Figure 6 [2]. Initial periodontal therapy for plaque retention factors

basis of treatment and prevention of periodontal disease. Insufficient plaque control in periodontal therapy substantially decreases the effects of dental therapy, including SRP, temporary splint and periodontal surgery, resulting in failure of periodontal therapy itself. 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]. On the other hand, self-care of oral hygiene control (not including routine control) does not frequently include cause-related therapy, which cannot be considered to be an effective approach to periodontal therapy[4,5].

Periodontal therapy maintains good oral hygiene conditions and inhibits progression of periodontitis[6,7]. There-

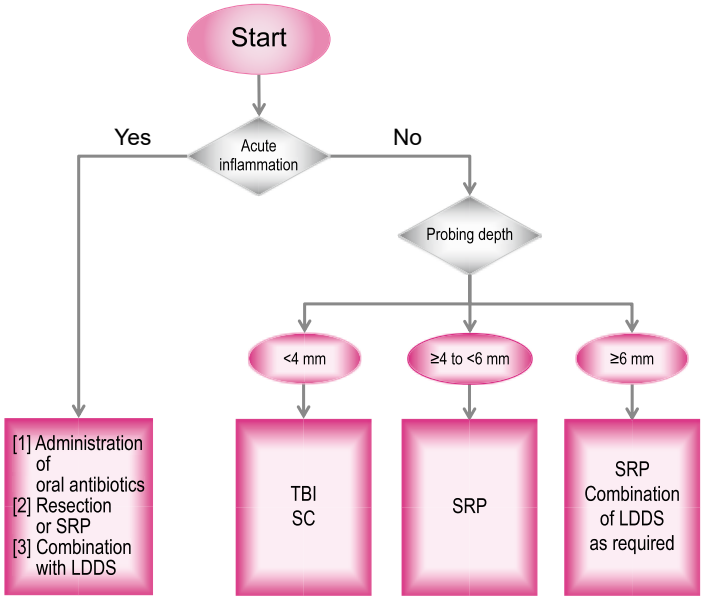

Figure 6 [3]. Initial periodontal therapy considering acute inflammation and probing depth
(LDDS: local drug delivery system, TBI: tooth brushing instruction, SC: scaling; SRP: scaling and root planing)

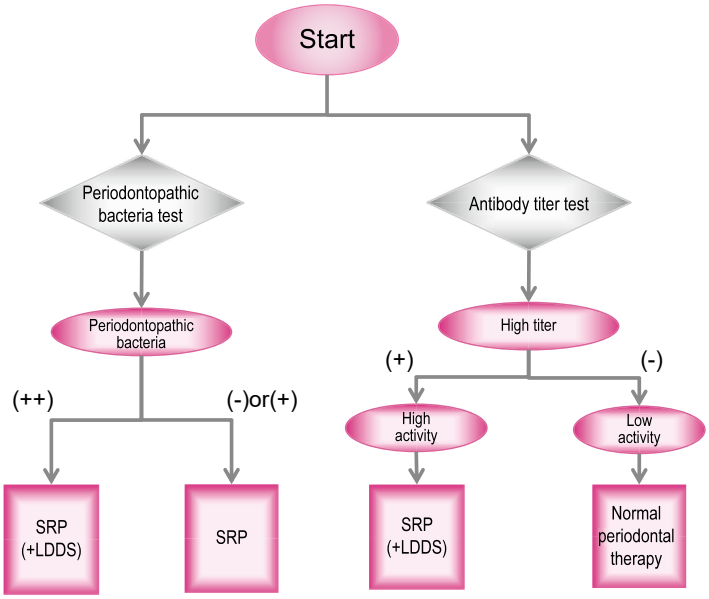

Figure 6 [4]. Initial periodontal therapy using a periodontopathic bacteria test and antibody titer test
(SRP: scaling and root planing; LDDS: local drug delivery system)

fore, 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 attach 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 for periodontal therapy to be successful. 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 examinations, 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 overtime; therefore, repeated motivation sessions are necessary and effective.

(2) Self-care (supragingival plaque control)

Plaque control is classified into mechanical and chemical control. The basic procedures are mechanical plaque control using a toothbrush and supportive cleaning devices (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, defects, type and form of restoration and prosthetic device) and technical level are chosen and instructions on effective brushing are given. Technicians must fully understand the characteristics of various brushing methods, understand a patient's conventional brushing method and oral conditions, and give brushing instructions. Technicians choose an appropriate and effective cleaning instrument (interdental brush, dental floss, electric, sonic and ultrasonic toothbrush). 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 an 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, technicians eliminate bacterial plaque on 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 and root planing

Scaling and root planing are extremely important procedures, in addition to plaque control, for periodontal therapy, and are performed during initial periodontal therapy and periodontal surgery and SPT. Scaling mechanically eliminates supragingival and subgingival bacterial plaque attached to teeth, calculus and other prostheses using various scalers. Calculus is calcified bacterial plaque. It has a crude surface and is attached to many bacterial plaques. 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 technicians 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 and root planing are performed in series as SRP.

(1) Significance and objective of scaling and 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 reach 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 with consideration of 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 showing 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 technician fatigue, resulting in poor efficiency. Therefore, sharpening (grinding) of the hand scaler is important for successful SRP.

(4) Ultrasonic scalers

Bacterial plaque, calculus and other deposits can be mechanically eliminated using ultrasonic scalers. These scalers are effective for elimination of supragingival calculus, and 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 causes transient dentin hypersensitivity after SRP. This should be explained to patients in advance. Patients with dentin hyperesthesia should be appropriately treated.

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

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

4) Extraction of teeth that can not be saved

Teeth that cannot be saved are extracted in initial periodontal therapy. However, such a tooth that maintains an occlusal relationship or plays an important role in oral function may be extracted after teeth in other regions are treated to maintain the occlusal relationship and oral function. If a tooth cannot be evaluated in the initial examination, it is not extracted in initial periodontal therapy and is re-evaluated after completion of this therapy. In particular, teeth with acute inflammation are likely to have increased movement as periodontal pockets become deeper. Therefore, these teeth are evaluated after elimination of acute inflammation to diagnose the condition cor-

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

rectly. When extraction is performed or scheduled, but teeth in other regions are treated before extraction in initial periodontal therapy, or extraction is indicated in re-evaluation, it is important to explain to patients and obtain informed consent because most patients who undergo periodontal therapy want to keep as many teeth as possible. Even for teeth that clearly require extraction after dentomedical assessment, informed consent is required for extraction.

4 Current treatment of bacterial infection (Table 9)

1) Mechanical supragingival plaque control

The major oral hygiene control is brushing by patients using a toothbrush. Use of a cleaning instrument including an interdental brush, dental floss, and electric, sonic and ultrasonic toothbrushes is necessary considering the periodontal severity, treatment period, and the patient's technique and lifestyle. Scaling and professional mechanical tooth cleaning are likely to help plaque control and enhance and maintain a patient's motivation[1]. Adjustment and removal of an incompatible restoration and prosthetic device disturbing supragingival plaque control and occlusion 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]. Periodontal pockets of depth 5-7 mm have decreases of 1-2 mm and attachment gain of 0.5-1 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 has inhibitory action on bacterial plaque formation

Table 9. Initial periodontal therapy chosen by diagnostic classification

Diagnostic classification	Systemic control* (medical cooperation)	Mechanical plaque control		Chemical plaque control			
				Supragingival	Subgingival		
				Application of antimicrobial and antiseptic agents		Antibiotic therapy	
		Supragingival (brushing, scaling)	Subgingival (scaling and root planing)	Mouthwash	Subgingival pocket irrigation	Interpocket application of antimicrobial drug (Local drug delivery system: LDDS)	Oral administration
Plaque-induced gingivitis	▲	●	▲	▲	▲		
Chronic periodontitis (slight)	▲	●	●	▲	▲	▲	
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 10. 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.
Cetylpyridini-um 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/MHLW 0327004, March 27, 2008.Cited from reference[5)]

and a depositing action on the tooth surface. Phenols, povidone-iodine, cetylpyridinium chloride, and essential oils are also used[4)]. In initial periodontal therapy, continuous use for 2-4 weeks after scaling prevents regrowth of periodontopathic bacteria (Table 10)[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] an understanding 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 subgingival 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) Interpocket application of antimicrobial drug

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 by ini-

tial periodontal therapy. However, incorrect administration may induce microbial substitution and antimicrobial resistance, and there has been no validation of repeated administration of antibiotics in SPT.

(3) Oral administration of antimicrobial agents

Oral administration of antibiotics is considered for patients with periodontitis that is not improved by initial therapy, patients who cannot undergo invasive treatment, immunocompromised patients with periodontitis, and patients with generalized aggressive periodontitis and severe generalized chronic periodontitis. Antibacterial therapy must be performed after [1] thorough planning, [2] clarification of 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 treatment-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. infectious endocarditis, aortic valve disease, cyanotic congenital disease, prosthetic valve/shunt).

The details of antibacterial therapy for patients with periodontal disease are described in the "Guidelines for Appropriate use of Antibiotics in Patients with Periodontal Disease 2020" published by the JSP.

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 18 "**6 Characteristics of occlusal trauma**"). Occlusal trauma is associated with degenerative necrosis in the pressed region of periodontal ligament and alveolar bone resorption (see Table 11). Before treatment, occlusal trauma should be accurately diagnosed (see Page 31 "**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 11: "tooth mobility" and "enhanced periodontal ligament space" are important[2].

