

Ss. CYRIL AND METHODIUS UNIVERSITY IN SKOPJE
FACULTY OF DENTISTRY – SKOPJE



Oral Hygiene



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ORAL HYGIENE

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Preface

Oral hygiene is a fundamental pillar of preventive dentistry and an essential component of overall health. The maintenance of oral cleanliness plays a crucial role in the prevention of dental caries, periodontal diseases, peri-implant conditions, and other oral pathologies that significantly affect quality of life. For dental professionals, a thorough understanding of oral hygiene principles is indispensable, not only for clinical practice but also for patient education and long-term disease prevention.

This textbook has been designed primarily for undergraduate dental students enrolled in English-taught programs. Its aim is to provide a clear, structured, and comprehensive overview of oral hygiene concepts, combining theoretical foundations with practical guidance. Special emphasis is placed on evidence-based practices, contemporary preventive strategies, and the development of clinical skills necessary for effective plaque control and patient motivation.

The content of this book covers essential topics such as dental plaque and biofilm, indices used in oral hygiene assessment, manual and powered toothbrushing techniques, interdental cleaning methods, professional plaque and calculus removal, polishing procedures, and oral hygiene maintenance in patients with special needs, including those with dental implants and orthodontic appliances. Each chapter is structured to facilitate learning, with clear explanations and terminology appropriate for students at an early stage of their professional education.

The primary goal of this textbook is not only to support students in acquiring knowledge but also to encourage critical thinking and a preventive mindset that will guide their future clinical practice. By mastering the principles presented in this book, students will be better prepared to promote oral health, educate patients effectively, and contribute to the prevention of oral diseases at both individual and community levels.

It is our hope that this textbook will serve as a reliable educational resource and a practical guide throughout students' academic training and professional development.

From the Authors

Chapter 1: The History of Oral Hygiene Products

The history of oral hygiene dates back thousands of years and reflects humanity's continuous effort to maintain dental health and aesthetic appearance. Throughout different civilizations, people have used various materials and techniques to clean their teeth, freshen their breath, and prevent oral diseases. Modern toothbrushes, toothpaste, and mouth rinses are the result of centuries of evolution in oral care practices.

Early Beginnings

Archaeological evidence shows that ancient civilizations were aware of the importance of oral cleanliness. As early as 3000 BCE, the Babylonians, Egyptians, and Chinese used “**chew sticks**”—thin twigs with frayed ends that served as primitive toothbrushes. These sticks were often taken from aromatic trees, such as neem or miswak, which possessed antibacterial properties.

In ancient Egypt, a mixture of powdered ox hooves, ashes, eggshells, and pumice was used to clean teeth. Although abrasive, this early toothpaste helped remove plaque and food particles. The Greeks and Romans later improved these mixtures by adding ingredients like crushed bones and oyster shells, combined with flavoring agents such as charcoal and bark.

The Middle Ages

During the Middle Ages in Europe, oral hygiene practices declined, especially among the lower classes. Tooth cleaning was often done with cloths or simple toothpicks made from metal or wood. Wealthier individuals sometimes used powders made from herbs and spices to freshen the breath. However, there was little understanding of dental decay or bacteria at the time, and oral diseases were common.

In contrast, Islamic culture maintained strong oral hygiene traditions. The Prophet Muhammad encouraged the use of **miswak**, a natural chewing stick from the *Salvadora persica* tree, which is still used today in many parts of the world for its cleansing and antibacterial effects.

The Renaissance and Early Modern Period

The Renaissance period brought renewed interest in health and personal care. Toothbrushes resembling modern designs began appearing in China around the 15th century, made with boar bristles attached to bamboo or bone handles. These designs later spread to Europe, where softer materials like horsehair were preferred.

By the 18th century, dental care became more refined. In 1780, William Addis of England produced the first mass-manufactured toothbrush, using animal bone for the handle and boar bristles for the brush head. This marked a turning point in the commercialization of oral hygiene tools.

The Birth of Modern Toothpaste

Toothpaste as we know it began to develop in the 19th century. Early formulations contained ingredients such as chalk, soap, and glycerin. In the 1890s, Colgate introduced the first toothpaste sold in collapsible tubes, revolutionizing convenience and hygiene.

The discovery of **fluoride's protective effects** in the early 20th century was a milestone in preventive dentistry. Fluoridated toothpaste became widespread by the 1950s, significantly reducing dental caries worldwide. Since then, toothpaste formulations have continued to evolve, incorporating ingredients for whitening, tartar control, sensitivity relief, and antibacterial protection.

The Evolution of Mouthwash and Dental Floss

Mouth rinsing is also an ancient practice. Early rinses were made from saltwater, vinegar, or herbal extracts. The first commercial mouthwash, **Listerine**, was developed in the late 19th century as a surgical antiseptic and later marketed for oral use. Today's mouthwashes contain ingredients like chlorhexidine, cetylpyridinium chloride, and essential oils to combat bacteria and promote fresh breath.

Dental floss, another crucial innovation, was first suggested by American dentist Levi Spear Parmly in 1819, who recommended using silk thread to remove food debris between teeth. By the mid-20th century, nylon replaced silk, making floss more durable and affordable.

Contemporary Developments

Modern oral hygiene products now combine technology and science to optimize dental care. Electric toothbrushes, first introduced in the 1950s, have become increasingly advanced with oscillating, sonic, and ultrasonic movements. Recent innovations include smart toothbrushes with Bluetooth connectivity that track brushing habits and provide feedback through mobile apps.

Additionally, eco-friendly products such as biodegradable toothbrushes, refillable toothpaste containers, and herbal-based formulas are gaining popularity as awareness of sustainability grows.

Conclusion

From simple chew sticks to sophisticated electric toothbrushes and fluoride-based toothpastes, the evolution of oral hygiene products illustrates humanity's persistent pursuit of better health and cleanliness. Each historical stage contributed valuable knowledge, ultimately leading to the scientifically advanced dental care we enjoy today. Maintaining oral hygiene remains a fundamental aspect of overall health, bridging ancient wisdom with modern innovation.

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Chapter 2: Implementation of Oral Hygiene Care for the Patient

The implementation of oral hygiene care for the patient should be understood as a complex process that involves several sequential phases through which a basic plan is established to identify and meet the needs of each individual patient. The procedure of oral hygiene care consists of five phases:

1. Data collection
2. Assessment of oral hygiene
3. Treatment planning
4. Implementation
5. Outcomes

1. Data Collection

This refers to the gathering of relevant information about the patient, including medical/dental history, vital signs, extraoral and intraoral examination, periodontal and dental assessment, radiographs, indices, and risk assessment (e.g., smoking, systemic diseases).

In evaluating the patient's history, symptoms are key—these are abnormalities experienced by the patient. Information obtained through questioning the patient is called *subjective findings*. In clinical examination, *signs* are crucial—these are abnormalities observed by the clinician. The information collected through the examination performed by the clinician is called *objective findings*.

Data collection begins with a discussion of the medical/dental history, followed by intra/extraoral examination, evaluation of restorations, gingival and periodontal assessments, oral hygiene assessment, radiographs, and additional diagnostic lab tests if necessary.

2. Assessment of Oral Hygiene

After determining the objective and subjective findings, the next step is to analyze the gathered information. The assessment of oral hygiene differs from dental diagnosis. While the dental diagnosis names the disease, the oral hygiene assessment identifies the patient's current and potential responses to the disease process.

The goal of oral hygiene diagnosis is to focus oral health care planning on the patient's specific problems or conditions that require oral hygiene interventions. For example, a patient may have inflamed gingiva but no radiographic evidence of bone loss. The dentist would diagnose gingivitis, while the oral hygiene focus would be on educating the patient about the importance of effective plaque control to reduce supragingival plaque accumulation.

It is also necessary to understand the importance of eliminating pathogenic bacteria so that beneficial microflora can repopulate the tooth/soft tissue surfaces.

After diagnosing the condition, the clinician must determine the cause to develop an appropriate treatment plan aimed at eliminating or controlling the condition. It is essential to identify the reasons for the development of a condition to take measures to overcome or alleviate it.

3. Treatment Planning

The treatment plan refers to the formulation of appropriate goals and therapeutic strategies to ensure optimal oral health. It includes the development of a written treatment plan tailored to the patient's specific needs based on subjective and objective findings and assessments.

Alternative solutions must be included if the ideal plan is not suitable due to the patient's poor health, lack of motivation or dissatisfaction, or financial limitations. The treatment plan must be presented to the patient and agreed upon before any intervention begins. The correct sequence of therapeutic phases must be determined.

The course of therapy involves knowledge from various disciplines related to oral hygiene, including behavioral sciences, pharmacology, anatomy and physiology,

chemistry, and microbiology. Critical thinking and decision-making skills are essential for delivering effective and efficient services.

The oral health care plan must define goals or expected outcomes. A goal is a clearly defined intent that precisely identifies the reason for specific procedures. The individualized plan also includes interventions necessary to achieve the defined goals of care. Interventions are actions taken to help the patient achieve desired outcomes.

For example, in the case of a diagnosis of pregnancy-related gingivitis, from an oral hygiene perspective, the issue is gingival inflammation linked to increased hormone levels and inadequate home care by the patient. The goals of oral hygiene therapy would be to reduce plaque levels through education and training on the effects of plaque and hormones on oral health. Oral hygiene interventions prevent plaque formation through mechanical debridement.

4. Implementation

Once the treatment plan has been presented and agreed upon by the patient, therapy can begin. This implementation phase includes:

1. Preparing the clinic for the patient
2. Applying proper sterilization protocols
3. Performing periodontal debridement procedures
4. Managing pain control
5. Applying chemotherapeutic agents
6. Fluoride therapy
7. Coronal polishing
8. Educating the patient on denture care
9. Educating the patient on maintenance of restorations (fillings)
10. Providing health education and preventive advice
11. Nutritional counseling
12. Proper documentation of the procedures

5. Outcomes

The outcomes phase of therapy examines the feedback effects of the treatment and procedures. This phase takes place after the therapy is completed, during the patient's follow-up visit, when another oral hygiene assessment is conducted.

Social, Economic, and Cultural Considerations

From the moment the patient enters the clinic, they should be viewed as a complex individual. Therefore, it is necessary to consider factors such as their medical background, trust in health care, cultural background, social and economic status, education, and work-related outcomes. These factors play a significant role in determining the patient's home care regimen and the results achieved.

Reviewing the patient's dental and medical history from a socio-economic perspective provides insight into their capacity for maintaining additional home care routines. Often, factors such as people's trust in their role in maintaining their own health and the influence of poor habits on periodontal and dental diseases affect their willingness to maintain oral health before receiving more extensive dental care.

A thorough discussion with the patient is crucial for gathering information—unlike a silent, questionnaire-style medical history form, which is often completed without verifying these factors.

Documentation is an integral part of the oral hygiene care process. Good documentation is especially important for forming the patient's record file.

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Chapter 3: Patients History

During the patient's first visit, all subjective data that represent the reason for the visit to the office must be collected. A complete dental/medical history is essential for this initial evaluation. The therapist becomes a partner to the patient in the process of improving healthcare. The patient's history (interview) is composed of: personal data, social status, chief complaints, history of the present illness, medical history, family history, and dental history. The overall diagnostic information obtained through this interview provides a baseline for future comparison to evaluate disease progression, treatment effectiveness, and the appearance of new findings. Therefore, taking the patient's history is a mandatory first step in the treatment process.

1. Personal Data

The medical history must begin with questions related to the patient's identity. This personal profile includes name, age, address, occupation, and phone number. Some of this information is required for identification, as age and gender can be useful in classifying periodontal diseases. Documenting the name, address, and phone number of the patient's primary physician may also be helpful if consultation is needed.

2. Social History

Social history includes the patient's occupation, lifestyle, marital status, diet, and use of alcohol and tobacco. Habits such as smoking or tobacco use should be noted as they are potential risk factors for periodontal disease.

Smoking is expressed in **pack-years**, calculated by multiplying the number of cigarette packs smoked per day by the number of years the patient has smoked. Documenting the quantity of cigarettes smoked annually provides a better understanding of the individual's lifetime nicotine exposure.

The patient's lifestyle—including family and social structure, attitudes, and behaviors—are part of the social history. Social perceptions, priorities, stress exposure, and aesthetic expectations provide insight for aligning treatment with dental health care goals. The therapist can work on modifying patient behavior and attitudes by understanding differences in culture, education, and expectations.

3. Chief Complaint

The next step in taking a medical history is to ask the patient to describe their main complaint. The patient should explain, in their own words, why they need treatment. Identifying the chief complaint helps in diagnosing the current disease. Symptoms of periodontal disease may include pressure in the gums or jaw, or itching in the gums. Signs include bleeding, bad breath, and/or tooth mobility. Due to the subtle and progressive nature of this disease, many patients are unaware they even have a problem. If the chief complaint is unrelated to periodontal disease, it must be identified and treated before any other dental treatment is initiated.

4. Medical History

Taking a patient's history, which is crucial for successfully completing the dental and medical history, requires a high level of communication between the patient and the therapist. If taken properly, the history helps to establish a friendly and trusting relationship between the patient and the therapist. The history can be collected using a **questionnaire**, an **interview**, or a combination of both. The most practical and successful method for assessing a patient's health status is the combination of questionnaire and interview. During the interview, descriptive questions such as "What changes or improvements have you noticed since your last visit?" or "What is bothering you in your mouth?" allow you to gather a lot of information about the patient. A well-established friendly relationship makes the patient feel more comfortable, and as the interview progresses, they begin to share more information on their own. Descriptive questions are generally easier for patients, but specific questions are also necessary, such as: "When was the last time you visited a dentist?" These types of questions don't take much time and can often be answered in one sentence.

5. History of Present Illness

This part of the history collects information about the onset of the main complaint. The therapist should ask how long the problem has persisted, if any treatments have been done previously, and whether the problem has occurred before. For example, if the chief complaint is "bleeding gums," the therapist should ask when it started, whether it was spontaneous or triggered, identify the location, and determine how long it has lasted.

6. Medical History

The patient's current and past general health status—i.e., medical history—should be the next area of inquiry. This may involve a questionnaire, interview, or both. Sometimes, even a simple phone call before the first visit can provide useful information about potential medical issues. The written questionnaire provides a treatment baseline, while the interview offers personal interaction and detailed clarification.

It is important to listen closely and show genuine interest in the patient's responses to obtain a clear and accurate medical picture. Allowing the patient to describe symptoms at length encourages openness and trust, though only relevant details should be documented.

The interview should end with specific questions and a review of details. Before ending the interview, the therapist should re-check the form to ensure all information is complete and no data has been overlooked. Many patients may not understand the terminology on the forms due to language, educational, or cultural differences.

There are many different standard medical history forms, which vary in length, content, and format based on the intended setting. The **American Dental Association (ADA)** has designed a **Comprehensive Medical History Form and Interview**, typically completed on the first visit and reviewed at each follow-up. All questions must be answered, and any positive responses can be highlighted (e.g., in red) for easy review at future visits.

Medical history includes the date of the last physical exam, a review of organ systems, and any current medical conditions. It also lists medications, if the patient is under therapy. These forms help in identifying diseases associated with specific body systems. Afterward, the therapist may ask disease-specific questions, including disease duration.

Many dental patients have systemic illnesses that affect clinical decision-making. Questions about current medication use and drug allergies are crucial, as answers can directly impact dental treatment. Both prescribed and self-administered medications should be documented. The name, dosage, and purpose must be recorded. Therapists must be alert to drug-drug or drug-food interactions. Side effects of some medications can lead to dental issues; e.g., antidepressants and antihypertensives may cause **xerostomia** (dry mouth). Some antibiotics (like tetracyclines) are affected by calcium-containing foods, such as dairy.

Sometimes, consultation with the patient's primary physician is necessary. If the patient doesn't know the medication names, they should be asked to bring the packaging during the next visit. For patients on medications for diabetes or hypertension, it is essential to verify that they took the prescribed dose the day of the dental visit. Doses and frequencies must be documented. Patients may forget their blood pressure medication, arriving with uncontrolled hypertension—requiring physician consultation.

Medical history may also reveal other conditions impacting periodontal health or treatment (e.g., diabetes mellitus, leukemia, or HIV). If the patient is medically compromised, written medical clearance is required before beginning treatment.

Infective endocarditis is partly a dental concern. It is an infection of the inner heart lining (endocardium) that may damage heart valves. Any dental procedure that may cause bleeding can introduce bacteria into the bloodstream (bacteremia). For patients at risk, antibiotic prophylaxis is recommended before procedures. The **American Heart Association** provides guidelines for such cases. Since recommendations vary per patient, the therapist must collaborate with the physician to determine premedication needs. It is the therapist's responsibility to identify at-risk patients by obtaining a complete medical history.

The medical history form is a legal document providing a profile of the patient's current and past health. Once completed, the document must be dated and signed by both the patient and the dentist. Every follow-up visit must be dated on the form. The patient should re-review and sign the updated information. A new form should be completed once per year. The form must be filled out in permanent ink, preferably black (for better photocopying). If the patient is a minor, the form must be dated and signed by a parent or legal guardian.

7. Family History

Family history includes current or past medical conditions in the patient's family. This record helps identify familial diseases that may be risk factors for dental/periodontal diseases, such as diabetes and ischemic heart disease.

8. Dental History

Dental history includes past and current dental treatments, problems with teeth, oral habits, nutritional profile, and oral hygiene status. This information is collected via

a written form or patient interview. Numerous dental history forms exist, tailored to individual clinics' requirements. **Table 1** presents one such dental history form.

Previous dental history often reveals experiences—positive or negative—with all dental areas, including oral surgery, restorative treatment with endodontics, and orthodontics. Experiences with local anesthesia should be noted.

The patient's diet can help identify a caries-prone diet. During the interview, the therapist can suggest ways to modify the diet to promote better dental health.

Past dental history also provides insight into the patient's attitude toward dental health. The periodontal history may be particularly important. For example, if a patient had two periodontal surgeries last year but only one follow-up visit, it may indicate poor compliance and low oral hygiene commitment.

The patient should also be asked about specific oral hygiene routines and tools used, including the type of toothbrush (soft, medium, hard), floss, and mouthwash. The frequency of use and adherence to recommended dental visits should be documented.

Table 1: Dental History Form

- 1. Date of last dental examination**
- 2. Reason for the visit**
- 3. Date of last X-ray**
- 4. Do you currently have any pain in your mouth?**
- 5. Do you have difficulty chewing food?**
- 6. Does food get stuck between your teeth?**
- 7. Have you ever had serious problems related to any dental treatment (pain, bad experience)?**
- 8. Do your gums bleed when brushing your teeth?**
- 9. How often do you brush your teeth?**
- 10. What other oral hygiene products do you use (floss, bridge cleaners, gum stimulators)?**
- 11. Do you live in an area with fluoridated water?**
- 12. Do you use any of the following at home:**

Yes	No
a. Fluoridated toothpaste	

- b. Fluoride mouthwash / gel
- c. Other antimicrobial products — *Describe:* _____

13. Have you ever had any of the following procedures (if you don't understand a term, ask your dentist to explain):

Yes No

- a. Periodontal treatment or surgery
- b. Orthodontic treatment
- c. Tooth extraction
- d. Endodontic treatment (root canal)
- e. Dental implants — *If yes, when:* _____

If yes, explain: _____

14. Have you ever had any type of reaction to:

Yes No

- a. Local anesthesia
- b. Latex gloves — *If yes, when:* _____

15. How do you feel about your teeth?

16. Do you have any of the following habits:

Yes No

- a. Teeth grinding (bruxism)
- b. Biting cheeks or lips
- c. Mouth breathing
- d. Thumb sucking
- e. Nail biting or chewing on objects
- f. Smoking

17. Do you use any of the following:

Amount per day	How many years	When did you
quit (if applicable)		

- a. Cigarettes
- b. Cigars
- c. Pipe
- d. Chewing tobacco
- e. Snuff (snorting tobacco)

18. What measures have you tried to quit smoking? When?

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Chapter 4: Types of Deposits on the Teeth

Dental plaque is a dense, non-mineralized substance composed of numerous bacterial colonies. In addition to bacteria, some viruses and fungi are also present in plaque.

Tissue changes depend on the interaction between the microorganisms in the plaque and the host's immune response. Numerous local factors can encourage the accumulation of plaque, while general factors may modify the host's response to plaque bacteria. However, if dental plaque is removed and its accumulation is prevented, gingival health can be maintained regardless of other factors.

1. Supragingival Plaque

When a tooth erupts, it has an organic coating known as the enamel cuticle. This coating is quickly lost due to abrasion or digestion by bacteria. Within seconds of contact with saliva, a coating of salivary glycoproteins forms on the tooth surface as an amorphous, sticky, firm membrane. The pellicle is considered acellular and does not require bacteria to form. It allows bacterial colonization of the tooth surface and therefore plays a role in plaque formation. The pellicle is composed of glycoproteins that selectively bind to the tooth; not all bacteria present in saliva can adhere to it.

It can be removed during prophylaxis, but the pellicle begins to reform within minutes, and complete formation occurs after about 2 hours. Bacteria adhere to the tooth surface through molecules called adhesins located on their cell surfaces. These adhesins-proteins that bind to specific carbohydrate structures in the pellicle-are called lectins.



Figure 1. Supragingival Plaque

1.1 Formation of Supragingival Dental Plaque

Plaque formation begins with bacterial adhesion to the pellicle, which serves as a nutrient source. During the metabolism of salivary proteins, peptides and amino acids are released, essential for bacterial survival.

The initial colonization phase lasts 1–2 days in the absence of plaque removal techniques. The supragingival plaque is gradually colonized by cocci, short rods, longer rods, and motile forms including spirochetes. Most of these bacteria are gram-positive aerobes (living in oxygen-rich environments). However, many of these aerobes are facultative, meaning they can survive with or without oxygen.

Later, gram-negative and more motile bacteria increase in number. Microorganisms grow as individual colonies that spread laterally and vertically, forming parallel

palisade layers. Early colonies consist of gram-positive cocci and short rods, including *Streptococcus mutans* and *Streptococcus sanguis*.

The second phase lasts 2–4 days after discontinuing oral hygiene. The initial plaque mass provides a base for further colonization. New colonizers include gram-positive rods and gram-negative cocci. Cocci still dominate, along with filamentous forms and some rods competing for space.

The extracellular matrix forming around bacterial colonies is derived primarily from saliva and gingival fluid. Bacteria can synthesize extracellular polysaccharides (carbohydrates) from sucrose. These glucans, levans, and fructans aid bacterial adhesion. Their insolubility increases plaque resistance and hinders removal. Levans and soluble glucans also serve as energy sources for bacteria.

From days 4 to 7, the third phase of plaque formation occurs. Rods, filaments, and fusobacteria become dominant and interact. As plaque matures, vibrios and spirochetes may colonize. New plaque can form over mature plaque or spread coronally. This new plaque is characterized by cocci. Filamentous forms serve as binding sites for cocci, forming "corn-cob" structures. Gram-positive filaments like *Actinomyces* species bind to cocci like *Streptococcus sanguis*.

The third colonization phase continues from days 7 to 11. Spirochetes multiply, and new species like vibrios appear. Gingival tissues begin to show early signs of inflammation due to plaque presence. This inflammatory response is easily reversible by plaque removal.

2. Subgingival Plaque

Anaerobic bacteria (true or obligate anaerobes) inhabit deep subgingival plaque. As plaque matures (14–21 days), vibrios and spirochetes become prevalent in subgingival areas. Growth, accumulation, and pathogenicity of subgingival plaque are strongly influenced by supragingival plaque. Gingival inflammation caused by supragingival plaque alters the relationship between the tooth and gingiva. Gingival enlargement (edema) creates space for bacterial colonization of the subgingival area, forming subgingival plaque.

This newly formed space is shielded from natural oral cleaning mechanisms, allowing unchecked bacterial growth. Subgingival microflora is generally more anaerobic, with more gram-negative and motile organisms. Many motile microbes are free-floating in the plaque matrix and produce toxins, enzymes, and metabolic

products that damage periodontal tissues. These bacteria also act as antigens, triggering immune responses that contribute to tissue destruction.

2.1 Types of Subgingival Plaque:

1. Tooth-associated (attached)
2. Tissue-associated
3. Unattached

Unattached gram-negative anaerobes are near the epithelium and play a major role in initiating and advancing periodontal disease.

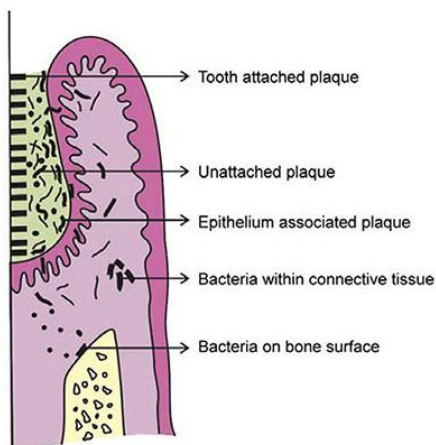


Figure 2. Subgingival Plaque

Nutrients:

Nutrients from periodontal fluid are easily accessible, favoring bacteria that use proteins over those that require carbohydrates. For example, heme-containing components in the fluid support the growth of *Porphyromonas* and *Prevotella* species. The bacterial composition in subgingival regions results from numerous interacting processes.

Microorganisms on Dental Implants: Clinical studies show that healthy, stable implants have microflora similar to healthy teeth, while unstable or failing implants have flora similar to diseased natural teeth. Dental plaque must be removed from around implants just like from natural teeth.

2.2 Other Components of Plaque:

Cells:

Besides bacteria, plaque contains other cell types. Epithelial cells are found throughout plaque samples. White blood cells, especially polymorphonuclear neutrophils (PMNs), are also common. Red blood cells are found near periodontal pockets with bleeding upon probing, indicating epithelial disruption.

Table 2: Bacteria Found in Periodontal Disease

Gram-positive	Gram-negative
Facultative anaerobes: Cocci – <i>Streptococcus sanguis, mitis, salivarius</i>	Facultative anaerobes: Rods – <i>Eikenella corrodens, Capnocytophaga spp., Actinobacillus actinomycetemcomitans</i>
Facultative anaerobes: Rods – <i>Actinomyces, Corynebacterium</i>	Obligate anaerobes: Rods – <i>Porphyromonas gingivalis, Bacteroides forsythus, Prevotella intermedia, Fusobacterium nucleatum</i>
Obligate anaerobes: Cocci – <i>Peptostreptococcus mitis</i>	Obligate anaerobes: Cocci – <i>Veillonella alcalescens</i>
	Spirochetes – <i>Treponema denticola</i>

Table 3: Bacteria in Healthy vs. Diseased Periodontium:

Healthy Periodontium	Diseased Periodontium
Gram-positive	Gram-negative
Aerobic	Anaerobic
Non-motile	Motile
Saccharolytic	Asaccharolytic

2.3 Mechanisms of Bacterial Action

Different bacterial strains produce pathogenic substances that contribute to the progression of gingivitis to destructive periodontitis. Pathogenic flora initiates periodontal destruction through both direct toxic effects and indirect activation of host cells.

Direct Effects:

- **Cytotoxic agents:** Unattached subgingival plaque contains endotoxins lipopolysaccharides (LPS) or lipooligosaccharides (LOS). LPS found in the outer walls of gram-negative bacteria can initiate inflammation, cause soft tissue destruction, and stimulate bone resorption. These endotoxins are released when bacteria are destroyed. LOS has also been found in necrotic cementum.
- **Enzymes:** Many plaque bacteria produce numerous enzymes that accumulate in the sulcus and penetrate intact epithelium into deeper tissues. These enzymes break down connective tissue (e.g., collagen) and the ground substance. New findings focus on matrix metalloproteinases (MMPs) a group of structurally similar enzymes (collagenases, gelatinases, stromelysins) produced by stimulated host cells. MMPs degrade collagen (main component of connective tissue), proteoglycans, and other matrix proteins. They also promote osteoclastic bone resorption.

Indirect Effects:

- **Immunopathological mechanisms:** Several bacterial antigens cause inflammation in periodontal tissues by triggering immune responses. Both humoral (antibody-based) and cell-mediated (lymphocyte-based) immune responses are observed in periodontal disease patients. The immune system's role in periodontitis is not fully understood, but it clearly contributes to tissue destruction through immunopathological mechanisms.

Combined Mechanisms:

Multiple mechanisms are involved in initiating and progressing gingivitis and periodontitis. Bacterial enzymes and/or cytotoxic substances directly affect sulcular and sub-sulcular tissue and indirectly trigger immune responses. Thus, dental plaque acts through multiple pathogenic mechanisms.

3.Dental Calculus

Supragingival calculus is described as a deposit of mineralized substance on the tooth surface. It is rough and irregular, creating areas where new plaque accumulates.

Unlike plaque, calculus is visible and poses aesthetic problems. Aesthetic concerns are often the main reason patients seek help, unaware of its harmful effects. In

addition to removing it, the clinician should educate patients about its consequences and the benefits of its removal.



Figure 2: Deposits of dental calculus

Calculus is considered the most significant local contributing factor. It is mineralized dental plaque but can also form in the absence of bacteria. Mineralization initially occurs supragingivally. Subgingival calculus forms more slowly in a confined space and adheres firmly to the root, making it harder to remove. It is always covered by plaque and contains toxic bacterial products. Subgingival calculus is often deposited in root surface grooves or depressions. It is porous and can act as a reservoir for bacteria and endotoxins.

4. Materia Alba and Debris

Materia alba is a bacterial aggregate mixed with food debris but differs from plaque in that it is not firmly attached to the tooth surface. It lacks the structured composition of plaque and plays a minimal role in the etiology of periodontal disease. Unlike plaque, it can be easily removed with a water spray or rinsing.



Figure 3. Materia alba

Many features can contribute to higher plaque accumulation such as:

4.1 Anatomical Factors

- **Tooth morphology** - Palatal grooves are present in approximately 5–9 % of maxillary incisors and can be a cause of narrow, deep periodontal pockets. Plaque can also accumulate undisturbed in the deep mesial fissure of the upper first premolars. The enamel in the furcation areas of the root surface may exhibit cervical enamel projections or enamel pearls. These enamel grooves can enable increased plaque accumulation.
- **Tooth position** - The position of the teeth can influence plaque accumulation, oral hygiene, and treatment. Most authors who have studied the impact of crowding, tilting, and rotation of teeth have concluded that such anomalies in tooth positioning lead to increased plaque accumulation (and greater tissue inflammation), especially in patients who do not maintain adequate oral hygiene. The absence of contact between teeth allows food impaction, which can cause plaque-induced inflammation.