Table 11. Clinical findings and X-ray images of occlusal trauma (revised 1999 AAP New Periodontal Disease Classification)

One or more clinical findings are included
1) Increased tooth movement
2) Early contact
3) Marked attrition
4) Deep periodontal pocket formation
5) Pathological tooth migration
6) Abfraction (wedge shape detect)
7) Tooth fracture
Findings on X-ray images include one or more of the following items
1) Enhanced periodontal ligament space
2) Changed alveolar bone (loss, hyperplasia)
3) Bone loss (furcation, vertical, circumferential)
4) Root resorption
5) Cementum hyperplasia

1) Relationship of occlusal trauma with progression of periodontitis

Traumatic occlusion is not an initial factor for periodontitis, but is 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 as follows.

[1] Initial periodontal therapy for bacterial infection. If functional impairment is found, occlusal adjustment may be a priority.

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

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

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

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 bite force on periodontal tissues during dental occlusion and calm inflammation in periodontal tissues by correcting traumatic occlusion. Selective grinding makes bite 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 movement. 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, revise food impaction, and eliminate premature contact interfering with orthodontic treatment. Occlusal reshaping[5] is performed to revise the ridge and buccolingual diameter of the 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, bite force is reduced by preserving 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, strong tooth movement is detected, or periodontal tissues are disrupted, 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 movement 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 movement is temporally increased by in-

vasion 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 disruption in 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, early 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 bite force on the splint site.

4) Devices for periodontal therapy (provisional restoration)

For patients with a tooth defect who require extraction or elimination of incompatible restoration and prosthetic devices, 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 bite force to remaining teeth, and are referred to as devices for periodontal therapy and denture base and crown type devices[7]. If incompatible restoration and prosthetic devices are involved in onset of periodontal disease, periodontal tissues are stabilized by eliminating incompatible restoration and prosthetic devices for periodontal therapy during initial 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 initial 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 the periodontal tissue conditions during installation of devices for periodontal therapy, confirm the regions with possible recurrence, consider appropriate forms, and incorporate these results into design of the final prosthetic device.

[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 bite 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 (oc-

clusal 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 disruption. Occlusal adjustment after orthodontic treatment is essential and it is important to obtain balanced occlusal conditions and continue to follow up. An improved dental arch by orthodontic treatment makes oral hygiene control easier and stabilizes periodontal tissues.

6 Support for smoking cessation

Smoking is a risk factor for periodontal disease. Therefore, support for smoking cessation of patients with periodontal disease based on an understanding of smoking history including tobacco products, physical/mental nicotine dependence, and preparation of smoking cessation is important to make periodontal therapy successful[1-3]. Smokers who require periodontal therapy do not intend to quit smoking and many have risks for various diseases[1-3]. Therefore, patients with findings[4] induced by self and passive smoking should be positively enlightened about relationships between smoking and worsening of periodontal disease[5], passive smoking and periodontal disease, and systemic health problems, and should receive smoking cessation instructions as part of initial periodontal therapy.

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 local plaque retention factors, see Page 28. In addition, the characteristics and procedures are described for elderly people, sick persons, women, and smokers at risk of treatment.

1) Systemic risk factors (see Page 19 " ❼ Systemic conditions and periodontal disease")

Systemic risk factors include age, sex, ethnic differences, genetics, systemic disease, and genetic factors such as individual sensitivity to 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 drinking. In particular, smoking is an important risk factor for progression of periodontal disease[2]. 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.

❶ 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 healthcare. 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 elderly people, it is necessary to consider the general characteristics of old age, mental and physical conditions, the level of finger function, swallowing hypofunction 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, and non-surgical treatment should be repeated. This should be mainly debridement in periodontal pockets including plaque control and SRP as required, and supplemental combined chemical plaque control. Elderly people also often develop new systemic disease during maintenance, preventive treatment

for severe periodontal disease and SPT; consequently, medication has to be changed or increased. Therefore, there is a need to ask about new disease or medication at every visit. Cognitive decline may also occur. If unprecedented problems with a patient's fingers or brushing actions decline during maintenance, preventive periodontal therapy and SPT, and it is necessary to contact their family and provide assistance according to cognitive function and brushing actions.

Patients with oral hypofunction associated with decreased swallowing function should undergo tongue coating test and oral biofilm test to assess bacteria counts to examine contamination of the entire oral cavity and manage the whole oral cavity, including the tongue and mucosa. Even for patients without oral hypofunction, it is useful to understand oral conditions using an oral biofilm test and control the whole oral cavity for suppression of systemic disease, including aspiration pneumonia in elderly patients. More attention should be given to physical, mental and environmental changes in periodontal therapy for elderly people, compared to therapy for those in late middle age.

❷ 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 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" (JSP).

(1) Type 1 diabetes

When undergoing tooth extraction or periodontal surgery, it is necessary to be careful not to develop hypoglycemia in patients who are restricted in eating and drinking for a long period of time.

(2) Type 2 diabetes

It is generally preferable not to perform SRP until patients achieve plaque control by themselves; however, periodontopathic 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 with 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 details of antibacterial therapy, refer to the "Guidelines for Appropriate use of Antibiotics in Patients with Periodontal Disease 2020" published by the JSP.

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.

❸ 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 tooth cleaning, 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 basically be performed after delivery. Periodontal disease is a risk factor for preterm and low birth weight infant delivery; 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 39 "❷ **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 25 "❸ **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.

❹ 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 heavy smokers, 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 JSP published a clinical path for a standardized periodontal surgical process as guidelines for periodontal surgery. The clinical path facilitates appropriate and safe periodontal surgery, and has been improved by revision, leading to improvement in the quality of healthcare. The JSP recommends use of this clinical path in periodontal surgery. It is preferable to refer a patient to a JSP Board-Certified Periodontist in case of difficulties with periodontal surgery by oneself. The indications for periodontal surgery are [1] a deep periodontal pocket after initial periodontal therapy, [2] poor plaque control and relapse of periodontitis due to soft and/or hard tissue morphological abnormality, and [3] esthetic dysfunction and anatomical morphological abnormality preventing installation of appropriate restoration and prosthetic devices[1].

A patient should also meet the following conditions before periodontal surgery: [1] provision of informed consent after a full explanation, [2] good general conditions, [3] good oral hygiene, and [4] current non-smoker. Periodontal surgery is classified into four types: tissue attachment therapy, resective therapy, periodontal tissue regenerative therapy, and periodontal plastic surgery. The type of periodontal surgery is determined by comprehensive consideration based on the bone defect type, oral hygiene conditions, probing depth, BOP, and radiographic findings (Table 12, Figure 7). The indications for periodontal surgery are probing depth ≥4 mm with BOP in re-evaluation; however, surgery may be conducted to improve poor gingival forms in cases with a lower probing depth and no BOP. Bone defect conditions are important criteria in the choice of the surgical procedure (Figure 8)[2].

Definition of flap surgery: Flap surgery is periodontal surgery to detach the gingiva using a full thickness or partial thickness flap; curette plaque, calculus and inflammatory granulation tissues with clear visibility; and eliminate or decrease periodontal pockets. Flap surgery is classified into flap curettage and modified Widman flap surgery based on the incision and detachment procedures. Recently, less invasive flap surgery has been conducted using MIST (minimally invasive surgical technique) and M-MIST (modified minimally invasive surgical technique) for localized lesions, with consideration of flap design to avoid postoperative gingival recession and depression and to maintain clots obtained from tightly closed wounds[3,4]. These procedures apply to incision methods to conserve interdental papilla using MPPT (modified papilla preservation technique) and SPPF (simplified papilla preservation flap)[5,6]. The procedures are also combined with periodontal regenerative therapy.

1 Tissue attachment therapy

Tissue attachment therapy is a surgical procedure to eliminate bacteria and bacteria-derived contaminants on roots

Table 12. Bone defect type and periodontal surgical procedures

Vertical bone loss	Tissue attachment therapy	· Flap curettage (flap surgery) · Modified Widman flap surgery
	Resective therapy	· Apically-positioned flap surgery + osteoplasty or ostectomy
	Periodontal tissue regenerative therapy	· Bone graft · Guided tissue regeneration (GTR) method · Enamel matrix derivative (EMD) applied surgical procedure · Surgical procedure using basic fibroblast growth factor (FGF-2) · Surgical procedure using other biologically active substances
Horizontal bone loss	Tissue attachment therapy	· Periodontal curettage · Excisional new attachment procedure (ENAP) · Flap curettage (flap surgery) · Modified Widman flap surgery
	Resective therapy	· Apically-positioned flap surgery (+ ostectomy) · Gingivectomy