4.2 Iatrogenic Factors

Restorative Dentistry - Irregular surfaces and overhanging amalgams, as well as composites, crowns, bridges, and other types of restorations, are associated with increased gingival inflammation and periodontitis. Subgingival restorations, especially those with defective or oversized margins, can significantly impact periodontal health by causing plaque retention in the sulcus or pocket. During restorative dental procedures, gingival injuries may occur. For example, a large portion of the interdental papilla can be destroyed by careless use of dental instruments in conservative dentistry. Retraction cords, impression materials, and temporary restorations may also cause irreversible damage to the periodontium. Fixed dentures must be designed in such a way that the patient can clean all surfaces of the restorations, including the bridge area. Crown morphology, specifically the prominence of the crown's equator, is also very important. If the equator is not sufficiently pronounced, food may be forced into the gingival sulcus during mastication. If it is overly prominent, self-cleaning is impaired, and plaque accumulation increases. If removable dentures are constructed in a way that compresses the soft tissue or the clasps excessively load the tooth, this will inevitably lead to periodontal damage. In the presence of dental plaque, these insults can result in rapid and severe destruction of the periodontal structures.

4.3 Orthodontic Appliances

Orthodontic appliances have long been associated with increased plaque accumulation, gingivitis, and caries. Fixed appliances provide excellent retention sites for bacterial growth and can significantly contribute to the progression of inflammation. Special attention must be paid to plaque-retentive areas in orthodontics. More frequent check-ups may be indicated for patients with orthodontic appliances, especially in adults.

4.4 Toothbrushing Trauma

Can completely destroy the free or attached gingiva and result in severe recession. In fact, toothbrush-induced gingival injuries are one of the two most common factors associated with recession.

4.5 Bad Habits

Some patients may habitually scratch the gingiva with their nails or other tools. These actions lead to localized inflammation and localized recession. Although relatively rare, such habits should be considered when isolated recession is observed, and no other cause can be determined through examination. Changes in the local gingival anatomy (high frenulum attachment, lateral folds, or an insufficient zone of attached gingiva) often lead to increased plaque accumulation and inflammation.

4.6 Food Impaction

Is one of the most common local factors that can contribute to the initiation and progression of inflammatory periodontal disease. Food retention leads to food decomposition and chemical irritation, and also provides an excellent nutrient source for bacteria that can initiate disease processes.

4.7 Chemical Injury

Improper local application of aspirin, strong mouthwash solutions, and other medications, including cocaine, can cause ulceration of the gingival tissue. These injuries are usually transient but can temporarily impair plaque control and contribute to periodontal inflammation

4.8 Tooth Discolorations

These are discolorations found on the surface or within the tooth itself. Depending on their origin, they can be **exogenous** or **endogenous**, and depending on their location, they can be incorporated into the hard dental tissues or remain on the tooth surface.

Exogenous discolorations originate from external sources and are most often located on the outer surface of the tooth. They may come from chromogenic bacteria, food, or chemical agents. In contrast, **endogenous discolorations** are incorporated into the tooth and cannot be removed by polishing.

Types of discolorations incorporated into the tooth: These are always endogenous because they originate from within the tooth and are found embedded in the dental structures. Common examples include:

1. Non-vital (depulped) teeth, where pulp contents cause discoloration of dentin. This may also occur in the presence of deep caries.
2. In older patients, where teeth develop a dark gray color due to dentin exposure. With age, enamel becomes thinner, exposing the darker color of the dentin.
3. Excessive fluoride intake (fluorosis). If fluoride intake is increased between the third month of pregnancy and the eighth year of life, the teeth develop an opalescent whitish or brown color.
4. Use of tetracyclines during the calcification and development of teeth. Tetracyclines should not be used after the second trimester of pregnancy and up to the eighth year of life. Discoloration of teeth has also been observed in adults with excessive use of tetracyclines. The staining from tetracycline use is gray-brown.

Some **external stains** may become incorporated into the enamel or dentin (such as amalgam or nicotine stains).

Types of external discolorations:

- **Yellow stains** are most often associated with the presence of dental plaque and can be removed by eliminating the plaque.
- **Dark brown to black stains** can be seen in people who drink a lot of coffee or tea and do not brush adequately to remove tannins. These tannins can penetrate the initial pellicle of dental plaque. With more effective brushing and by replacing the current toothbrush with a firmer and more abrasive one, these stains can often be removed. Tobacco stains discolor the tooth from dark brown to black. They result from tobacco tar and carbon monoxide. Initially,

they appear in the irregularities of enamel and in tooth fissures. Later, they may accumulate to the point where the teeth appear coated in tar. This is most often observed on the lingual surfaces of the lower incisors. Tobacco stains make the tooth surface rougher, which facilitates more plaque accumulation.

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Chapter 5: Oral Hygiene Indices

Introduction

Oral hygiene indices are clinical tools used to assess the level of oral cleanliness, the presence of plaque and calculus, and the effectiveness of oral hygiene maintenance in individuals or groups. They serve as a quantitative method for describing and comparing the condition of the oral cavity, both for research and educational purposes.

An index provides a **numerical expression** that represents a specific clinical condition, allowing for objective evaluation, statistical comparison, and monitoring of progress or treatment effectiveness over time.

Criteria for Selecting an Index

When choosing an appropriate oral hygiene index, the following criteria should be considered:

1. **Simplicity** – The index should be easy to use and not require complex procedures.
2. **Clarity** – The definitions and scoring system must be clear and easily understood by both examiners and students.
3. **Reproducibility (Reliability)** – The index should produce consistent results when used by different examiners or at different times.
4. **Sensitivity** – It should be capable of detecting small changes in the condition being measured.
5. **Objectivity** – The scoring should rely on measurable criteria rather than subjective impressions.
6. **Practicality** – The index should require minimal equipment and be applicable in both clinical and educational settings.
7. **Relevance** – It should provide meaningful information regarding the patient's oral hygiene and risk for oral diseases.

Classification of Oral Hygiene Indices

Oral hygiene indices can be divided into several categories based on the type of deposits or criteria being evaluated:

1. **Plaque or Debris Indices** – assess soft deposits on the tooth surface (e.g., O’Leary, Silness & Løe).
2. **Calculus Indices** – measure the presence and amount of mineralized deposits.
3. **Combined Indices** – evaluate both plaque and calculus together (e.g., Green & Vermillion OHI, OHI-S).
4. **Hygiene Efficiency Indices** – used to measure the effectiveness of oral hygiene instruction or treatment.

Purpose of Using Oral Hygiene Indices

- To evaluate the effectiveness of **oral hygiene techniques** and patient education.
- To monitor **changes in plaque accumulation** over time.
- To assess the **efficacy of preventive programs**.
- To support **clinical decision-making** and improve patient motivation.

1. **O’Leary, Drake, and Naylor Plaque Control Record (PCR)**
2. **Silness and Løe Plaque Index (PI)**
3. **Green and Vermillion Oral Hygiene Index (OHI, OHI-S)**

Each of these indices evaluates oral cleanliness using specific criteria and measurement techniques.

1.O’Leary, Drake, and Naylor Plaque Control Record (1972)

Purpose

The O’Leary Plaque Control Record is designed to identify and record all tooth surfaces covered by dental plaque. It helps to determine the percentage of tooth surfaces with visible plaque and to evaluate the patient’s oral hygiene habits and effectiveness of brushing.

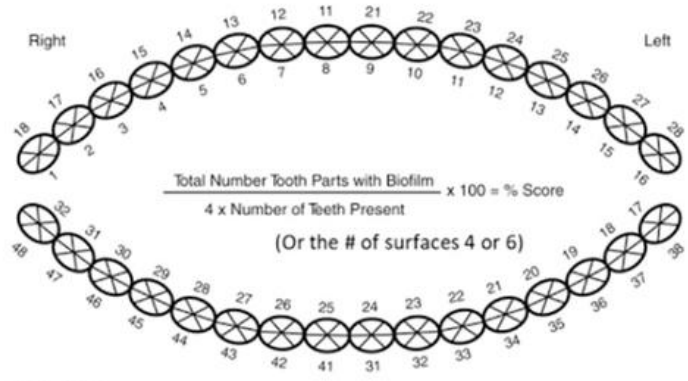
Method

All teeth are examined, and each tooth is divided into four surfaces:

- Mesial

- Distal
- Buccal (labial)
- Lingual (palatal)

Each surface is disclosed using a plaque disclosing agent (such as erythrosine). The examiner records whether plaque is present on each surface.



Scoring

Each surface with visible plaque receives a score of **1**.
 Each surface without plaque receives a score of **0**.

The total number of surfaces with plaque is divided by the total number of examined surfaces and multiplied by 100 to obtain a percentage.

Interpretation

PCR (%) Oral Hygiene Level

- 0–10% Excellent
- 11–30% Good
- 31–60% Fair
- >60% Poor

Example of Calculation

If a patient has 28 teeth (112 surfaces total) and 34 surfaces show visible plaque:

$$34 \div 112 \times 100 = 30.4\%$$

Result: The patient's oral hygiene is considered **good**, but plaque control should be improved through better brushing and interdental cleaning.

2.Silness & Loe Plaque Index (PI, 1964)

Purpose

The **Silness and Loe Plaque Index (PI)** is designed to assess the **thickness of plaque** on the tooth surface near the **gingival margin**. It is particularly useful for evaluating the relationship between **plaque accumulation and gingival inflammation**.

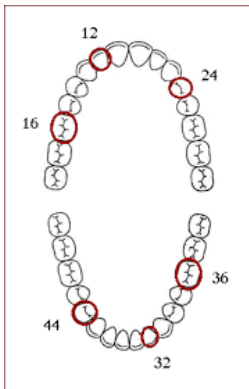
The index is applied to specific teeth, and each surface is examined and scored individually.

Teeth Examined

Typically, six representative teeth are used:

16, 12, 24, 36, 32, and 44.

If any of these teeth are missing, the adjacent tooth is substituted. Each tooth is divided into **four surfaces**: Mesial (M), Distal (D), Buccal (B), Lingual (L).



Scoring Criteria

Score	Description
0	No plaque in the gingival area

Score	Description
1	A thin film of plaque adhering to the gingival margin and adjacent tooth area, detected only by a probe or disclosing agent
2	Moderate accumulation of soft deposits visible to the naked eye along the gingival margin
3	Abundant soft deposits in the gingival pocket and/or on the tooth and gingival margin

Calculation

For each tooth, the scores for all four surfaces are added and divided by four to obtain the **mean score per tooth**.

Then, the mean scores of all examined teeth are added and divided by the number of teeth examined to obtain the **overall Plaque Index (PI)**.

Interpretation

PI Value Oral Hygiene Level

0	Excellent
0.1 – 1.0	Good
1.1 – 2.0	Fair
2.1 – 3.0	Poor

Example of Calculation

Tooth No.	M	D	B	L	Total	Mean per Tooth
16	2	1	1	2	6	1.5
12	1	0	1	1	3	0.75
24	2	2	1	2	7	1.75
36	1	1	0	1	3	0.75
32	0	1	1	0	2	0.5
44	2	1	2	2	7	1.75
TOTAL					28	

Number of surfaces examined: 24

$$28 \div 24 = 1.16$$

Result: Plaque Index = 1.16 → *Fair oral hygiene*

Practical Notes for Students

- Plaque should be assessed **before cleaning** or rinsing the teeth.
- Disclosing agents may be used to improve visibility of plaque deposits.
- Each score should reflect the **most severe condition** observed on the surface.
- The PI is often used together with the **Löe & Silness Gingival Index (GI)** to study the correlation between plaque and gingival health.

3. Green & Vermillion Oral Hygiene Index (OHI, 1960)

Purpose

The **Green and Vermillion Oral Hygiene Index (OHI)** was developed to evaluate the **presence of plaque (debris)** and **calculus (tartar)** on tooth surfaces. It provides a combined score that reflects the **overall oral cleanliness** of an individual.

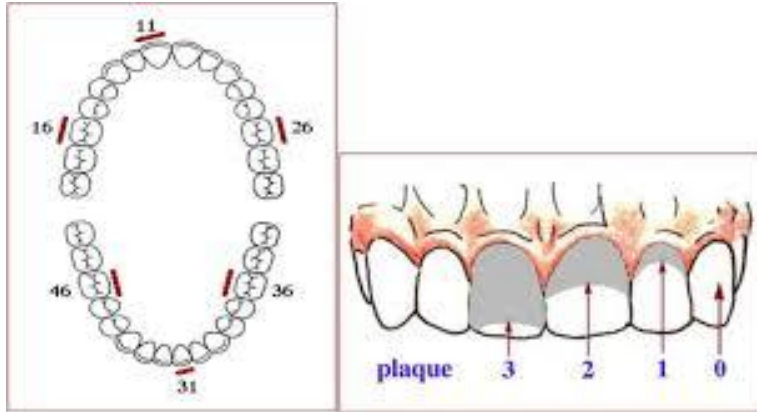
The index is often used in population studies and for evaluating the effectiveness of oral hygiene programs.

Components

The OHI consists of two separate components:

1. **Debris Index (DI)** – for soft deposits and plaque
2. **Calculus Index (CI)** – for mineralized deposits

Each tooth surface is examined and scored separately for **debris** and **calculus**.



Teeth and Surfaces Examined

The following teeth are usually selected:

16, 11, 26, 36, 31, and 46 (or their substitutes if missing).

The **buccal and lingual surfaces** of each tooth are examined.

Scoring Criteria

Score	Debris (DI)	Calculus (CI)
0	No debris or stain	No calculus
1	Soft debris covering $\leq 1/3$ of the tooth surface	Supragingival calculus covering $\leq 1/3$ of the surface
2	Soft debris covering $> 1/3$ but $\leq 2/3$ of the surface	Supragingival calculus covering $> 1/3$ but $\leq 2/3$ of the surface, or flecks of subgingival calculus
3	Soft debris covering $> 2/3$ of the surface	Heavy supragingival and subgingival calculus covering $> 2/3$ of the surface

Calculation

Each surface receives separate **DI** and **CI** scores.

The averages are calculated for each index and then combined:

$$\text{OHI} = \text{DI} + \text{CI}$$

Example of Calculation

Tooth No.	Surface	DI	CI	Total (DI + CI)
16	B	2	1	3

Tooth No.	Surface	DI	CI	Total (DI + CI)
11	L	1	0	1
26	B	2	1	3
36	L	1	1	2
31	B	0	0	0
46	L	2	1	3
Total		8	4	12

Number of surfaces examined = $6 \times 2 = 12$

DI = $8 \div 12 = 0.67$; CI = $4 \div 12 = 0.33$

OHI = $0.67 + 0.33 = 1.0$

Result: OHI = 1.0 → *Good oral hygiene*

Interpretation

OHI Value Oral Hygiene Level

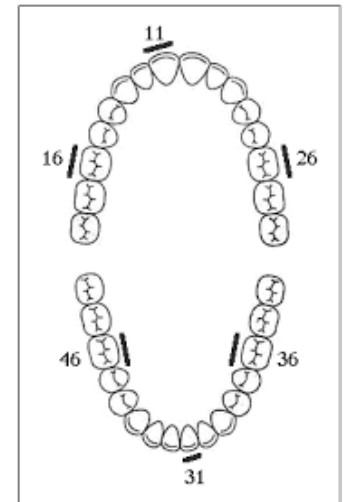
0.0 – 1.2 Good

1.3 – 3.0 Fair

3.1 – 6.0 Poor

Practical Recommendations for Students

- Use a mouth mirror and good lighting for visibility.
- Ensure teeth are **not dried** before examination.
- Evaluate the **most stained or calculus-covered area** of each surface.
- Record findings clearly and consistently.