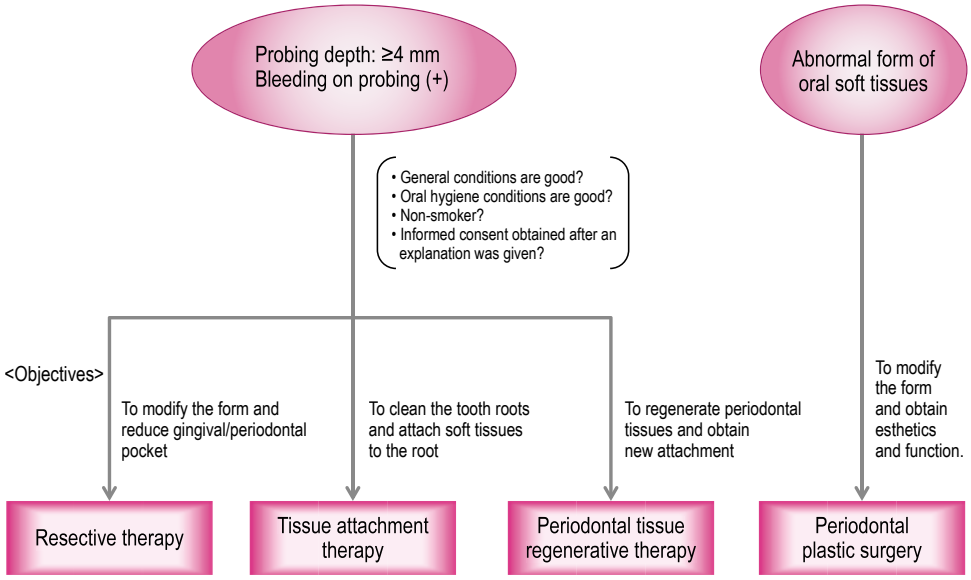

Figure 7. Selection criteria for periodontal surgery by purpose

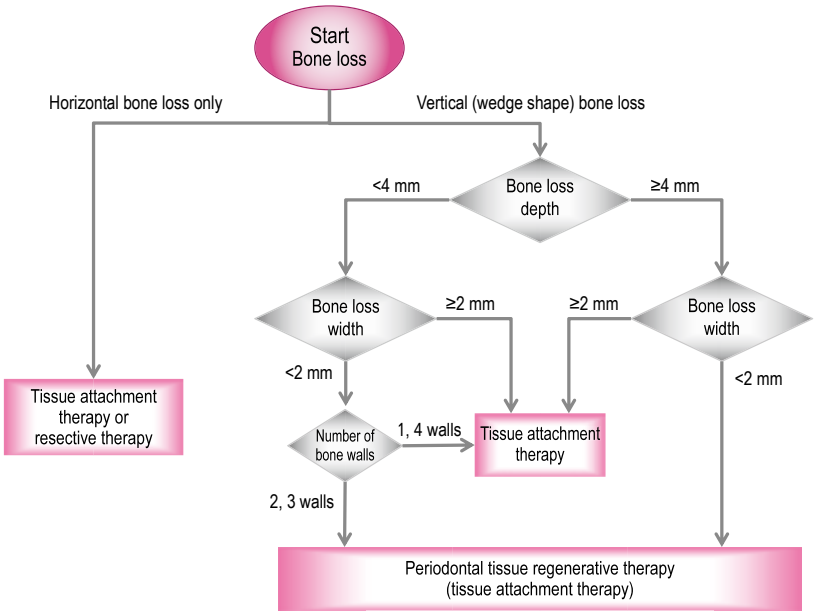

Figure 8. Selection criteria for periodontal surgery by bone defect type
* The depth and width of the bone defect are radiographic findings.

and inside periodontal pockets, and facilitate attachment of gingival soft tissues on roots[7]. Tissue attachment therapy does not include ostectomy, osteoplasty or apically positioned flap surgery, but includes periodontal curettage, excisional new attachment procedure (ENAP), flap curettage (access flap surgery), and modified Widman flap surgery. The major selection criteria, surgical characteristics and indications for tissue attachment therapy are shown in Figure 9. In patients with fully controlled oral hygiene, tissue attachment therapy results in better attachment gain than resective therapy[7].

1) Periodontal curettage

Periodontal curettage treats roots (e.g., elimination of bacterial biofilm, calculus and pathological cementum) with simultaneous curettage of inflammatory lesions (periodontal pocket epithelium, inflammatory granulation tissue)

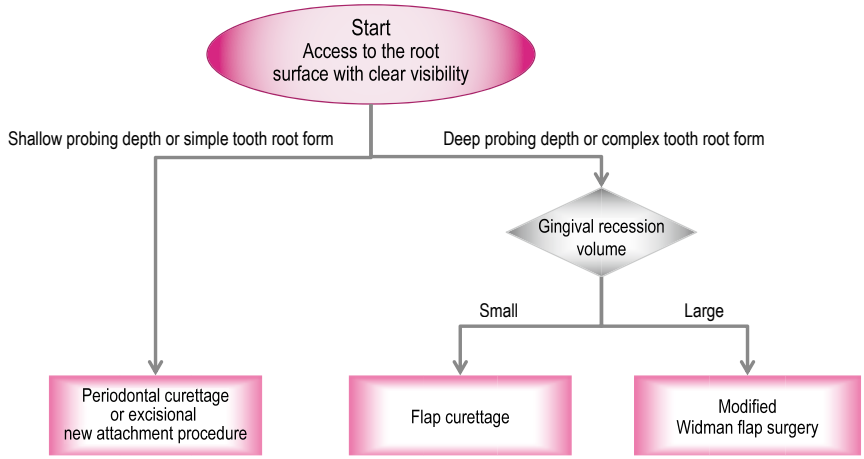

Figure 9. Selection criteria for tissue attachment therapy

on the inner walls of periodontal pockets using curette type scales. This is a procedure for promoting attachment of the gingiva on root surfaces and decreasing periodontal pockets. This procedure is performed to attenuate inflammation in the tissues surrounding periodontal pockets and stabilize the pathology, even for deep periodontal pockets that are 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 procedure for removing the periodontal epithelia and inflammatory tissues using a 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 curettage, ENAP is less invasive and results in less gingival recession than flap surgery. However, new attachment is seldom gained and outcomes result in cure with long epithelial attachment.

3) Flap surgery

Flap surgery is periodontal surgery to detach the gingiva from the alveolar bone, remove contaminants including plaque and calculus on the tooth root with clear visibility, remove the periodontal epithelia and granulation tissues, and then return and suture the gingival flap to remove or decrease periodontal pockets.

Characteristics: The surgical procedure is also usable for vertical bone resorption. Cure condition is long epithelial attachment[8].

(1) Flap curettage

This surgery is conducted with almost similar objectives and procedures as those of modified Widman flap surgery described below. The gingiva is incised from the gingival margin to alveolar crest to access the tooth root and detached to make the alveolar crest slightly exposed in the full thickness flap. The tooth root can be cleansed with clear visibility. Surgical invasion is reduced and postoperative gingival recession is minimal.

(2) Modified Widman flap surgery

Modified Widman flap surgery was introduced by Ramförd[4]. The gingiva is incised from 1-2 mm outside of the gingival margin and detached 2-3 mm from the alveolar crest in the full thickness flap. This surgery ensures definite removal of periodontal pockets, but postoperative gingival recession and the exposed tooth root are large.

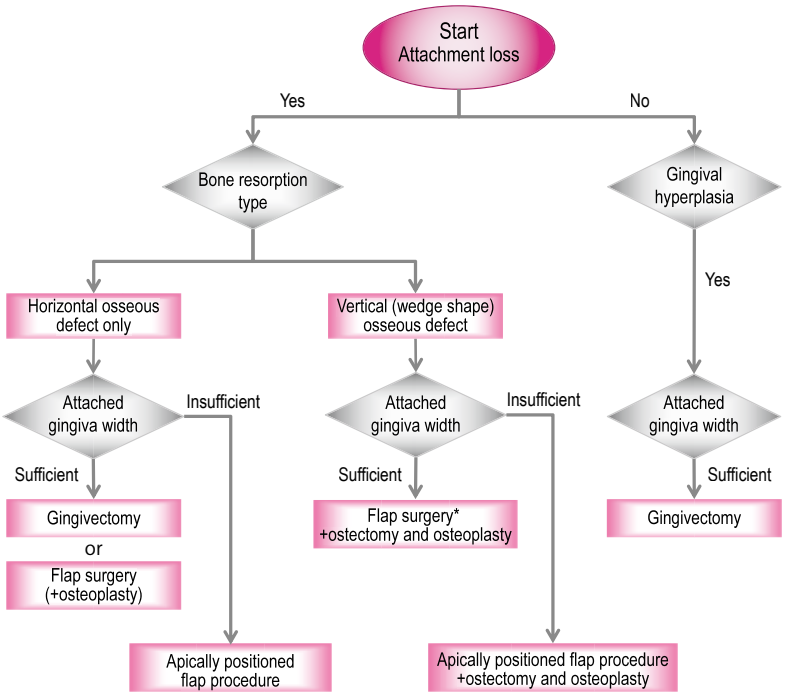

Figure 10. Inclusion criteria for resective therapy
* Incise further outside of the gingival margin.

❷ Resective therapy

Resective therapy includes gingivectomy, an 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 dentin hyperesthesia are needed.

1) Gingivectomy

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

Characteristics: Gingivectomy is a simple procedure for definite elimination of gingival and periodontal pockets, and outcomes after surgery are easily predictable. However, gingivectomy may cause 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 surgery

The gingival flap over the mucogingival junction is removed, and then transferred to the apical side before suture. This procedure is classified as resective therapy because it completely eliminates periodontal pockets, but is also included in periodontal plastic surgery because the attached gingiva width is allowed to increase. The gingival flap over the mucogingival junction is removed and then transferred to the apical side before suture. However, the gingival flap of the maxillary palate cannot be transferred to the apical root and the gingival thickness and height are adjusted using a 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, osteoplasty and ostectomy are usually combined to eliminate vertical osseous defects and bone torus or keep supracrestal tissue attachment and biologic width.