4. Simplified Oral Hygiene Index (OHI-S, 1964)

Purpose

The **Simplified Oral Hygiene Index (OHI-S)** was introduced by Green and Vermillion (1964) as a **simplified version** of the original OHI, making it more suitable for educational use and field studies.

It evaluates fewer teeth but provides similar information on **plaque (debris)** and **calculus** accumulation.

Teeth and Surfaces Examined

The OHI-S uses **six indicator teeth: 16, 12, 24, 36, 32, and 44.**

Examined surfaces:

- Buccal surfaces of **16, 12, 24, 36, 32, 44**
- Lingual surfaces of **36 and 32** (optional depending on visibility)

Scoring Criteria

Score	Debris Index (DI-S)	Calculus Index (CI-S)
0	No debris	No calculus
1	Soft debris covering $\leq 1/3$ of the tooth surface	Supragingival calculus covering $\leq 1/3$ of the surface
2	Soft debris covering $> 1/3$ but $\leq 2/3$ of the surface	Calculus covering $> 1/3$ but $\leq 2/3$ of the surface
3	Soft debris covering $> 2/3$ of the surface	Heavy calculus covering $> 2/3$ of the surface

Components of OHI-S

The OHI-S consists of two indices:

- Debris Index–Simplified (DI-S)
- Calculus Index–Simplified (CI-S)

Calculation

$$\text{OHI-S} = \text{DI-S} + \text{CI-S}$$

Each index is calculated separately as the average score of examined surfaces.

Example of Calculation

Tooth No.	Surface	DI-S	CI-S	Total
16	B	2	1	3
12	B	1	0	1
24	B	2	1	3
36	L	1	1	2
32	L	0	0	0
44	B	2	1	3
TOTAL		8	4	12

Number of surfaces examined = 6

DI-S = $8 \div 6 = 1.33$; CI-S = $4 \div 6 = 0.67$

OHI-S = $1.33 + 0.67 = 2.0$

Result: OHI-S = 2.0 → *Fair oral hygiene*

Interpretation

OHI-S Value Oral Hygiene Level

0.0 – 0.9	Good
1.0 – 1.9	Fair
2.0 – 3.0	Poor

Practical Notes for Students

- The OHI-S is ideal for **educational purposes** and short clinical sessions.
- Use gentle air-drying to improve visibility of debris and calculus.
- Always examine **buccal and lingual surfaces separately**.
- Record values accurately to ensure reliable group comparisons.

Comparison Between OHI and OHI-S

The **Oral Hygiene Index (OHI)** and the **Simplified Oral Hygiene Index (OHI-S)** are closely related, as both were developed by **Green and Vermillion** to assess plaque and calculus accumulation. However, the OHI-S was designed as a **simplified version** to make data collection

and clinical application easier and faster, particularly for educational and field purposes.

Main Differences

Feature	OHI	OHI-S
Year of introduction	1960	1964
Number of teeth examined	More teeth (entire dentition)	6 indicator teeth
Surfaces examined	Buccal and lingual of all selected teeth	Buccal and selected lingual surfaces of 6 teeth
Time required	Longer, more detailed	Shorter, easier for students
Purpose	Clinical and epidemiological studies	Educational and screening purposes
Precision	More detailed, higher accuracy	Slightly less precise but efficient for teaching
Ease of use	More complex	Simplified and faster

Practical Recommendation

- Use **OHI-S** for **teaching, clinical demonstrations, and student exercises**.
- Use **OHI** for **research and population studies** where higher precision is required.

Both indices give comparable information regarding **oral cleanliness**, and their use should depend on the **time available** and **educational objectives**.

5. Quigley & Hein Plaque Index (1962, Modified by Turesky et al., 1970)

Purpose

The **Quigley & Hein Plaque Index**, later modified by **Turesky et al. (1970)**, is designed to measure the **amount of dental plaque on the tooth surfaces** after using a disclosing agent.

It provides a more **sensitive and detailed assessment** of plaque distribution, especially for research and clinical trials evaluating plaque control products.

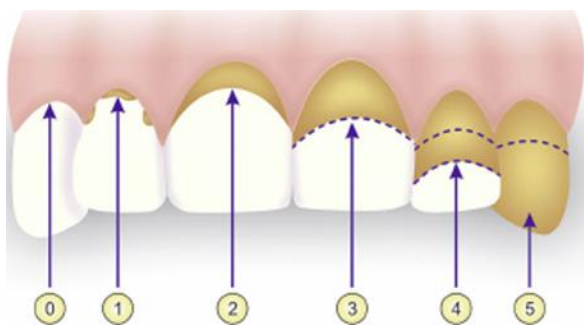
Teeth and Surfaces Examined

All teeth are examined on the **facial and lingual surfaces**.

The use of a **disclosing agent** (erythrosine or fluorescein) is mandatory for visualizing plaque.

Scoring Criteria (Turesky Modification)

Score	Description
0	No plaque
1	Separate flecks of plaque at the cervical margin of the tooth
2	A thin continuous band of plaque (up to 1 mm) at the cervical margin
3	A band of plaque wider than 1 mm but covering less than one-third of the crown
4	Plaque covering one-third to two-thirds of the crown
5	Plaque covering more than two-thirds of the crown



Calculation

$$QH = (\text{Sum of all plaque scores}) \div (\text{Number of surfaces examined})$$

Interpretation

Score Oral Hygiene Level

0.0 – 1.0 Excellent

1.1 – 2.0 Good

2.1 – 3.0 Fair

3.1 – 5.0 Poor

Example

If a patient has a total plaque score of 40 for 20 surfaces examined:

$$QH = 40 \div 20 = 2.0$$

Result: Fair oral hygiene

6. Löe & Silness Gingival Index (GI, 1963)

Purpose

The **Gingival Index (GI)** evaluates the **severity of gingival inflammation** based on color, consistency, and bleeding on probing.

It is often used **together with the Silness & Löe Plaque Index** to determine the relationship between plaque accumulation and gingival health.

Teeth and Surfaces Examined

The same representative teeth are used: **16, 12, 24, 36, 32, 44.**

Each tooth is divided into **four surfaces**: mesial, distal, buccal, and lingual.

Scoring Criteria

Score	Description
0	Normal gingiva, no inflammation or bleeding
1	Mild inflammation, slight color change, mild alteration in texture, no bleeding on probing
2	Moderate inflammation, redness, edema, glazing, bleeding on probing

Score	Description
3	Severe inflammation, marked redness, edema, ulceration, tendency to spontaneous bleeding

Calculation

$GI = (\text{Sum of all surface scores}) \div (\text{Number of surfaces examined})$

Interpretation

GI Value Gingival Condition

0.0 – 0.1 Excellent

0.1 – 1.0 Mild inflammation

1.1 – 2.0 Moderate inflammation

2.1 – 3.0 Severe inflammation

Clinical Note

- The GI is **non-destructive** and suitable for student practice.
- It measures **inflammation, not attachment loss**.
- Commonly used in studies on **plaque control and periodontal therapy**.

7. Patient Hygiene Performance (PHP) Index

Introduction

The Patient Hygiene Performance (PHP) Index is a clinical tool developed by Podshadley and Haley in 1968 to evaluate a patient's effectiveness in performing oral hygiene. Unlike indices that measure overall plaque levels, the PHP index focuses specifically on the performance of daily plaque removal on selected tooth surfaces. It is widely used in preventive dentistry, dental hygiene education, and clinical research.

Purpose of the PHP Index

The PHP Index is designed to:

- Assess the **quantity and distribution of plaque** on selected tooth surfaces.
- Evaluate a patient's **daily oral hygiene routine**, particularly brushing technique.
- Demonstrate the need for oral hygiene instruction (OHI).
- Monitor progress after repeated instructions or interventions.
- Serve as a **sensitive index** in clinical studies involving plaque control.

It is especially valuable because it helps clinicians identify **specific areas** where plaque tends to accumulate.

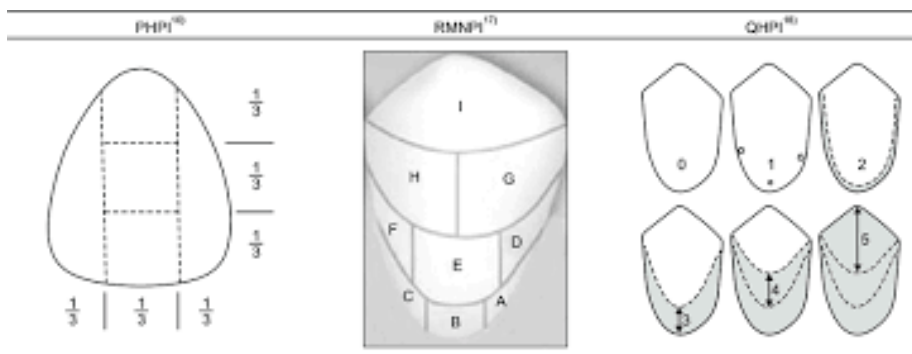
Selection of Teeth

The original PHP method uses **six index teeth**, similar to other simplified indices. These teeth are selected to represent different regions in the mouth and to provide a reliable estimate of overall oral hygiene performance.

Common index teeth include:

- **Maxillary right first molar**
- **Maxillary right central incisor**
- **Maxillary left first molar**
- **Mandibular left first molar**
- **Mandibular left central incisor**
- **Mandibular right first molar**

If any index tooth is missing, it is substituted with the **next posterior tooth** that is present.



Surface Division

Each tooth surface examined is divided into **five subareas**:

1. **Mesial third**
2. **Distal third**
3. **Middle third – incisal/occlusal portion**
4. **Middle third – gingival portion**
5. **Middle third – central area**

These subdivisions allow the clinician to locate plaque precisely and to evaluate brushing efficiency in detail.

Procedure

The PHP Index is recorded using the following step-by-step method:

1. Apply disclosing solution

The patient rinses to distribute the dye evenly. Stained plaque becomes clearly visible.

2. Dry the tooth surfaces lightly

Moisture control helps with visibility.

3. Examine each index tooth

Inspect the designated surface and mentally divide it into the five subareas.

4. Score each subarea

- **1 point** = plaque present
- **0 points** = no plaque present

Every discolored plaque deposit, no matter how small, is counted.

5. Record scores

The clinician records the total number of subareas with plaque for each tooth.

Calculation of the PHP Score

The PHP score is calculated as follows:

PHP = Total number of subareas with plaque \ Total number of subareas examined

- The maximum score per tooth surface is **5** (all subareas contain plaque).
- A lower score indicates better oral hygiene.

Example:

If 20 subareas were examined and 8 contained plaque:

$$\text{PHP} = 8 / 20 = 0.40$$

Interpretation of Scores

Although ranges vary slightly in the literature, the following guidelines are commonly used:

PHP Value	Interpretation
0.0	Excellent oral hygiene
0.1–1.7	Good oral hygiene
1.8–3.4	Fair/Moderate hygiene
≥3.5	Poor oral hygiene

A higher score reflects a larger amount of plaque and poorer hygiene habits.

Advantages of the PHP Index

- **Sensitive to small changes** after oral hygiene instruction.
- Easy for clinicians and students to learn.
- Provides **visual, motivating feedback** for patients.
- Identifies specific areas where brushing is inadequate.
- Useful for **research**, especially in preventive dentistry.

Limitations

- Evaluates **only selected teeth**, not the entire dentition.
- Requires the use of **disclosing agents**, which may not be tolerated by all patients.
- Possible **inter-examiner variability** if criteria are not standardized.
- Time-consuming for large populations unless simplified.

Clinical Application

The PHP Index is commonly used:

- In dental hygiene clinics during initial assessment.
- Before and after patient education sessions on brushing technique.
- To track long-term improvements in plaque control.
- In studies evaluating the effect of manual vs. electric toothbrushes, flossing interventions, or mouthrinses.

- **Summary**

The Patient Hygiene Performance (PHP) Index is a reliable, evidence-based tool for evaluating the effectiveness of daily plaque removal. By scoring plaque presence in specific subareas of selected teeth, clinicians gain a detailed understanding of a patient's oral hygiene habits. Its sensitivity, simplicity, and educational value make it a foundational index in preventive dentistry and dental hygiene training.

Guidelines for Selection and Application of Oral Hygiene Indices

When conducting practical exercises or clinical research, the selection of the appropriate index should be based on the **objective of the examination** and the **group of subjects** being evaluated.

1. Educational Settings (Student Practice)

- Use simple and time-efficient indices such as:
 - **O'Leary, Drake, and Naylor Plaque Control Record**
 - **Silness & Løe Plaque Index (PI)**
 - **Simplified OHI-S**
- These indices are suitable for demonstrating:
 - Plaque detection techniques
 - Toothbrushing and interdental cleaning effectiveness
 - Short-term oral hygiene improvements after instruction

2. Clinical Settings

- For patient assessment in dental offices:
 - **O’Leary PCR** can be used for daily motivation and plaque control monitoring.
 - **Silness & Loe PI** allows evaluation of plaque in relation to gingival inflammation.
 - **OHI-S** is useful for quick overall oral hygiene assessment.

3. Research and Epidemiological Studies

- For scientific data collection and population surveys, use:
 - **OHI (Green & Vermillion, 1960)** full version
 - **Modified indices** or combinations depending on study goals
- The index should allow **statistical comparison** between groups and over time.

General Instructions for Using Oral Hygiene Indices

1. **Perform examination under adequate lighting.**
2. **Use a dental mirror and explorer** for detection of plaque and calculus.
3. **Avoid drying the teeth completely**, as moisture helps visualize deposits.
4. **Use disclosing agents** when appropriate, especially for educational purposes.
5. **Record results clearly and systematically** in the patient chart or worksheet.
6. **Repeat the index periodically** to monitor progress in oral hygiene practices.

Advantages of Using Indices in Student Education

- Provide an **objective and measurable** method of assessing oral cleanliness.
- Improve **students’ observation skills** and clinical accuracy.
- Facilitate **motivation and instruction of patients.**
- Enable **comparison of oral hygiene results** before and after preventive education.

Conclusion

Maintaining proper oral hygiene is fundamental to preventing dental caries and periodontal disease.

By using indices such as:

- **O’Leary, Drake & Naylor Plaque Control Record (PCR)**
- **Silness & Loe Plaque Index (PI)**
- **Green & Vermillion OHI and OHI-S**

students and clinicians can systematically assess, record, and improve oral cleanliness.

The regular application of these indices enhances the **quality of dental education**, promotes **patient awareness**, and supports the long-term goal of **preventive oral health care**.

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Chapter 6: Principles and Application of Ultrasonic Instrumentation in Periodontal Therapy

1.Introduction to Mechanized Instrumentation

Ultrasonic instrumentation, often termed power-driven, mechanical, or mechanized instrumentation, is an essential procedure in preventive and periodontal dentistry. This technique utilizes high-frequency sound waves to achieve the mechanical

removal of **dental calculus (tartar)**, oral biofilm, plaque, and root surface constituents from both supragingival and subgingival areas of the teeth. Unlike manual scaling, ultrasonic scaling relies on multiple synergistic effects to achieve thorough debridement with minimal tissue trauma.

1.1 Principles of Ultrasonic Scaling

Ultrasonic instruments (scalers) convert electrical energy into mechanical energy, generating acoustic vibrations in the range of **18,000 to 50,000 vibrations per second (Hz)** at the instrument tip. These vibrations fragment and dislodge deposits from the tooth surface. Two main types of ultrasonic scalers exist:

1. **Magnetostrictive scalers** – generate vibrations through a stack of metal strips that expand and contract in a magnetic field. The tip moves in an elliptical pattern (Fig.1A).
2. **Piezoelectric scalers** – use ceramic crystals that change shape when subjected to an electric current, causing the tip to vibrate linearly (back and forth) (Fig.1B).

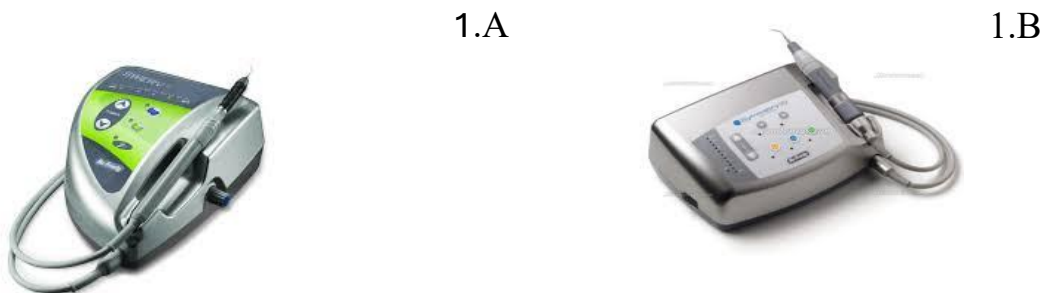


Figure.1. Ultrasonic Units: A. Magnetostrictive: Swerv. B. Piezoelectric: Symmetry IQ 3000. (Courtesy Hu-Friedy Manufacturing, Chicago, Illinois.)

The efficacy of ultrasonic scaling is based on three primary modes of action: **Mechanical Vibration, Cavitation and Acoustic Streaming**. These mechanisms work together in the presence of a fluid environment (irrigation) to achieve thorough periodontal debridement with minimal tissue trauma. Here is how these modes of action interact:

1. **Mechanical Vibration:** The rapid oscillations of the working end fragment and dislodge deposits from the tooth surface. The instrument's **clinical power**—its

ability to remove calculus under load—is influenced by the stroke length, frequency, type of motion, and angulation against the tooth surface.

2. **Cavitation:** High-frequency sound waves cause the formation and immediate collapse of microscopic air bubbles in the irrigating water surrounding the working end. The resulting shock waves help to **disrupt bacterial cell walls** and **detach biofilm**, thereby contributing to antimicrobial activity. Cavitation simultaneously results in **lavage**, which is the therapeutic washing of the sulcus or pocket to remove endotoxins and loose debris (Fig.2).
3. **Acoustic Streaming:** *Acoustic streaming* describes the rapid movement of the irrigating fluid caused by the vibration of the ultrasonic tip. This continuous fluid motion helps **flush debris, bacteria, and loosely attached particles** from the gingival sulcus and interdental areas (Fig.3).

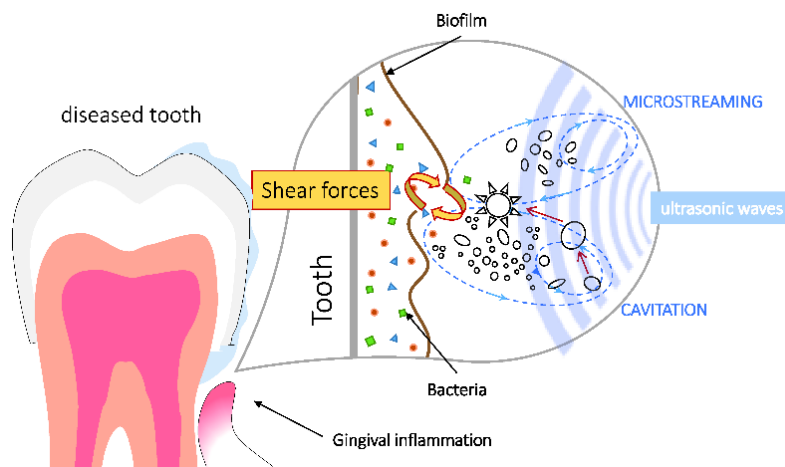


Figure 2. Cavitation in a periodontal pocket by an ultrasonic dental scaler

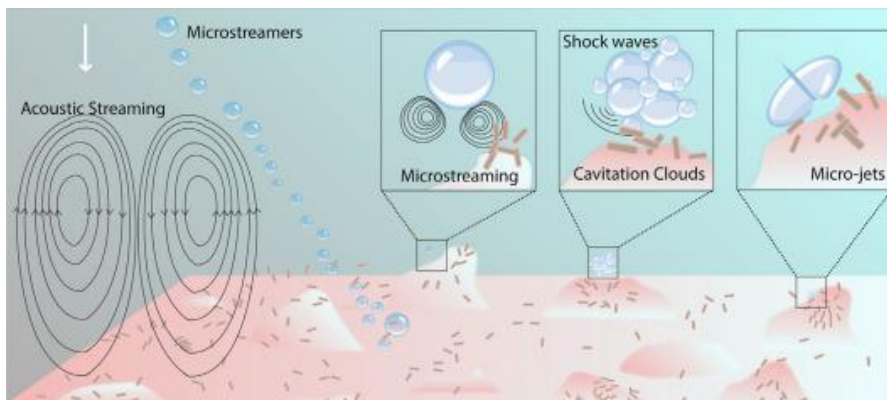


Figure 3. Enhanced acoustic streaming effects

Synergy and Therapeutic Goal

Optimal removal of plaque and calculus, while maintaining tissue integrity, is ensured by the **combined effects** of mechanical vibration, acoustic streaming, and cavitation. The mechanical action breaks down tenacious deposits, while the combined fluid dynamic actions (cavitation and acoustic streaming) specifically target non-adherent bacteria, disrupt biofilm, and thoroughly flush the pocket, providing enhanced subgingival cleaning.

2. Types of Ultrasonic Units

There are two main types of ultrasonic units: magnetostrictive and piezoelectric, differentiated by their transducer material and tip motion. Active surfaces of magnetostrictive and piezoelectric scalers differ significantly due to their internal mechanisms:

2.1. Magnetostrictive Scalers

Motion and Transducer: Magnetostrictive scalers generate vibrations through a stack of metal strips (or a ferrite rod core) that expands and contracts in a magnetic field. This mechanism causes the tip to move in an **elliptical pattern** or an **orbital pattern**.

Active Surfaces and Adaptation: Magnetostrictive inserts deliver energy from **all four working end surfaces**: the point, the concave surface, the convex surface (back), and the sides or lateral surfaces.

- **Most Energy:** The **point generates the greatest amount of energy** and is **not used** on the tooth surface to prevent unwanted surface alterations and sensitivity.
- **Adaptation:** The surfaces that are adapted to the tooth are the **lateral surfaces (sides) and the convex back** of the working end.
- **Least Energy:** The **lateral surfaces** generate the least amount of energy.
- **Active Tip Area:** For 25,000 to 30,000 Hz units, the portion of the working end that performs the instrumentation (the active tip area) is approximately the **last 4.3 mm**.

2.2. Piezoelectric Scalers

Motion and Transducer: Piezoelectric scalers use **ceramic crystals** as their transducer. Vibration occurs when alternating electrical currents are applied to these crystals.

- **Theoretical Motion:** The working end moves in a **linear pattern** (back and forth).
- **Actual Motion:** Research indicates that once the working end is **loaded against the tooth**, the tip moves in a tight **elliptical pattern** similar to the magnetostrictive insert.

Active Surfaces and Adaptation: All surfaces of the piezoelectric working end are activated.

- **Adaptation:** However, **only the lateral surfaces** are adapted to the tooth surface in clinical practice. The lateral surfaces emit the least amount of energy.
- **Active Tip Area:** The active tip area for 25,000 to 30,000 kHz piezoelectric units is typically **2.3 to 3.5 mm**, depending on the tip design.

Feature	Magnetostrictive Scalers	Piezoelectric Scalers
Transducer	Stack of metal strips (e.g., Permalloy) or ferrite rod.	Ceramic crystals.
Tip Motion	Elliptical or orbital pattern.	Linear motion, though it becomes a tight elliptical pattern when loaded against the tooth.
Heat Generation	Generates heat as a by-product, necessitating constant water flow (coolant) to prevent pulp tissue damage.	Generates virtually no heat from the transducer; less water is needed specifically for cooling, but water is essential for lavage.
Activated Surfaces	All surfaces are activated, but the back and lateral sides are used most often. The point generates the greatest energy and is avoided.	All surfaces are activated; however, only the lateral sides are adapted to the tooth surface.

Active Tip**Area (25-30 kHz)** Approximately the last **4.3 mm**.Typically **2.3 to 3.5 mm**, depending on tip design.

Units can be either **autotuned** (most common, with preset frequency that adjusts automatically to maximize efficiency based on the insert used and power setting) or **manual-tuned** (allowing the clinician to adjust the frequency via a tuning knob).

3. Specific design features of the working ends. Difference between Standard, Universal, and Precision Thin inserts.

Ultrasonic inserts are classified based on their size and purpose, primarily falling into three categories: Standard, Universal, and Precision Thin (or Slim), which facilitate different levels of subgingival access and calculus removal. The difference between Standard, Universal, and Precision Thin ultrasonic inserts lies primarily in their size, power requirements, and intended subgingival access capabilities.

Here is a detailed breakdown of the design, indications, and adaptation for deep pockets and furcations, drawing on the sources:

3.1. Standard/Conventional Inserts

- **Design and Indication:** Standard designs are characterized by their **large working end** and are primarily indicated for the removal of **moderate to heavy calculus deposits**. They can be used for supragingival debridement or, depending on access and tissue health, subgingivally (Figure 4).
- **Subgingival Access:** Standard inserts typically only extend subgingivally about **1 to 3 mm**, depending on the gingival tissue condition and overall access to the area.
- **Adaptation:** The clinician uses **quick, controlled, eraser-like motions**.

3.2. Standard Universal Inserts

- **Design and Indication:** Universal inserts (such as #1000, #100, or #10) are a type of standard insert intended for use in **all areas** of the mouth for **light, moderate, and heavy calculus removal**. They are used supragingivally,

primarily for initial debridement of moderate to heavy, non-tenacious deposits.

- **Subgingival Access:** These inserts **can be used subgingivally** for moderate and heavy calculus removal in anterior and posterior areas, depending on the accessibility and gingival contour.
- **Adaptation:** The clinician works with the **side of the working end**.

3.3. Precision Thin/Slim/Microultrasonic Inserts

- **Design and Indication:** These are **narrower** working ends, also referred to as periodontal or slim designs, specifically intended for **subgingival access**. They have a probe-like, slim working-end design, often ranging from **0.3 to 0.6 mm wide**. They are indicated for periodontal debridement and the removal of **light deposits and oral biofilm**.
- **Subgingival Access in Pockets:** Thin inserts are at least **40% narrower** than standard inserts, which enhances subgingival access and client comfort.
 - **Straight designs** are best adapted for straighter surfaces, anterior teeth, and **periodontal pockets that are 4 mm or less**.
 - **Right and left designs** are curved and indicated to reach **depths greater than 4 mm**.
- **Access in Furcations and Concavities:** Thin tips are necessary for accessing furcation entrances, a significant percentage of which are not treatable by hand curets because standard inserts or manual curets are too wide.
 - Thin inserts are used in **concavities and furcations**.
 - A specialized type of thin insert, the **Furcation insert**, terminates with a **small ball-end feature (0.8-mm ball)**, designed specifically for periodontal debridement in and adjacent to furcations and root concavities.
- **Adaptation and Power:** Thin inserts are used with the **lowest effective power setting** (low to medium). The **sides and back** of the working end are adapted to the root surface. The back surface can be adapted in deep pockets, on proximal surfaces, or in furcation invasions, using a light, minute, overlapping stroke.



Figure 4. Conventional Inserts Examples of piezoelectric tip designs. A, Standard (#3). B, Standard (#10). C, D, E, Thin (straight, right, and left). (Courtesy Hu-Friedy Manufacturing, Chicago, Illinois).



Figure 5. Ultrasonic scaller tips

- **Subgingival Access in Deep Pockets (Greater than 4 mm)**

Thin Insert Design	Indication	Adaptation
Straight Design	Indicated for periodontal pockets that are 4 mm or less . Best adapted to straighter surfaces (e.g., anterior teeth and narrow pockets).	Used with the back surface to negotiate the apical extent of the pocket.
Right and Left Designs	Indicated to reach depths greater than 4 mm and are used in concavities and furcations. These curved designs facilitate adaptation to the curved tooth and root surfaces, including proximal surfaces.	Adapted like a universal curet in the posterior regions. Trends indicate they debride the apical oral biofilm border in deep pockets.



Figure 6. Negotiating deep pocket with ultrasonics

4. Indications and Contraindications

4.1 Ultrasonic scaling is indicated for:

- Removal of supragingival and subgingival calculus
- Treatment of gingivitis and periodontitis

- Preoperative and postoperative dental cleaning
- Regular professional oral hygiene maintenance
- Orthodontic and prosthodontic plaque control

4.2 Contraindication

Ultrasonic instrumentation is a highly efficient technique, but its use requires strict adherence to safety guidelines concerning the patient's systemic health and oral condition. Mechanized instrumentation should **not be used** in clients reporting the following unstable conditions:

- **Unstable Pulmonary Disease:** This includes acute pulmonary infections (like bronchitis or pneumonia) or unstable chronic conditions (such as asthma, emphysema, chronic obstructive pulmonary disease (COPD) or cystic fibrosis) presenting with symptoms like **shortness of breath at rest**, a productive cough, or oxygen saturation less than 91%. These conditions contraindicate elective dental hygiene care due to the risk of aspiration and breathing difficulty.
- **Dysphagia (Swallowing Difficulty):** Clients experiencing difficulties swallowing (e.g., due to muscular dystrophy, multiple sclerosis, or paralysis) should not undergo ultrasonic scaling because of the unavoidable **water flow** and risk of aspiration.
- **Infectious Diseases (Active Stages):** Conditions like active tuberculosis, respiratory infections, or infectious diseases (such as HIV or Hepatitis) present a high risk of **aerosol spread**. Clients with communicable diseases should not receive elective dental hygiene care until the disease has been appropriately treated.
- Patients with **cardiac pacemakers** or **implantable defibrillators**, especially with older, unshielded magnetostrictive units. (depending on type – consult cardiologist)
- **Uncontrolled bleeding disorders**
- **Hypersensitive teeth, exposed dentin, exposed root surfaces, demineralized tooth structure** (should be desensitized prior to procedure) **and restorative materials (e.g., porcelain, composite)**

4.3 Precautions (Situations requiring caution or modification)

Specific precautions must be taken to prevent iatrogenic damage or adverse health effects.