Characteristics: Periodontal pockets are reduced by the periapical flap procedure, but the root exposed area increases; therefore, it is necessary to give instructions on careful oral hygiene management. This procedure is also used as a clinical crown lengthening procedure.

❸ Periodontal regenerative therapy

(see "2012 Guidelines for Regenerative Therapy in Patients with Periodontal Disease" (JSP[9]))

Several periodontal regenerative therapies are based on recent studies of periodontal regeneration. There is a long history of bone transplantation and guided tissue regeneration (GTR) as regenerative therapy. In the 21st century, clinical applications include use of biologically active substances. The main procedures with these substances are surgery using enamel matrix derivative (EMD) or basic fibroblast growth factor (FGF-2). 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 transplantation

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

Characteristics: Indications are various bone defects and furcation. Good bone regeneration is expected when many bone walls support graft materials. Bone transplantation 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 a GTR membrane.

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

3) Enamel matrix derivative-applied surgery

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

Characteristics: The indications are vertical osseous defect in 2 or 3 walls, but some cases with osseous defect in 1 wall are also included. EMD is considered to have outcomes similar to those of GTR (nonabsorbable mem-

brane) for probing depth and attachment gain one year after surgery. For furcation involvement, there are studies showing that EMD provides significantly improved attachment gain and improved vertical osseous defect in comparison with flap surgery; however, furcation is not currently included in indications of EMD in Japan and its use requires careful consideration. Use of EMD requires treatment of tooth roots (EDTA, etc.).

4) Surgical procedure using basic fibroblast growth factor (FGF-2)

This is a surgical procedure for inducing regeneration of periodontal tissues with topical application of FGF-2 products. FGF-2 is a cytokine that acts upstream of the wound healing cascade and facilitates healing. FGF-2 application promotes proliferation and migration of periodontal stem cells, induces angiogenesis, and prepares the local environment for reconstruction of periodontal tissues, leading to regeneration of these tissues. In 2016, the world's first periodontal tissue regenerator was made in Japan (0.3% FGF-2; Product name: REGROTH®, dental fluid kit, 600 μg/1,200 μg). This has achieved marketing approval and is commercially available in Japan.

Characteristics: The indication is vertical osseous defect with probe depth ≥4 mm and osseous defect depth ≥3 mm. No treatment of tooth roots is needed and fluid is applied to tooth defect sites. The contraindications are malignant tumors in the oral cavity or a past history of these tumors, and thorough examination is necessary before surgery.

5) Surgical procedures using other biologically active substances

Commercial regenerative materials combined with tricalcium phosphate (β-TCP), bone graft materials, and BB isoforms of platelet-derived growth factor (PDGF-BB) are used for periodontal regenerative therapy in the United States. Platelet-rich plasma (PRP) therapy that uses isolated platelet-rich components from autologous blood to activate biologically active substances including PDGF to induce periodontal regeneration is also applied clinically. The Law on Securing Safety of Regenerative Medicine was enforced on December 25, 2014 and PRP is classified as a Regenerative Medicine Class III. (The names of regenerative medicines and institutions performing regenerative medicine are shown on the website of the Ministry of Health, Labour and Welfare).

4 Periodontal plastic surgery (including gingival/alveolar mucosaplasty)

Periodontal plastic surgery is a collective term for surgical procedures for improving anatomical problems, including those of the labial frenum and muscle attachment, which inhibit the marginal gingiva, lack and loss of attached gingiva, shallow oral vestibule and frenulum, and exposed tooth roots (gingival recession) to treat and prevent periodontal disease, confirm the oral environment to facilitate plaque control, and improve esthetics[10].

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 an effective procedure 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 through a 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 advanced 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. This procedure is also used to cover a bone graft and GTR membrane in dressing of connective tissue transplantation and periodontal regenerative therapy. However, pressing on a gingival flap sometimes causes recurrence and necrosis, leading to relaxing incision. Another procedure is semilunar coronally positioned flap surgery that 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 Page 58 "❷ **Resective therapy**").

5) Free gingival graft

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

Characteristics: A graft meeting the size of the receptor can be collected, but the graft requires two surgical sites. Laterally-moved flap and periapical flap procedures are sometimes combined with the grafting. A disadvantage is that the grafted gingiva forms a keloid-like region (graft island).

6) Connective tissue graft

Connective tissue graft is a procedure for transplanting subepithelial connective tissues collected mainly from the palate. This procedure is divided into subepithelial and free connective tissue grafts. The objectives of the former include gingival recession and covering of exposed roots, and those of the latter include expanded oral vestibules, acquisition of attached gingiva, alveolar ridge augmentation in a region requiring esthetics, and protection of GTR membranes and newly formed tissues on the GBR membrane.

Characteristics: Subepithelial connective tissue graft in the receptor 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 perioplasty

Besides the periodontal plastic surgery mentioned above, vestibuloplasty and a bilateral papilla flap procedure 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 and Er,Cr:YSGG laser with high water-absorbability have particularly been used in debridement of pathologic roots, including calculus elimination. The Er:YAG and Er,Cr:YSGG laser output is absorbed by water in calculus and the internal pressure increases as vaporization is produced, with contaminants including calculus 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 non-contact action and is completely different from a 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[11].

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 with a dental X-ray 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.

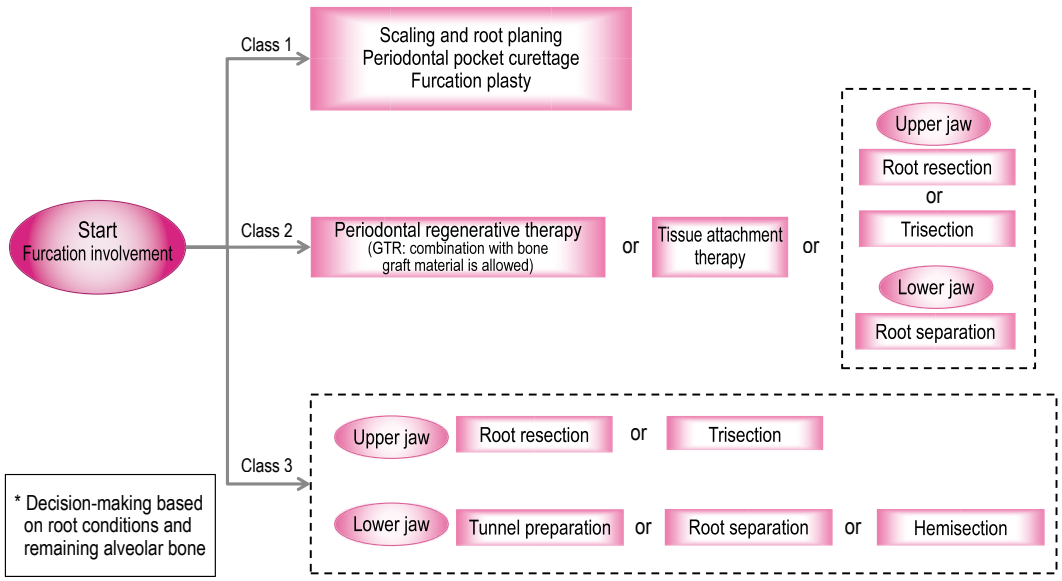

Figure 11. Inclusion criteria for therapy for furcation involvement

[1] Class I or mild Class II lesion: treated with basic periodontal therapy, selective grinding and removal of 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 periodontal-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 periodontal-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 periodontal-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 periodontal-endodontic lesions are suspected, the following items are examined: [1] pulp viability, [2] probing depth (position of pocket bottom) and probing of furcation, [3] X-ray image (form and number of the root or root canal; CBCT definitively shows the range of bone defect and the relationship 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 (ascending 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 restorative and prosthetic therapy, orthodontic treatment, and implant therapy. Oral rehabilitation for patients with periodontal disease is required for enamel and dentin defect, tooth loss, tooth mobility, 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). Splinted prosthesis and removal of partial denture are often performed to fix mobile teeth during initial periodontal therapy; 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 shows the importance of solving these problems and performing oral rehabilitation, an objective of dental treatment[1].

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, inflammation and occlusal trauma, including oral hygiene (O'Leary plaque control record), probing depth and BOP; and occlusal trauma based on X-ray images (bone resorption, root length, enhanced periodontal ligament space), tooth mobility and fremitus (slight vibration in occlusal contact), and number, placement and occlusion of remaining teeth (e.g., bruxism, bite force).