A. Thermal Damage and Heat Generation

Both magnetostrictive and piezoelectric units require continuous water use.

- **Magnetostrictive Units** generate heat as a by-product of the metal stack action, necessitating constant water flow (coolant) to control the heat and **prevent pulp tissue damage**.
- While **Piezoelectric Units** generate virtually no heat from the transducer crystals, the working end still creates **frictional heat** and requires water for cooling and flushing debris.
- **Technique:** Clinicians must keep the insert in **constant motion** at all times to prevent localized overheating of the tooth surface.
- **Children:** Special precautions are needed when treating children, as primary and newly erupted teeth have large pulp chambers that are **more susceptible to heat**. The lowest possible power setting is recommended for these patients.

B. Aerosol and Spatter Production

Mechanized periodontal debridement produces a large amount of contaminated **aerosols and spatter**.

- **Risk:** Aerosols contain bacteria, blood elements, and viral particles. Clients who are **immunosuppressed** (e.g., from chemotherapy or HIV infection) have an increased risk of opportunistic infection from breathing contaminated aerosols.
- **Mitigation:** To reduce the number of organisms in aerosols, all clients should receive a **30-second preprocedural rinse of 0.12% chlorhexidine gluconate**. High-volume suction and appropriate protective equipment (PPE) are also necessary.

C. Medical Devices (Pacemakers and Defibrillators)

Caution must be exercised with patients having **cardiac pacemakers** or implantable defibrillators.

- **Magnetostrictive Concern:** Older, unshielded, unipolar pacemakers may be disrupted by external electric fields generated by dental equipment, including ultrasonic units. **Magnetostrictive units are generally not recommended** depending on the device model and shielding.
- **Piezoelectric Safety:** **Piezoelectric units do not seem to affect** these devices, though further *in vivo* trials are still needed.
- **Procedure:** Clinicians should consult the cardiologist of record and encourage the client to carry their implant device identification card.

D. Localized Oral Conditions

The working end should be placed **adjacent to, and not on**, the following areas:

- **Hypersensitive Teeth and Exposed Dentin:** These areas should be **desensitized prior** to the procedure.
- **Demineralized Tooth Structure.**
- **Restorative Materials:** Placement on materials like **porcelain, gold, amalgam, or composite** should be avoided. Restorations can be adversely affected, potentially resulting in **roughness or striations** (e.g., black-colored striations on composite restorations).

5. Procedure

Preparation

- Take patient medical and dental history.
- Explain the procedure and obtain informed consent.
- Record plaque index and gingival condition.
- Position the patient in a semi-supine position.

Scaling Technique

- Select an appropriate tip for the area to be treated.
- Adjust power and water flow to a moderate level.
- Hold the handpiece lightly with a modified pen grasp.
- Place the tip **parallel to the tooth surface**, not perpendicular, to avoid damage.
- Use **light, sweeping, overlapping strokes**, with constant motion to prevent overheating.
- Begin with **supragingival scaling**, then proceed **subgingivally**.

Finishing

- Rinse and inspect all surfaces.
- Perform polishing with prophylaxis paste to smooth the enamel.
- Provide post-treatment instructions.

6. Equipment and Instrumentation

- Ultrasonic scaler unit (magnetostrictive or piezoelectric)
- Scaling tips (different shapes for supragingival and subgingival use)
- Handpiece and irrigation system (Water Cooling)

The ultrasonic tip generates heat due to high-frequency vibrations. Constant water flow (coolant) prevents thermal damage to the tooth and soft tissues, while simultaneously washing away dislodged calculus and debris.

- High-volume suction
- Protective eyewear, gloves, and face mask

7. Instrumentation Technique and Safety

Proper technique is critical to maximize effectiveness and minimize iatrogenic damage.

- **Adaptation:** The side or back of the working end must be applied **parallel to the tooth surface** at an angle of **no more than 15 degrees**. The point of the insert or tip should never be placed on the tooth surface as it generates the greatest amount of energy and can cause unwanted surface alterations (Fig. 7).
- **Stroke Pattern:** Strokes must be **overlapping** and **multidirectional**. Multidirectional strokes (primarily **oblique and vertical** strokes, but also horizontal and combination strokes) are used to help **break up calculus deposits** and treat all root surfaces.
- Ultrasonic scalers require **light lateral pressure** because tip activation, not pressure, removes deposits. Excessive lateral pressure should be avoided, as it dampens the action and makes calculus removal less effective. The instrument **must be kept in motion** at all times to prevent localized overheating.
- **Power Settings:** The **lowest effective power setting** is generally used for biofilm and light calculus removal (often utilizing thin working ends).

Medium- or higher-power settings are reserved for moderate to heavy deposits that are tenacious.

- **Motion Requirements:** The tip must be **moving at all times** to prevent excessive heat, a "shock" effect felt by the client, or iatrogenic damage to the root or crown. The motion should be initiated by **wrist movement** or rocking from the fulcrum, similar to hand instrumentation.
- When removing heavier, tenacious deposits, the clinician should use the working end like a periodontal probe, **tapping on the top and sides of the deposit to fracture it**. Activating the working end on the outside of the deposit and shaving layers should be avoided, as this causes **deposit smoothing (burnishing)**.

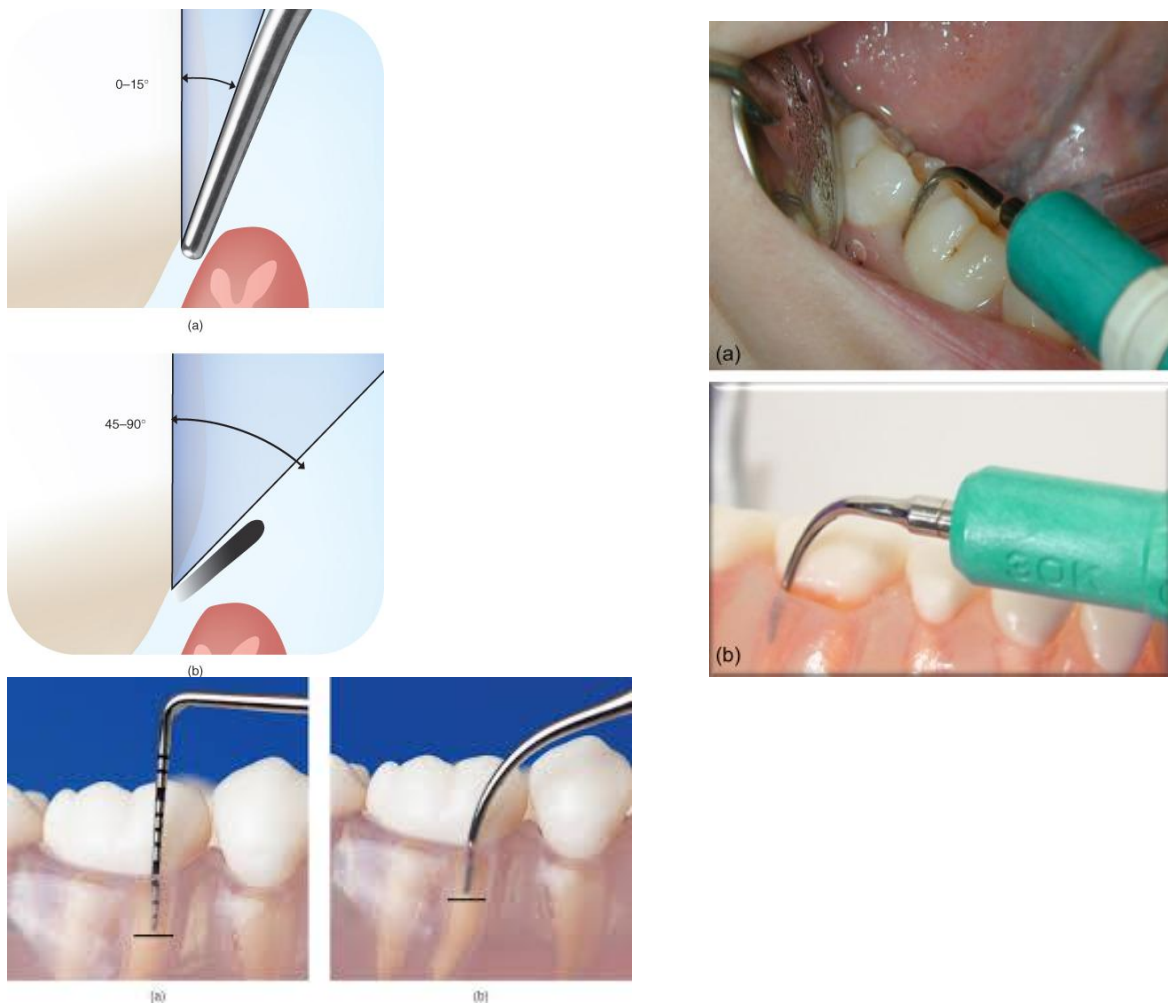


Figure 7. Ultrasonic instrumentation technique

8. Possible Complications

- Temporary tooth sensitivity
- Minor gingival bleeding or irritation
- Aerosol generation (requires proper suction and protection)
- Potential damage to restorative materials if improper technique is used

9. Postoperative Care and Follow-up Instructions

Providing thorough post-treatment instructions is a necessary final step in the ultrasonic scaling procedure. These instructions guide the patient through the healing period and ensure the longevity of the clinical results.

9.1 Immediate Postoperative Instructions

Patients should be advised regarding potential immediate side effects and necessary modifications:

1. **Dietary Restrictions:** Clients should **avoid hot or spicy foods** for a few hours following the procedure to minimize irritation to the treated gingival tissues.
2. **Possible Complications:** Clients should be informed about possible, usually temporary, complications, such as **temporary tooth sensitivity** or **minor gingival bleeding or irritation**.

9.2 Oral Hygiene and Medication

Maintaining meticulous oral hygiene is critical for healing:

1. **Brushing:** The client should use a **soft toothbrush** and maintain their regular hygiene routine.
2. **Rinsing (Chemical Adjunct):** If gingival inflammation is present, the client may be instructed to rinse with a **0.12% chlorhexidine** mouthwash for a period of **5–7 days**. This helps manage localized inflammation.

9.3 Recall and Evaluation

Postoperative care also involves scheduling necessary professional evaluation:

1. **Follow-up:** Clients should schedule a follow-up appointment for **re-evaluation** of the treated tissues and **oral hygiene reinforcement**.
2. **Instrumentation Goal:** The ultimate objective is to ensure optimal removal of plaque and calculus while maintaining tissue integrity, which requires proper instrument handling and **continuous evaluation** of the patient's response.

10. Clinical Advantages

Compared to manual instrumentation, ultrasonic scaling offers several advantages:

- Increased efficiency in removing large deposits
- Shorter procedure time compared to manual scaling
- Reduced operator fatigue
- Enhanced subgingival cleaning
- Cavitation provides **bactericidal** effects
- Effective in removing weakly adherent endotoxin (lipopolysaccharide)
- Comfortable for most patients
- Ultrasonic working ends do not require sharpening

11. Summary

Ultrasonic removal of dental calculus is a modern, efficient, and minimally invasive technique. Through the combined effects of **mechanical vibration**, **acoustic streaming**, and **cavitation**, it ensures optimal removal of plaque and calculus while maintaining tissue integrity.

Mastery of ultrasonic scaling requires proper instrument handling, anatomical awareness, and continuous evaluation of patient comfort and response.

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Chapter 7: Maintaining Oral Hygiene at Home

Motivation, willpower, and patient training to take personal care of oral hygiene and maintain dental plaque at a level that cannot cause disease represent the most effective preventive measures for which there is no better alternative. The use of these preventive measures is equally important for individuals with preserved oral health as well as for patients who already have mild or more serious deviations in oral health.

Common preventive measures include both home-based plaque control and professional care through mechanical plaque removal, assessment of oral hygiene maintenance success, patient education and motivation, identifying weaknesses and shortcomings in oral hygiene maintenance, detecting risk factors and conditions that may compromise oral hygiene and addressing them, as well as advising the patient on how to overcome such difficulties.

What is Oral Hygiene Practiced at Home?

This term is also known as **oral self-care** or **oral physiotherapy**. All these synonyms refer to the daily effort of each individual to prevent the occurrence of dental and gingival diseases, thereby maintaining optimal oral health. The ultimate goal of these procedures is the elimination of dental plaque, and thus the elimination or suppression of harmful microorganisms. Since not all microorganisms inhabiting dental plaque are pathogenic, nor can plaque be ideally removed from all surfaces, it would be more realistic to say that the goal of these measures is not the total elimination of bacteria but **control** of microorganisms - that is, maintaining plaque at the lowest possible level.

The oral cavity possesses mechanisms of physiological self-cleaning. The position of the teeth, occlusal forces, tongue and cheek muscles, the act of mastication, and saliva all contribute to the removal of plaque and debris. However, these mechanisms alone are insufficient - as evidenced by their inability to prevent caries and gingivitis. Therefore, **mechanical plaque control** is the most widely accepted method for preventing caries and periodontal disease.

Mechanical Plaque Control

Mechanical plaque control involves the regular removal of dental plaque from teeth and surrounding tissues and preventing its re-accumulation. It can be performed professionally in a dental office or by the patient at home.

Since dental plaque is invisible to the naked eye, one of the first steps in patient education is plaque visualization. Plaque staining reveals only the gross quantity of plaque without distinguishing food debris or indicating the presence or absence of microorganisms. However, plaque staining has proven to be an effective method for educating patients on oral hygiene maintenance.

Various plaque disclosing substances, available as tablets or liquids (often sold together with toothpaste), can be applied, after which the patient rinses with water. It is advisable for the patient, together with the therapist, to identify areas with the most plaque deposits and receive advice on how to remove them. Patients should be encouraged to use plaque disclosing agents at home before brushing until they master the proper brushing technique. Although these visual feedback methods are effective, they alone are insufficient for maintaining optimal oral hygiene.

Choosing a Toothbrush

Recommendations for proper toothbrush selection should come from the therapist, who should consider the patient's brushing technique, motivation, oral cavity specifics, and of course, price.

Types of Toothbrushes

Standard toothbrushes consist of a handle and a head with tufts of bristles. They come in many shapes and designs — straight or angled handles, some with finger grips or ergonomic shapes. The head may be flame-shaped, angular, or rounded, and its size usually depends on the user's age (infant, child, adolescent, adult).

Bristles are most often made of nylon, which has advantages over natural bristles — it is more durable, resists deformation, retains firmness longer, rinses more easily, and does not harbor bacteria or fungi. Unlike natural bristles, nylon ones do not absorb water, swell, or form porous retention areas for microorganisms.

Bristles are classified as **soft, medium, or hard**. Soft or medium ones are most often recommended, since hard bristles can cause gingival recession and tooth abrasion.