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, in-

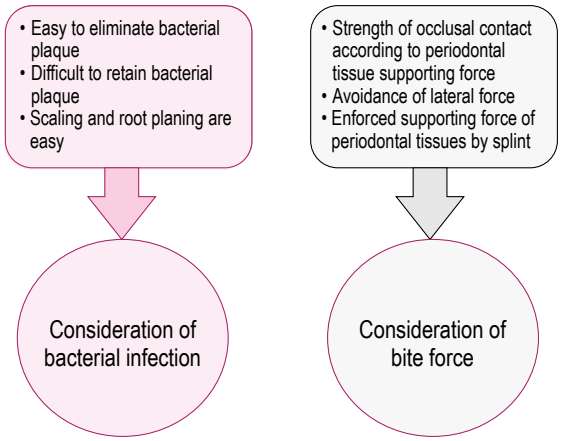

Figure 12. Bacterial infection and bite force in oral functional restoration in patients with periodontal disease[1-4]

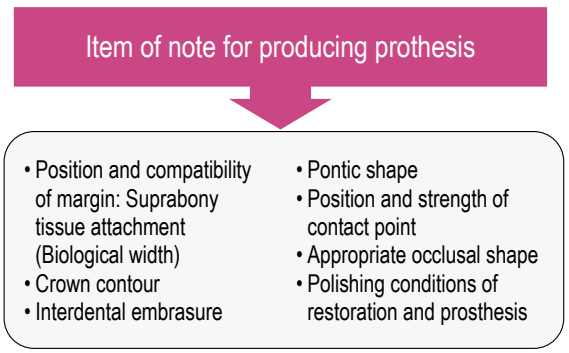

Figure 13. Precautions in production of a prosthesis for oral rehabilitation

cluding premature 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, a priority should be given to plaque control and scaling, although occlusal adjustment and temporary splint are sometimes necessary during initial periodontal therapy. For patients with dysfunction due to remaining mobility after these procedures, 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 mobility 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 destruction have decreased support from remaining teeth. Consequently, it is often necessary to determine whether the prosthesis is a cause of bacterial infection or occlusal trauma based on chronological data. The process in such a case is to produce devices for periodontal therapy, examine the form of the prosthesis and the splint range, and assess whether a less predictable tooth or a tooth with severe mobility is maintained. Specifically, a splint with devices for periodontal therapy is used for temporal restoration of occlusion and esthetics and also for assessment of cleaning, the form of prosthesis and conservation of remaining teeth.

❷ Choice of procedures for prosthesis and precautions

1) 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 mobility, or occlusal trauma remains. There are various problems with performance of crown restoration for permanent splint, including abutment tooth preparation, impressive accuracy, model production, compatibility of prosthesis, occlusion, and type of luting cement. Required root canal therapy may cause additional problems. Interdental embrasure and a contour of the prosthesis should be produced to make it easier 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. An incorrect splint range may induce occlusal trauma in a splint tooth or other remaining teeth, as well as avulsion and fracture of prosthesis[6]. Long-term maintenance of prosthesis requires decreased avulsion and fracture of prosthesis[8]. For patients with a strong bite force, it is particularly important to consider occlusal trauma (Figure 13)[5,6].

2) Treatment of partially edentulous arch

For tooth loss, prosthetic therapy is performed with a fixed bridge, denture removal, tooth transplantation, and implanting. Prosthesis for tooth loss is important to secure a continuous dental arch and occlusion and prevent occlusal trauma from remaining teeth. Understanding the cause of tooth loss is important to obtain good prognosis. If periodontal disease is the cause of tooth loss, it is necessary to understand whether occlusal trauma is involved in the tooth loss. If this is true, full consideration of the response to occlusion is needed. In a free-end missing without traumatic dental occlusion, the molar is not used for prosthetic therapy, but the short dental arch with occlusion to the premolar is used for building (Table 13)[9].

(1) Bridge[10-17]

A prosthetic bridge makes abutment teeth receive a bite force; therefore, it is important to examine the missing 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 splinting effect, leading to prevention of occlusal trauma.

Table 13. Choice of prosthesis

Missing level		Support of periodontal tissue and masticatory and bite force	Prosthesis			
			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 splint of remaining teeth)	△ (Abutment teeth bilaterally placed as indirect retainer)	○ (Attention to fracture of antagonist)	×
Multiple teeth loss	Number of occlusal support: 9-6	Support of periodontal tissue ≥ masticatory and bite force	△ (Canine protected articulation and molar occlusal support are confirmed)	◎ (Splint of remaining teeth and bilateral partial denture)	◎	×
		Support of periodontal tissue < masticatory and bite force	×	○ (Splint of remaining teeth and bilateral partial denture)	○ (Attention to fracture of antagonist)	×
	Number of occlusal support: 6-5	Support of periodontal tissue ≥ masticatory and bite force	×	◎ (Splint of remaining teeth and bilateral partial denture)	○	×
		Support of periodontal tissue < masticatory and bite force	×	○ (Splint of remaining teeth and bilateral partial denture)	○ (Attention to fracture of antagonist)	○ (Multiple teeth are lost due to root fracture)
Non-vertical stop occlusion		Support of periodontal tissue ≥ masticatory and bite force	×	×	◎ (Prognosis of remaining teeth have no problems)	◎ (Overlay denture)
		Support of periodontal tissue < masticatory and bite force	×	×	○ (Attention to choice of materials for superstructure)	◎ (Overlay denture)
Several teeth remaining		Under any condition	×	×	○ (Conditions of residual ridge and mucosa membrane are appropriate)	◎ (Overlay denture)

◎ Recommended, ○ Indicated, △ Indicated by condition, × Inadequate

(2) Removal of partial denture

Denture must be designed based on the missing range, number of remaining teeth and position, and number of antagonists. Denture design may cause load bearing of abutment teeth and induce occlusal trauma; therefore, the load bearing ratio of bite force to remaining teeth and residual ridge mucosa should be carefully determined. The requirements for stability of partial denture are support (vertical movement), grasp (horizontal movement), and retention (prevention of detachment); however, it is necessary to design denture with consideration of oral cavity cleansing. Stable denture reduces the load bearing of abutment teeth; however, it is important to design denture with full consideration of the load bearing capacity of remaining teeth.

(3) Implant[18,19]

An implant gives strong support and usually reduces the load bearing of remaining teeth. An implant can avoid splint associated with cutting of neighboring teeth, but may act as a traumatic force on an antagonist. 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 bacterial infection from natural teeth to peri-implant tissues.

(4) Tooth transplantation

Tooth transplantation is related to complicated factors for outcomes, including the choice of transplanted teeth, transplant site and transplant technique. Particularly in evulsion of transplanted teeth, as many healthy periodontal ligaments as possible should be kept[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 malocclusion.

2) Remodeling of the periodontal tissue 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, install rigid prosthetic devices, reduce prosthetic burden against abutment and retaining teeth, secure occlusal stabilization, prevent natural teeth grinding associated with restorative and prosthetic therapy, and improve masticatory efficacy and esthetics[1,2]. 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[3,4]. There are no strict criteria for extracting teeth with periodontal disease or use of implant therapy, and implant therapy should be determined based on the patient's preferences, a full examination by the dentist, and informed consent based on test results.

2 Peri-implant tissue structure

In comparison with periodontal tissues, tissues around implants have markedly different function and structure[5]. The important characteristics of periodontal 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 connecting directly with osseous tissues (osseointegration) have no connective tissue attachment containing periodontal ligaments because there is no cementum in implants[6]. Consequently, no physiological movement occurs in implants. In addition, in contrast to natural teeth, hemidesmosomes alone attached with epithelia form the adhesion mechanism of gingival tissues, and implant and gingival fibers are not attached to the surface of implants and run in parallel with the implant surface[7].

3 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, in contrast to natural teeth, subepithelial gingival fibers lie in parallel with an implant and there is no gingival fiber running resistant to probe insertion[7]. Consequently, external factors are likely to enter tissues[8] 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[9]. 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[10]. Based on these results, periodontal therapy should be performed for remaining teeth to reduce periodontopathic bacteria in the oral cavity as much as possible prior to implantation. To confirm the effect of periodontal therapy, it is preferable to conduct a periodontal tissue examination and a microbiological assay (bacteria test, serum antibody titer test) and evaluate the test results.

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 edentu-

lous 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. Implantation also produces new problems, including peri-implant mucositis and peri-implantitis presenting with clinical and histopathological manifestations[11,12]. The causes of failure in implant therapy are classified as traumatic and infectious. Periodontopathic bacteria in periodontal pockets in the implanted oral cavity are detected in areas surrounding implants developing peri-implantitis that resulted in failure due to bacterial infection[13].

3) Precautions for implant trauma

Microflora in implants with disintegrated osseointegration due to trauma are similar to those in a stable implant[14]. 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 (CI) 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 an excessive burden on implants[15]. To perform implant therapy for patients with periodontal disease, precautions for both bacterial infection and traumatic force and therapeutic guidelines are required. Therefore, in implant therapy for these patients, both risk factors for periodontal disease and for implantation should be controlled, in addition to the number of lost teeth and alveolar ridge conditions.

4 Implant therapy and maintenance and supportive therapy (ST) after implantation

Implant therapy requires pretreatment including plaque control, removal of the source of infection in basic periodontal therapy, and adjustment of occlusal relationships. 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 an osseointegration period, 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 overcontoured, which is a cause of more difficulty in self-care. The frequency of visits for maintenance or supportive therapy (ST) 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[16].

15 Treatment of peri-implant disease

1) Definition and classification of peri-implant disease

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 after implant therapy[1,2]. Therefore, it is important to recognize peri-implantitis and establish therapeutic procedures in implant therapy.

Peri-implant mucositis and peri-implantitis are defined as peri-implant disease with inflammatory lesions in peri-implant tissues (Table 14). Peri-implant mucositis is a reversible inflammatory process in peri-implant soft tissues, whereas peri-implantitis is an inflammatory lesion associated with peri-implant bone disruption caused by bacterial infection and an excessive burden on implants[3].

Clinical manifestations of peri-implantitis include redness, swelling, pus discharge in peri-implant tissues, BOP, increased probing depth, bone resorption and recession of surrounding tissues, followed by progression to abscess formation and implant movement. 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 periodontal tissues differs from that in implants. In periodontal tissues, lesions of periodontitis induced by bacterial plaque are localized in connective tissues early, whereas in peri-implant tissues, lesions spread to the alveolar bones[6]. Bacterial flora in pockets are similar to each other[7].

Given this background, if peri-implant tissues are exposed to bacterial plaque for a long period, peri-implant mucositis proceeds to peri-implantitis[8]. In addition, fracture and crack of the implant body, abutment (screw), upper structure loosening, and inflammation induced by cement residues after cementing are complications associated with implant therapy and causes of peri-implantitis. 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.

2) Causes of peri-implant mucositis and peri-implantitis

Causes of these diseases include poor oral hygiene conditions[9], history of periodontitis[10,11], diabetes[12], smoking[13], keratinized mucosa deficit[14], implant body surface properties[15], occlusal contact with the implant, and occlusal overloading on implants due to occlusal contact and changed occlusal conditions. 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]. Microflora formed around implants are similar to those around natural teeth and periodontopathic bacteria, with high proportions of *Porphyromonas gingivalis*, *Treponema denticola* and *Aggregatibacter actinomycetemcomitans*[16,17]. When the remaining teeth are affected by periodontal disease and not treated with plaque control, these teeth are reservoirs of periodontopathic bacteria around implants[18]; consequently, risks increase in

Table 14. 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 a case with progression

patients with generalized aggressive periodontitis and severe generalized chronic periodontitis (Stage III-IV, Grade C).

3) Clinical examination of peri-implant tissues

Systematic and consecutive modeling 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 for diagnosis of lesions.

(1) Assessment of plaque (biofilm) control

Biofilms form on the surface of implants, similarly to periodontal disease. Oral hygiene is closely related to onset of peri-implantitis; therefore, removal of biofilms by reliable plaque control is necessary to maintain healthy conditions of peri-implant tissues. Therefore, it is important to perform plaque control, using the modified plaque index (mPI) for objective assessment[19].

(2) Probing depth (PD) in peri-implant tissues

Peri-implant probing is an important and reliable method for continuous monitoring of peri-implant tissues. PB requires appropriate pressure (0.2-0.3 N) based on the conditions of the keratinized mucosa or alveolar mucosa[8]. The insertion direction is determined considering the type, mode (platform switching) and depth of the implant body. The approach using PD should depend on the chronological increase in PD, rather than the absolute value of PD, because PD changes are correlated with the conditions of peri-implant inflammation[1,19]. Resistance of tissues in inserting a probe is also helpful to determine whether tissues are healthy.

(3) Bleeding on probing (BOP)

The accuracy of BOP diagnosis is higher than that in natural teeth[20] and BOP is an important index to monitor inflammation in peri-implant tissues and disease progression. A BOP(–) status under appropriate probing pressure shows healthy conditions of peri-implant tissues.

(4) Pus discharge

There is a need to examine whether pus discharge from peri-implant pockets is found due to compressed peri-implant mucosa. Drainage 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[1,19].

(5) Radiographic assessment (bone resorption)

Radiography is used as a definitive step to examine the bone resorption level of the surrounding bone when clinical indices show a peri-implant lesion. Dental cone-beam computed tomography is used when the three-dimensional bone form or loss needs to be examined for assessment.

(6) Implant deflection

If the upper structure of the implant body is deflected, upper structure loosening and incompatibility or osseointegration loss in the implant body is suspected. Implant body movement after uninstalling upper structures is considered to be osseointegration loss, which is the criterion for uninstallation of the implant.

(7) Peri-implant keratinized mucosa

Insufficient keratinized mucosa results in poor plaque control and inappropriate probing depth and BOP[1,19]. However, there is no clear evidence showing a requirement for keratinized mucosa.

(8) Occlusal relation

Peri-implant bone disruption progresses acutely due to bruxism and occlusal trauma with advance of peri-implantitis[21]. Peri-implant bone is lost due to excessive overloading and upper structures are broken and fixation screws fracture.

(9) Microbiological tests

In general, periodontal bacteria are monitored to determine maintenance intervals for risk diagnosis in maintenance of high risk patients with periodontal disease.

4) Treatment of peri-implant mucositis and peri-implantitis

The priority for treatment of peri-implant mucositis and peri-implantitis is to extinguish inflammatory lesions in affected areas due to bacterial infection. It is necessary to diagnose and treat affected areas and simultaneously diagnose and treat periodontitis in remaining teeth. The success of conservative therapy or surgical treatment depends on debridement of bacterial biofilms attached to microstructures on the implant surface. The treatment is performed first according to basic periodontal therapy, followed by reassessment after elimination of inflammation is confirmed. Surgical procedures should be selected based on the test results. Periodontal tissue examination and periodontal therapy for remaining teeth are essential.

(1) Non-surgical treatment

Therapy for improvement of inflammation includes instructions for oral hygiene (plaque control) debridement of the implant body, mechanical cleaning, microbicides (antiseptic) therapy, antibiotic therapy, laser coagulation, air ablation and photodynamic therapy (PDT), which are consistent with basic periodontal therapy. Bacterial tests are also important in the treatment process. Remaining teeth including adjacent and opposing teeth are kept to maintain an appropriate relationship between them. Occlusal balance is secured by occlusal adjustment as required after contact with the implant and changed occlusion conditions. In addition, occlusal trauma of remaining teeth and overloading of occlusion to the implant are prevented[22,23]. Bruxism is treated considering the patient's condition, and smoking and systemic disease are also considered. Reassessment is then performed and possible use of surgery is determined depending on the patient.

(2) Surgical treatment

Surgery includes resective therapy (gingivectomy and periapical flap procedure) to expose the surface of a contaminated implant body, periodontal plastic surgery for immobile keratinized mucosa deficit surrounding an implant (free gingival graft and connective tissue graft), and regenerative therapy for vertical osseous defect). These respective procedures should be used considering the indications. Particularly in regenerative therapy, debridement of contaminated implant surfaces is important, with treatment using curettage with a pure titanium curette, laser, air ablation, PDT, and implant plasty; however, no appropriate procedure has been established and further work is needed[1,19]. Regenerative therapy includes a combination of membrane and autologous bone or bone grafting materials and application of Emdogain®. The requirements shown in Table 15 should be considered in choosing the surgical procedure.

(3) Cumulative interceptive supportive therapy (CIST) (Table 14)

For management after implant therapy, it is important to routinely monitor clinical parameters, identify pathological conditions earlier and conduct early treatment. Lang et al.[24] recommended a CIST protocol (Figure 14) for systematically integrated assessments (including bacterial tests) of peri-implant tissue conditions of plaque index (Pl.I), probing depth (PD), BOP and bone resorption in radiography; however, this methodology is not established. This protocol includes four categories (A to D) in accordance with the combination of assessment of clinical parameters.

Table 15. 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

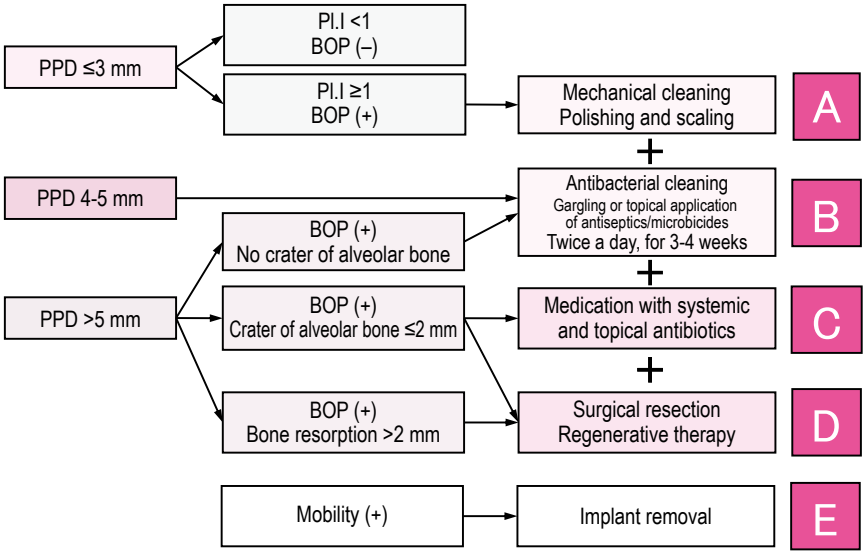

Figure 14. Cumulative interceptive supportive therapy (CIST)

A: mechanical plaque removal
B: application of microbicides
C: systemic or localized administration of antibiotics
D: surgical approach (resective or regenerative surgery)
E: implant removal

A flowchart of treatment until surgery is shown in Figure 15: A: initial therapy for peri-implantitis: mechanical plaque removal, B: application of microbicides, including chlorhexidine, and C: systemic or localized administration of antibiotics, for which the priority is thorough removal of pathogenic bacteria. Surgical procedures should be chosen, including the need for 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. For details, refer to the Therapeutic Strategy and Evidence for Oral Implants in Patients with Periodontal Disease 2018 (JSP)[25].