According to Frandesen, even the most thorough brushing with a standard flat-surface brush removes only about **50% of plaque** from broad surfaces, and even less from interproximal areas.

Newer models have **tapered and rounded bristle tips** to minimize gingival injury and better access to interproximal and sulcular areas. However, even among top brands, it is rare to find brushes where all bristles are perfectly rounded.

Alternative toothbrush designs include **special sponges** used for brushing teeth, mainly for small children, elderly individuals, or postoperative patients. Their efficiency is not fully studied, but current evidence suggests they help reduce plaque accumulation on broad surfaces.

Maintenance of Toothbrushes

Toothbrushes should be washed under warm running water after each use to remove food debris, toothpaste, and microorganisms. Then they should be shaken dry and stored upright without touching other toothbrushes. Closed cases are not recommended, as the lack of air promotes microbial growth.

The lifespan of a toothbrush depends on bristle quality, brushing technique, and applied force. Deformation of bristles is a clear sign it should be replaced, though some models include color indicators to show when replacement is needed.

Note: Patients with compromised health should be advised to disinfect toothbrushes daily, since bacterial contamination occurs within less than a month.

Proper maintenance of a toothbrush is essential for effective plaque removal and prevention of oral and systemic infections. A well-maintained toothbrush reduces bacterial accumulation, maintains optimal cleaning efficiency, and supports overall oral hygiene. The following report outlines evidence-based guidelines for toothbrush care, storage, replacement, and hygiene practices recommended for patients.

Importance of Toothbrush Maintenance

- The toothbrush is the primary instrument for daily plaque removal.
- Worn or contaminated toothbrushes are less effective and may harbor pathogenic microorganisms.
- Incorrect storage can increase bacterial growth and cross-contamination risks.
- Regular replacement ensures optimal bristle stiffness and cleaning capacity.

Recommendations for Daily Care

Rinsing After Use

- After each brushing session, the toothbrush should be thoroughly rinsed under running water.
- Rinsing removes residual toothpaste, debris, and dislodged plaque.
- The patient should ensure that no food particles remain between the bristles.

Drying

- The toothbrush should be shaken vigorously to remove excess water.
- It must be stored in an upright position to air-dry.
- A moist brush supports rapid bacterial growth; therefore, **air-drying is mandatory**.

Storage Guidelines

Individual Storage

- Toothbrushes should be stored **separately** to avoid bristle-to-bristle contact.
- Shared storage containers should have dividers.

Ventilation

- Brushes should be kept in open containers or breathable holders.
- Closed cases should only be used for transport; frequent storage in a closed container is not recommended, as it traps moisture.

Environmental Precautions

- The toothbrush should be kept away from toilets and sinks to reduce contamination from aerosols.
- It must not be placed on flat surfaces without protection.

Disinfection Methods

While not mandatory for all patients, disinfecting the toothbrush may benefit individuals with:

- weakened immune systems
- recent illness
- periodontal disease
- orthodontic appliances

Approved disinfection options:

- Soaking bristles in antimicrobial mouthwash for **15–20 minutes**.
- Using a UV-light toothbrush sanitizer (FDA-approved devices).
- Soaking in 3% hydrogen peroxide for **5–10 minutes**, followed by thorough rinsing.

NOT recommended: boiling water, microwaving, bleach, dishwashers — these damage the bristles.

Replacement Frequency

Standard Replacement

- Replace manual and electric toothbrush heads every **3 months**.
- Replacement is required sooner if bristles become:
 - splayed
 - frayed
 - bent
 - deformed
 - discolored

Post-Illness Replacement

- After viral or bacterial infection (flu, cold, strep throat), the toothbrush should be replaced immediately to prevent reinfection.

For Orthodontic Patients

- Replacement every **6–8 weeks** is recommended due to increased wear.

Additional Recommendations

Toothbrush Sharing

- Sharing toothbrushes is **strictly prohibited** due to the risk of cross-infection.

Travel Guidelines

- Use ventilated cases only during travel.
- Allow the toothbrush to dry completely upon arrival.

Electric Toothbrush Maintenance

- Clean the handle and attachment area regularly to remove toothpaste buildup.
- Follow manufacturer guidelines for charger and storage hygiene.

Clinicians should instruct patients to:

- visually check their toothbrush weekly for signs of wear;
- store it in a clean, dry environment;
- avoid aggressive brushing, which accelerates bristle damage;
- combine toothbrush maintenance with regular replacement and proper brushing technique.

Conclusion

Effective toothbrush maintenance is a critical component of oral hygiene. Proper care—including thorough rinsing, upright drying, ventilated storage, optional disinfection, and timely replacement—promotes optimal plaque control and reduces the risk of oral infections. Clinicians should provide individualized recommendations based on patient age, oral health status, and risk factors.

Electric Toothbrushes

Electric toothbrushes were originally designed for people with motor impairments or mental disabilities who could not perform effective manual brushing. They mimicked manual brushing movements.

Newer generations — sonic and ultrasonic brushes — have expanded use to patients with periodontal disease and dental implants.

Electric toothbrushes vary in bristle tuft arrangement, head shape, and motion type — including reciprocating (up-down, in-out), rotating, oscillating, or vibrating movements. The latest models use **sonic waves** and **ultrasonic motion**. However, despite technological advancements, no electric toothbrush is capable of completely removing dental plaque.

Effectiveness of Electric Toothbrushes

Most studies comparing manual and electric toothbrushes in plaque removal and gingivitis/caries prevention have not conclusively justified the superiority of electric ones.

However, studies by Bader (2) using sonic brushes showed greater effectiveness in both plaque removal and faster inflammation reduction. Though limited in number, these studies suggest potential advantages. Electric toothbrushes have proven particularly effective in removing tooth surface stains.

Recommendations for Using Electric Toothbrushes

When recommending an electric toothbrush, it is important to understand its characteristics, operation, and form, and to assess patient suitability. Avoid soft-tissue trauma, and consider patient motivation and cost.

Electric toothbrushes should glide **slowly** over the teeth **without pressure**. They

are safe for patients with dental implants. The reduction in plaque index values should guide individualized evaluation of effectiveness.

They are also useful for **orthodontic patients, young children, and people with disabilities**.

Instructions for Use

General guidelines (to be adapted per manufacturer's instructions):

- The brush should have **soft, rounded bristles**.
- Choose **low-abrasive toothpaste** — the high stroke rate of electric brushes combined with abrasive paste can cause tooth abrasion or damage implants/prosthetics.
- Apply the toothpaste before switching the brush on to avoid splattering.
- Any brushing technique may be used, but each tooth should be cleaned **individually**, systematically **quadrant by quadrant**, starting from distal to anterior teeth.
- Ensure all surfaces are covered; when brushing anterior vestibular surfaces, pull the lip aside for better visibility.
- Movements should be **slow and gentle** — bristles must not bend under pressure.
- In areas with implants, prosthetic restorations, or exposed roots, brushing should be done **without pressure**.

Key Points: Maintaining Oral Hygiene at Home (Summary)

1. **Motivation & Education** – The patient's motivation and knowledge are essential for effective oral hygiene and disease prevention.
2. **Home Oral Hygiene** – Daily self-care (brushing, flossing) prevents dental and gum diseases; goal is plaque *control*, not total removal.
3. **Mechanical Plaque Control** – Regular brushing is the best prevention for caries and periodontal disease; done at home or professionally.
4. **Plaque Visualization** – Disclosing tablets help patients see plaque and improve technique; useful for learning, not a substitute for cleaning.
5. **Toothbrush Selection** –
 - Medium hardness preferred (0.25 mm).
 - Nylon, rounded bristles, head ≤ 3 cm.
 - Soft brush for inflammation or after surgery.

6. **Toothbrush Care** –

- Rinse and dry upright after each use.
- Avoid closed cases.
- Replace when bristles deform.
- Disinfect daily if health-compromised.

7. **Electric Toothbrushes** –

- Originally for disabled users; now common.
- Sonic/ultrasonic models improve plaque removal and stain reduction.
- Safe for implants, children, orthodontic, and disabled patients.

8. **Use Guidelines** –

- Use gentle pressure, soft bristles, low-abrasive paste.
- Brush each tooth separately, quadrant by quadrant.
- No pressure on implants or exposed roots.

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Chapter 8: Interdental care

Interdental cleaning is a crucial component of comprehensive oral hygiene aimed at reducing the risk of dental caries and gum disease. Since brushing alone only reaches approximately 60% of tooth surfaces, interdental spaces are highly susceptible to plaque accumulation, which is the primary etiological factor in periodontal disease.

The recommendation for all patients is to **clean between teeth daily**. The selection of the most appropriate interdental cleaning device must be customized based on individual factors, primarily the size and shape of the interdental space (embrasure type), as well as patient motivation and manual dexterity.

Interdental Space Classification (Embrasures)

Interdental spaces are typically categorized into three types, which determine the indicated cleaning aid:

- **Type I (Closed Embrasure):** The interdental space is completely filled with interdental papilla. This type is most often seen in young, healthy patients.
- **Type II (Open Embrasure):** Mild to moderate gingival recession means the interdental papilla fills roughly 51% to 75% of the space.
- **Type III (Wide Open Embrasure):** There is significant or complete loss of the interdental papilla, leaving the interdental spaces widely open. These are common in the aging population or those with a history of periodontal disease.

1. Comparison of Interdental Cleaning Devices

1.1. Dental Floss (DF)

Dental floss (or dental tape) remains the traditional cleaning method.

Benefits

First Choice for Type I Embrasure and high patient compliance.

Limitations & Indications

Technique-sensitive, requiring demonstration and patience to master.

Highly effective at removing plaque and food particles.

Can remove subgingival plaque, penetrating 2.0 to 3.5 mm into the sulcus if properly used.

Portable and convenient for use on the go.

Flossing, adjunct to brushing, significantly reduces gingivitis compared to brushing alone.

Low compliance is reported among users because it is difficult to use, especially for those lacking dexterity or motivation.

May cause gum irritation or damage if used improperly or aggressively.

Waxed floss may be rigid and difficult to insert in tight contacts or around restorations where it may shred or fray.

Alternatives like **easy flossers** are recommended for Type I patients lacking dexterity or motivation.

1.2. Interdental Brushes (IDBs)

Interdental brushes are small brushes designed to clean the spaces between teeth, consisting of a handle and bristles resembling miniature bottle brushes.

Benefits

Superior Plaque Removal: IDBs are generally considered **more effective** than dental floss, especially in wider gaps.

Higher Efficacy in Periodontal Patients: IDBs resulted in a significantly lower plaque index (39.6%) compared to DF (58.3%) in one study focusing on teeth and implants.

Easier to Use: Patients report IDBs are simpler and more convenient than dental floss, leading to better compliance.

Gentle on Gums: IDBs minimize the risk of gum irritation or bleeding when used correctly.

Key Findings & Indications

IDBs are the **first recommendation for Type II and Type III open embrasures.**

Particularly effective for patients with moderate to severe periodontitis because the brush fills the embrasure space and extends into exposed root concavities.

IDBs (0.6 to 0.7 mm diameter) can also be used as an alternative to floss in Type I closed embrasures for patients with low motivation or poor dexterity.

They are essential for cleaning around **implants, braces, bridges, and fixed prosthetics.**

IDB Sizing: Choosing the correct size is crucial for safety and effectiveness; the brush must fit snugly but **must not be forced**. For optimal results, patients often need more than one brush size.

- The principal criterion for size classification is the **Passage Hole Diameter (PHD)**, although inconsistencies exist across different manufacturers and ISO standards.
- Some brands use **color coding** to standardize size identification (e.g., Pink often represents the smallest size at 0.4mm).
- For smaller interdental spaces, cylindrical brushes are proposed, while conical, longer brushes are suggested for larger sizes to accommodate a broader range of PHD sizes and facilitate insertion.
- The placement of the brush should be performed without force, moving it gently back and forth a few times in each interdental space.

1.3. Other Interdental Aids

Device	Indication and Efficacy
Rubber Interdental Bristle (RIBB) / Soft Picks	Effective alternatives for Type I embrasures and patients with gingivitis; reported to be more comfortable and pleasurable to use than metal-core IDBs.
Oral Irrigators (OI)	Recommended as an adjunct to brushing, particularly for patients with orthodontic appliances or implants. OI significantly improves bleeding scores and gingival health by washing away loose microorganisms and food debris. However, OI cannot remove adherent plaque or dental calculus.
Woodsticks / Gum Stimulators	Used for Type II and Type III open embrasures. They reduce interdental gingival inflammation and bleeding tendency. However, their effectiveness is limited, especially in subgingival and lingual areas, and they should be used as an adjunct rather than the sole home care aid.

Clinical Context and Personalized Care

Plaque accumulation is accelerated in interproximal areas (molars and premolars) for patients susceptible to periodontal disease. Daily oral self-care is vital for slowing the shift to a pathogenic environment following professional debridement.

It is important to remember that:

- **Residual Plaque:** When using IDBs or woodsticks, residual plaque may accumulate over lingual embrasures because devices are typically used from the buccal (cheek) aspect. Clinicians should ensure instructions include a lingual approach (or c-shape dental flossing) if necessary to address this.
- **Patient Compliance:** Compliance is closely linked to the ease of use and patient acceptance of the device. Devices that are easy to perform are more likely to be integrated into a daily routine. For patients who struggle to clean between their teeth, the appropriate interdental cleaning tool should be specifically considered.
- **Implants:** Biofilm control is critical for implants, which are affected by mucositis and peri-implantitis. The use of dental floss or interdental brushes, added to brushing, is important for effective biofilm removal in both teeth and implants.

Interdental cleaning is an indispensable element of oral hygiene, as a conventional toothbrush is only capable of reaching approximately 60% of the tooth surfaces. Since dental biofilm accumulates readily in the interproximal areas, daily interdental cleaning is recommended for all patients to reduce the risk of dental caries and periodontal disease.

The selection of the appropriate cleaning device is critical and must be individualized based on factors such as the size and shape of the interdental space (embrasure type), patient motivation, and manual dexterity. The most effective method for cleaning spaces that are difficult to access must be defined for each patient.

I. Dental Floss (DF)

Dental floss or dental tape remains the initial recommendation for individuals with **Type I (closed) embrasures** who have high motivation and good manual dexterity. Its effectiveness is highly dependent on the technique used.

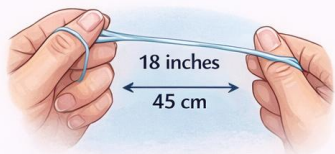
Technique for Conventional Flossing:

1. **Preparation:** An appropriate length of floss is pulled out, wrapped, and tightened between the index fingers of both hands.
2. **Insertion:** The tightened floss is introduced into the interdental space **gently and without pressure**. The floss must be passed carefully through the contact point.
3. **Cleaning Motion:** The floss is pressed against one proximal surface of the tooth. Movement consists of back-and-forth and **coronally** (towards the crown) strokes.
4. **Repetition:** The floss is then removed, and a new length is introduced into the same space, tightened against the adjacent tooth, and the procedure is repeated.
5. **Caution:** Patients should be advised to be cautious and avoid forcefully pulling the floss out from under the contact point, as this can cause injury to the gingiva. Applying the floss with great force beneath the gingiva can damage the attached epithelium, especially in healthy tissue.
6. **Systematic Approach:** The entire procedure should be carried out systematically, often starting from the last maxillary right molar and finishing with the last mandibular right molar.