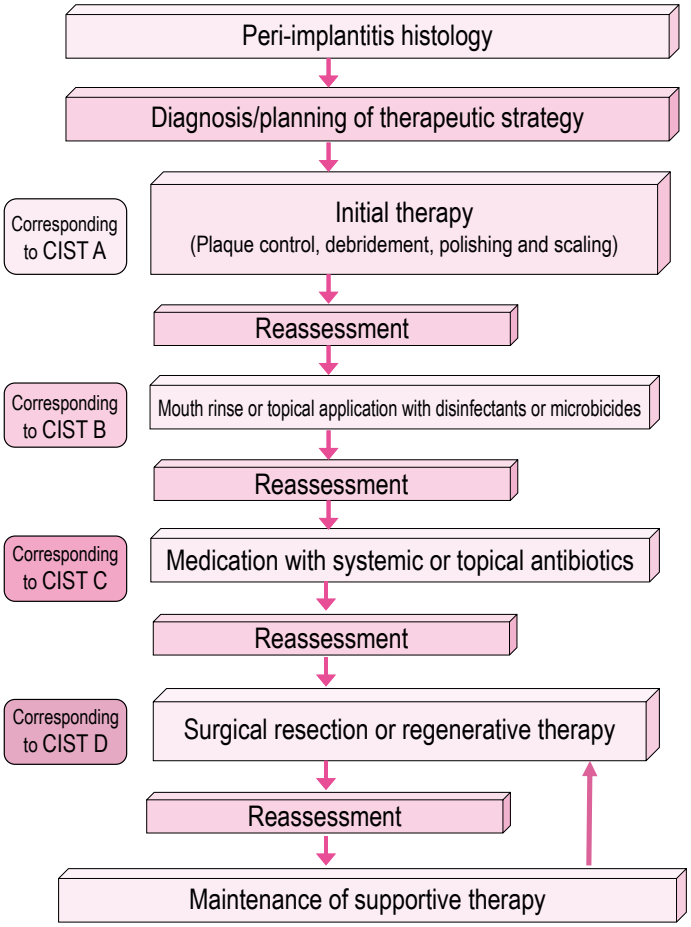

Figure 15. Flowchart of treatment for peri-implantitis

16 Follow-up

Bacterial plaque, the main factor for periodontal disease, is always present in the oral cavity. Since traumatic factors are also resident, periodontal pockets of ≥4 mm and furcation involvement remain after completion of appropriate periodontal therapy. Inflammation or BOP is also often found in patients with periodontal pockets of <4 mm. 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, making periodontal disease highly likely to recur[1]. Therefore, it is important to classify the conditions after periodontal therapy into "healing", "stable state" and "preventive stage," which have been incorporated into Social Insurance in Japan, and improve the patient's motivation to maintain periodontal tissues that are cured or stabilized by periodontal therapy, with performance of plaque control and SPT based on instructions in daily life, and to provide continuous management from a dental stand point[2,3]. As described above, primary care dentists should consider the patient's periodontal tissues management status. Such management prevents recurrence, exacerbation, tooth loss and disruption of periodontal tissues, maintains long term masticatory performance, improves quality of life (QOL), and increases the healthy lifespan.

1 Term definitions

1) Maintenance

Maintenance is long-term health management to maintain periodontal tissues cured by initial periodontal therapy, periodontal surgery and oral rehabilitation. Periodontitis is likely to recur due to insufficient plaque; 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 specialists.

2) Preventive periodontal therapy (PPT)

Preventive periodontal therapy (PPT) is a follow-up concept that has been newly incorporated in Social Insurance in Japan. Periodontal disease is determined to be in the "preventive stage" when the gingiva is improved with probing depth <4 mm, but remaining inflammation is confirmed after scaling, SRP or periodontal surgery. Follow-up is performed to prevent progression of periodontal disease. PPT can prevent progression from gingivitis to periodontitis and worsening of periodontitis. A patient with a worsening disease status during PPT should discontinue PPT and undergo initial periodontal therapy, periodontal surgery, or SPT.

3) Supportive periodontal therapy (SPT)

In a case in which most periodontal tissues are cured by initial periodontal therapy, periodontal surgery and oral rehabilitation, but periodontal pockets remain in a progression-resting stage, the patient is considered to be in a "stable state". 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 instructions for oral hygiene and re-motivation.

4) Healing

Healing indicates clinically healthy conditions restored in periodontal tissues: no gingival inflammation or BOP, probing depth <4 mm and tooth movement within physiological ranges. Patients with probing depth <4 mm, but gingival recession and exposed furcation are also sometimes determined to be "healing". Dentine reinforcement with fluoride is used in maintenance.

5) Suppression of progression (a new concept in health insurance)

When reassessment results show that a patient has inflammation in some gingiva, but recovery in all regions with probing depth <4 mm, the patient is considered to be in a "preventive stage". In this stage, failure of continuous maintenance may cause progression of periodontal disease. Therefore, PPT is performed to improve, maintain and stabilize the pathological conditions. It is necessary to assess risks in the patient and continue to conduct reassessment and PPT.

6) Stable lesion

Patients with healthy periodontal conditions, but a periodontal pocket ≥4 mm without BOP, furcation involvement and tooth movement without inflammation in a 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 undergo a reassessment test and SPT. Patients who have tooth movement, bruxism and a parafunctional habit, decreased tooth support volume due to severe alveolar bone resorption resulting in occlusal trauma even with physiological bite force, or a systemic disease (e.g. diabetes) should also undergo SPT[4].

7) Professional tooth cleaning (PTC)

PTC includes plaque removal, SRP, and polishing of the tooth surface, all of which are periodontal therapy, performed by a dentist or dental hygienist.

8) Professional mechanical tooth cleaning (PMTC)

PMTC is mechanical removal of plaque from teeth by a dentist or dental hygienist using cleaning instruments. SRP is not included, in principle. In addition, Axelsson defines PMTC as mechanical tooth cleaning by specialists, or procedures for mechanically choosing and removing supragingival and subgingival plaque of 1-3 mm on all the tooth surface, including the interdental adjacent area using an EVA tip system and paste containing fluoride with a reciprocating Profin band handpiece[3].

❷ Examination and diagnosis

Reassessment before transfer to follow-up is performed similarly to the first dental examination, in principle. After examination results and risk factors are determined, the effect of periodontal therapy and disease state are assessed. If no repeated basic periodontal therapy or periodontal surgery is necessary, a patient is defined to be in a "preventive stage", "stable state" or "healing", and is transferred to PPT, SPT or maintenance. Even during PPT and SPT as part of periodontal therapy, or maintenance as healthy management, reassessment is conducted in 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 for PPT, SPT and the maintenance stage after reassessment and criteria are shown in Figures 16 and 17, respectively.

1) Time of assessment

The time of "healing", "suppression of progression" or "stable state" depends on the state of progression.

(1) Plaque-induced gingivitis

In a case of plaque-induced gingivitis, "healing" is assessed when a healthy status is recorded by initial periodontal treatment and PPD <4 mm without inflammation are confirmed by reassessment. 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). In case of plaque-induced gingivitis, the stage of "suppression of progression" is determined when the gingiva improves with PPD <4 mm, but PPT and reassessment

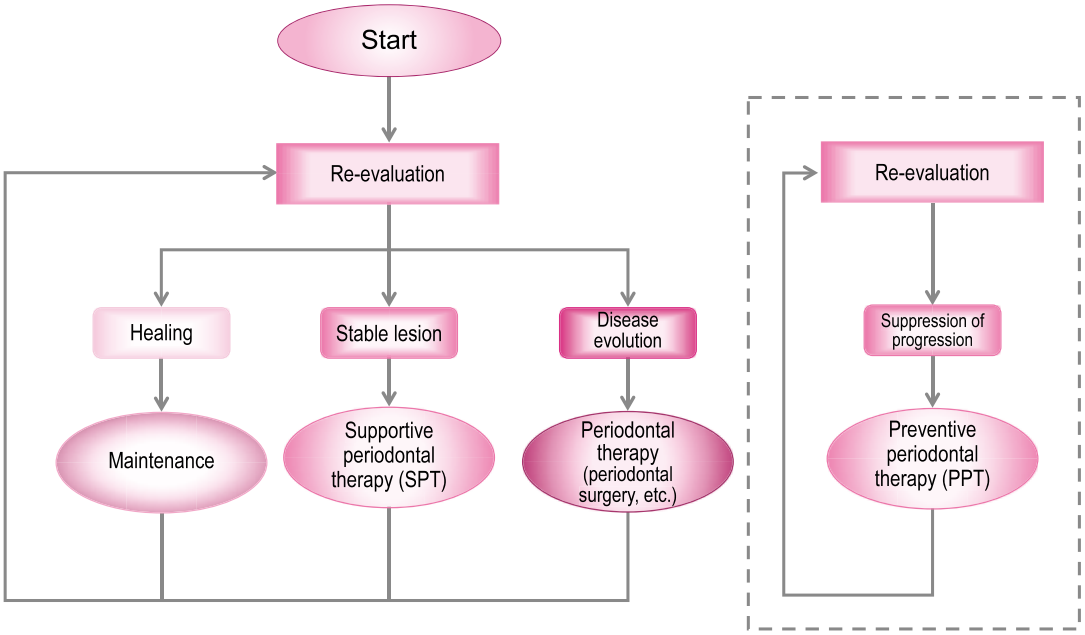

Figure 16. Flow of maintenance, SPT, pathological progression and PPT

Preventive periodontal therapy (PPT) is a new concept in Japanese health insurance.

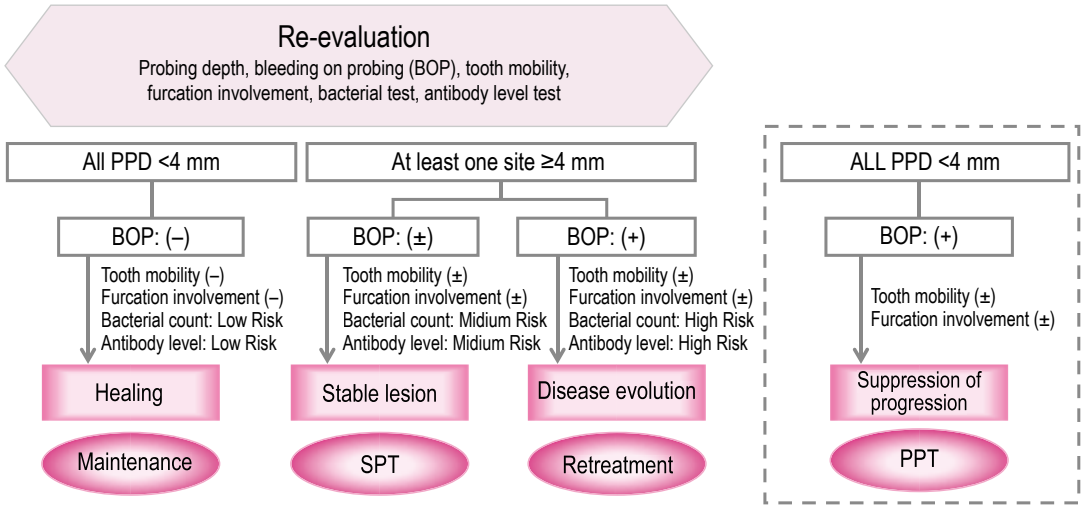

Figure 17. Determination of the effect of periodontal therapy

A comprehensive diagnosis includes reference with PPD, bleeding on probing (BOP), tooth mobility, furcation involvement, and bacterial and serum antibody level test.

For risk assessment of bacterial counts and serum antibody levels, see the “Guidelines for Appropriate use of Antibiotics in Patients with Periodontal Disease 2020”, page 16.

Preventive periodontal therapy (PPT) is a new concept in Japanese health insurance.

should be performed continuously when gingival inflammation remains.

(2) Periodontitis

In a case of slight periodontitis, it is possible to reach a stage where the case can be assessed as “healing” or “suppression of progression” with only initial treatment. Moderate or severe periodontitis may involve areas requiring periodontal surgery. After periodontal surgery, a reassessment examination should be performed to assess treatment efficacy and periodontal status. Patients who are assessed to be in the “suppression of progression”, “stable lesion” or “healing” stage at completion of oral rehabilitation should transfer to PPT, SPT or maintenance.

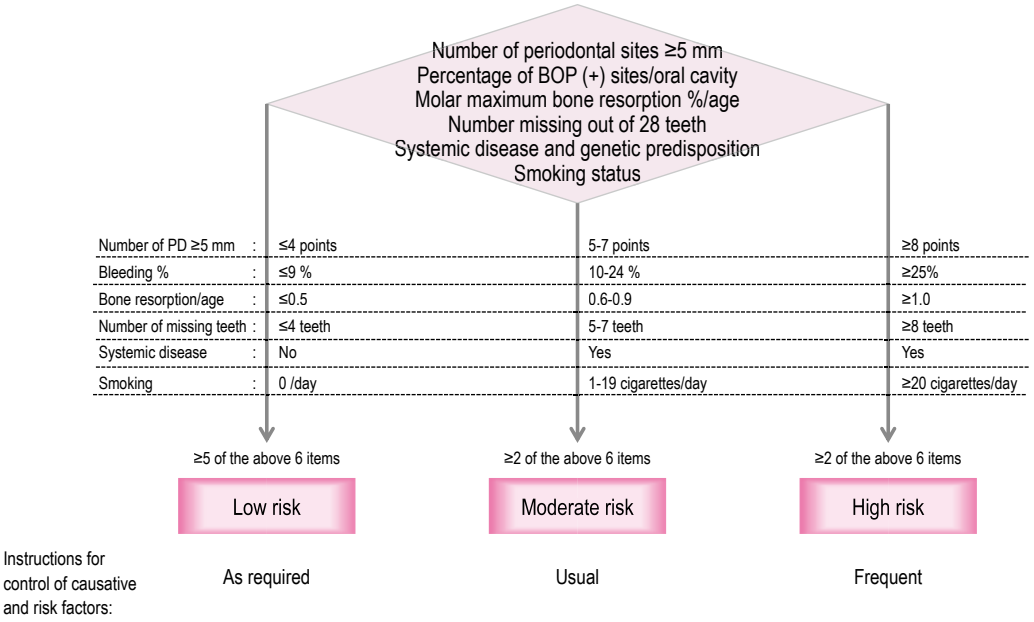

Figure 18. Risk assessment in SPT[5)]

2) Items of clinical examination

(1) Periodontal tissue examination

The decision to move to SPT or maintenance depends on reassessment of oral hygiene conditions, PPD, BOP, tooth mobility, radiography, occlusion and furcation involvement.

(2) Bacterial tests

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

(3) Other examinations

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

(4) Risk assessment in SPT (revised Lang & Tonetti[5)], 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] Number of sites with PD ≥5 mm: low risk ≤4 sites, high risk of recurrence ≥8 sites.

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

[3] Bone loss and age, measured as radiographic bone loss in percentage of molar root length divided by age of subject: low risk ≤0.5%, high risk ≥1.0%.

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

[5] Systemic disease/hereditary factors: diabetes or IL-1 genotype-positive is high risk, unknown or IL-1 genotype-negative is no risk.

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

Periodontal disease risk is classified into the following three risk groups according to the above six 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.

❸ Therapeutic planning

The contents of therapy after reassessment examination are roughly divided into maintenance[6-9] and SPT[10], and the following therapies are chosen.

1) Maintenance[6-9]

Maintenance is performed to prevent recurrence in patients who are judged to be "healing" in reassessment. The objectives of maintenance are [1] prevention of recurrence of periodontal disease, [2] early detection of recurrence of periodontal disease, and [3] long-term maintenance of a good environment of periodontal tissues. Maintenance procedures are based on maintaining motivation and confirming appropriate self-care, and PMTC and SRP are added according to the oral conditions. PTC and PMTC are critical procedures. Dentine reinforcement by application of fluoride and plaque removal by professional care provide an excellent oral hygiene environment. Furthermore, it is necessary to give guidance for improvement of lifestyle corresponding to the patient's background, including living environment, oral conditions and risk factors. For patients with risk 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 reasonable plaque control and give instructions on these environmental factors and systemic risk factors. Recall interval is an important factor and should be decided based on information from various examinations and the condition of periodontal tissue.

2) Suppressive therapy for periodontal disease progression (new follow-up in health Insurance)

Suppressive therapy for periodontal disease progression is treatment to suppress progression from gingivitis to periodontitis for patients with a probing depth <4 mm, but slight gingival inflammation in reassessment. The objectives of suppressive therapy for periodontal disease progression are [1] prevention of worsening of periodontal disease, [2] early findings of recurrence of periodontal disease, and [3] long-term maintenance of a good environment of periodontal tissues. Treatment includes maintenance of motivation, enhanced plaque control, SRP and PMTC. A patient with worsening of disease status or periodontal pockets ≥4 mm should restart initial periodontal therapy, periodontal surgery, or SPT. Recall every 1 to 3 months is generally recommended.

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

If disease conditions are determined as stable in reassessment, the therapeutic stage moves to SPT. The objectives 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 periodontal pocket irrigation and occlusal adjustment as required, as well as administration of antibacterial agents into periodontal pockets (Table 16). However, when the disease is advanced (probing depth ≥4 mm, BOP (+), many bacteria, high antibody level), periodontal surgery may be performed (Figure 17, Table 16). Recall intervals for SPT depend on periodontal tissue conditions and the plaque control level in each patient, but recall every 1 to 3 months is generally recommended. Recall intervals can increase or decrease as the condition changes; e.g. every one month initially, then every 3 months or every 6 months.

Table 16. Therapeutic contents of healing, stable state and progression state

Healing	Maintenance	Maintenance at appropriate intervals Oral hygiene instructions (plaque control) Professional mechanical tooth cleaning (PMTC) Scaling and root planing
Preventive stage	Preventive periodontal therapy (PPT) (new follow-up in Japanese health insurance)	Preventive periodontal therapy at appropriate intervals Oral hygiene instructions (plaque control) Professional mechanical cleaning Scaling and root planing
Stable lesion	Supportive periodontal therapy (SPT)	Based on SPT at appropriate intervals Oral hygiene instructions (plaque control) Professional mechanical tooth cleaning (PMTC) Scaling and root planing Periodontal pocket cleaning Administration of antibacterial agents into periodontal pockets Elimination of traumatic factors (occlusal adjustment, splint)
Disease evolution	Periodontal surgery, etc.	Periodontal surgery • Flap surgery • Gingivectomy, etc. Oral rehabilitation

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