Aids for Flossing:

- **Floss Threaders :** These have a shape similar to a sewing needle and allow the floss (about 30 cm long) to be drawn through inaccessible areas, such as under fixed prosthetic bridges, around dental implants, or in crowded teeth.
- **Floss Holders:** These are often U-shaped plastic devices where the floss is tensioned between the ends. They are recommended for patients with **limited manual dexterity**.
- **Implant Floss:** Special nylon-wrapped implant floss is used around the abutment in a loop form (bucco-lingual direction). It is gently pushed subgingivally until minimal resistance is met, then moved back and forth and coronally.

How to Use Dental Floss



Use about 18 inches (45 cm) of floss.

Wrap the floss around your fingers, leaving 1-2 inches of floss between them.



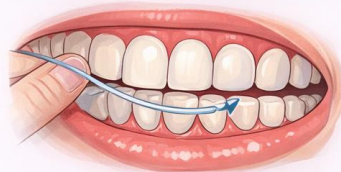
Gently slide the floss between your teeth using a gentle sawing motion.



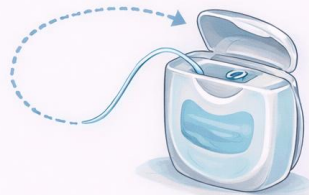
Gently slide the floss between your teeth using a gentle sawing motion.



Use a clean section of floss as you move from tooth to tooth.



Use a clean section of floss as you move from tooth to tooth.



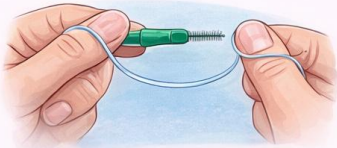
II. Interdental Brushes (IDBs)

Interdental brushes are recommended as the **first choice** for all individuals presenting with **Type II and Type III (open) embrasures**. They are also an effective alternative for Type I spaces, especially for patients who lack dexterity or motivation, provided the interdental space allows passive insertion of a small brush (0.6 to 0.7 mm diameter).

Technique for Interdental Brushes:

1. **Sizing is Key:** It is essential to choose the correct size brush that fits snugly, but **must not be forced** into the space. For optimal cleaning, most people require 2–3 different brush sizes.
2. **Insertion:** Insert the brush **gently** into the interdental space.
3. **Motion:** Move the brush full length **back and forth a few times** in each space.
4. **Back Teeth Access:**
 - **Small IDBs** (e.g., Pink, Orange, Red, Blue): The soft neck may be slightly curved by applying pressure with a finger to facilitate access between the back teeth.
 - **Larger IDBs:** The wire may be slightly curved to improve access to posterior teeth.
 - **Angled Brushes:** Devices like TePe Angle, which have an angled head, facilitate easier access, especially to the back teeth, and can be used from both the outside and the inside (lingual).
5. **Addressing Lingual Plaque:** Since plaque accumulation is often observed over lingual embrasures, it is sometimes necessary to use the IDB from a **lingual approach** or to supplement with a c-shape flossing technique to ensure complete removal. The device can be bent at the plastic shank or handle for a lingual approach.
6. **Routine:** Use the brush once daily, preferably in the evening in front of a mirror. Replace the brush when the filaments are worn or deformed. Regular toothpaste, due to its abrasives, should be avoided; specialized gels can be used instead.

How to Use an Interdental Brush



Select the right size brush.
The brush should fit snugly between your teeth without forcing it.



Use the smallest size that fits comfortably.



Insert the brush gently between your teeth.
Do not force the brush into a tight space.



Move the brush back and forth to remove plaque and food debris.



Move the brush back and forth to remove plaque and food debris.
Clean between each tooth, including the molars.



Rinse the brush after each use to keep it clean.

III. Oral Irrigators (OI)

Oral irrigation is recommended as an **adjunct** to brushing. It is particularly indicated for patients with orthodontic appliances, implants, or those who struggle with conventional mechanical cleaning methods.

Technique for Oral Irrigators:

1. **Device Operation:** The device typically ejects a stream of water or medicament in a **pulsational mode**.

2. **Angle:** The standard tip is applied at a **90-degree angle** to the long axis of the tooth.
3. **Positioning:** Position the tip interproximally so that the stream passes slightly above the gingiva. The tip is moved to the adjacent interproximal space systematically.
4. **Duration and Force:** The time spent per space is typically 5–6 seconds. Patients should start with the lowest intensity and gradually increase the stream strength to a comfortable level that does not irritate the gingiva.
5. **Limitations:** Oral irrigation effectively removes loose or non-adherent microorganisms and food debris, significantly improving gingival health. However, it **cannot remove adherent plaque, dental calculus, or pigmentations.**



IV. Other Interdental Aids

- **Rubber Interdental Bristle (RIBB) / Soft Picks:** These can be used as alternatives to small IDBs for Type I embrasures, especially in gingivitis patients. The flexible rubber tip is gently pushed into the interdental space and angled **45 degrees toward the occlusal surface** (following the gingival contour). The movement can be back-and-forth or rotational. RIBBs should not be used in healthy gingiva or Type I spaces.



- **Woodsticks (Wooden Toothpicks):** These are suggested for Type II and Type III open embrasures. If selected, they must be **triangular** in shape. Before application, the woodstick should be moistened in saliva. The base of the triangle should rest on the interdental papilla. They reduce interdental gingival inflammation. However, their effectiveness is limited, especially in subgingival and lingual regions.

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Chapter 9: Toothbrushing Techniques

Introduction

Toothbrushing is the primary method for mechanical plaque removal and an essential component of daily oral hygiene. Effective brushing technique directly influences plaque control, gingival health, and the prevention of dental caries and periodontal diseases. Numerous brushing methods have been developed to address different clinical needs, patient age groups, and dexterity levels. The following report outlines the most widely recommended techniques, their indications, advantages, and limitations.

1. The Bass Technique (Modified Bass Technique)

Description

The Bass Technique is one of the most commonly recommended brushing methods, particularly for patients with gingivitis or early periodontal involvement. The toothbrush bristles are positioned at a 45° angle to the gingival margin, gently inserted into the sulcus, and activated with small vibratory movements.

Steps

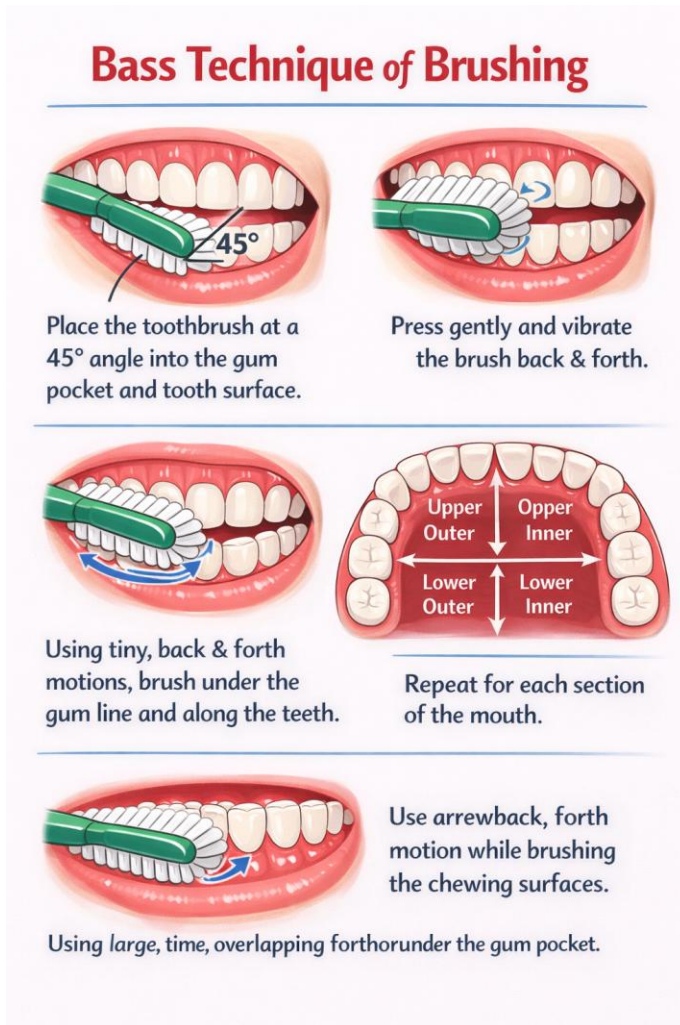
1. Place soft bristles at a 45° angle toward the gingival sulcus.
2. Apply gentle pressure to allow the bristle tips to enter the sulcus.
3. Vibrate the brush with short, back-and-forth motions for approximately 10–20 seconds per area.
4. Sweep the bristles coronally to remove loosened debris.
5. Repeat on all teeth, including lingual surfaces.

Advantages

- Excellent for subgingival plaque removal.
- Helps manage gingivitis and early periodontal disease.
- Reduces bleeding and inflammation.

Limitations

- Requires good manual dexterity.
- May be difficult for children or elderly patients to master.



2. The Stillman Technique (Modified Stillman Technique)

Description

The Stillman Technique emphasizes gingival stimulation in addition to plaque removal. Bristles are placed partly on the gingiva and partly on the cervical area of the teeth, angled at 45°.

Steps

1. Position bristles partly on the gingiva and partly on the enamel.
2. Apply gentle pressure to flex the bristles.
3. Use a vibratory, small circular or back-and-forth motion.
4. Sweep coronally away from the gingiva.

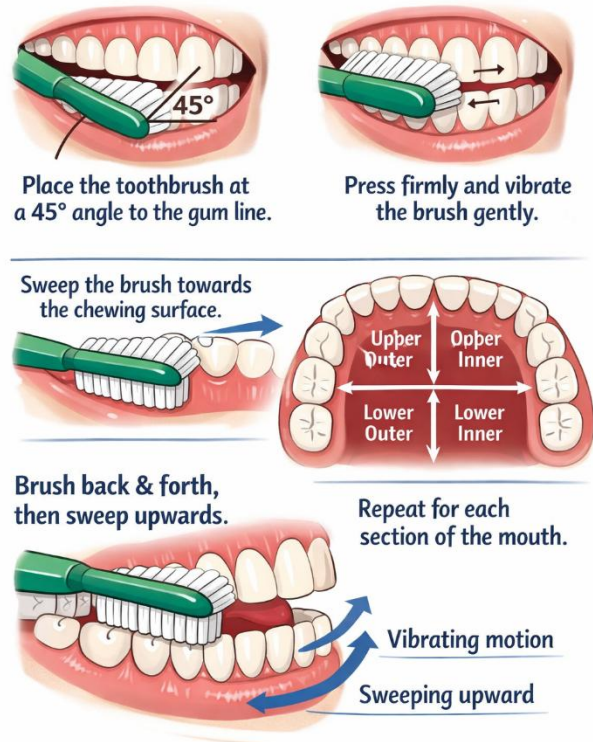
Advantages

- Stimulates gingival tissues.
- Useful in patients with gingival recession or hypersensitivity.

Limitations

- Less effective in cleaning the sulcus compared to Bass.
- Requires practice for proper execution

Stillman Method of Brushing



3. The Fones Technique

Description

The Fones (Circular) Technique is widely recommended for children because it is simple, quick, and easy to learn. Brushing is performed with wide circular motions.

Steps

1. Have the patient occlude the teeth.
2. Place the toothbrush perpendicular to the buccal surfaces.
3. Use large, sweeping circular motions covering both teeth and gingiva.
4. For lingual surfaces, use back-and-forth motions.

Advantages

- Easiest technique for young children.
- Good for patients with limited dexterity.

Limitations

- Less effective in removing plaque near the gingival margin.
- May miss interproximal areas.

Fones Technique of Brushing



Close your mouth slightly.
Gently place the toothbrush
against the outer surface of the teeth.



Make large, overlapping circles
over the outer surfaces of
your teeth and gums.

Brush in a large circular motion.
The brush should move across the teeth and gums.



Make large, overlapping circles
over the outer surfaces of your
teeth and gums.



Repeat for the upper and lower
teeth. Ensure all outer surfaces
are thoroughly brushed.

Repeat for the upper and lower teeth.
Ensure all outer surfaces
are thoroughly brushed.
Use a back & forth motion
while brushing the chewing
surfaces.



Charter Method of Brushing

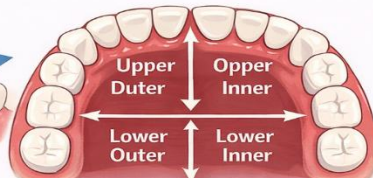


Place the toothbrush at a 45° angle at the gum line, with bristles pointing towards the chewing surface.



Press gently and vibrate the brush in small circles. Bristles should be partially on the gums.

Brush in a circular motion, cleaning the gum line and just under the gums.



Sweep towards the chewing surface to dislodge plaque & debris.



Sweep towards the chewing surface to dislodge plaque & debris. Repeat for each section of the mouth.

Repeat for each section of the mouth.

4. The Charter's Technique

Description

The Charter's Technique is recommended for patients with orthodontic appliances, fixed prostheses, or after periodontal surgery. Bristles are angled toward the occlusal surface rather than the gingiva.

Steps

1. Angle the bristles at 45° toward the occlusal/incisal surface.
2. Position bristles at the gingival margin or appliance brackets.
3. Use short vibratory motions.
4. Reposition and repeat around all appliances.

Advantages

- Excellent for cleaning around orthodontic brackets and fixed bridges.
- Useful for postoperative plaque control when the gingiva is sensitive.

Limitations

- Not ideal for sulcular cleaning.
- Technique may feel unnatural for beginners.

5. Horizontal (Scrub) Technique

Not recommended for adults but still widely used.

Description

The brush is moved horizontally across the teeth with strong back-and-forth strokes.

Advantages

- Simple and fast.
- Often used by children due to ease.

Limitations

- Can cause cervical abrasion and gingival recession.
- Ineffective near the gingival margin and interproximal areas.
- Not recommended as a primary technique.

6. Vertical (Leonard) Technique

Description

Teeth are brushed with an up-and-down (vertical) motion.

Indications

- Primarily recommended for children or individuals learning basic brushing.

Limitations

- Limited plaque removal effectiveness.
- Does not adapt well to all tooth surfaces.

7. The Roll Technique (Rolling Stroke)

Description

This technique is intended to remove plaque from the gingival margin using a sweeping motion.

Steps

1. Place the toothbrush on the gingiva.
2. Sweep the bristles coronally across the tooth surface.
3. Repeat for each section.

Advantages

- Good supplement to other brushing methods.
- Simple and safe for all ages.

Limitations

- Does not effectively clean the sulcus.
- Should not be used alone for periodontal patients.

8. Technique Selection Guidelines

Considerations

- **Age and dexterity** — children benefit from simpler methods (e.g., Fones).
- **Periodontal status** — Bass Technique is preferred for gingivitis or early periodontitis.
- **Orthodontic appliances** — Charter's Technique offers superior plaque removal around brackets.
- **Recession or sensitivity** — Modified Stillman Technique is gentle on the gingiva.
- **Patient compliance** — simpler techniques may improve consistency.

General Clinical Recommendation

For most adults:

✓ **Modified Bass Technique** is the gold standard.

For children:

✓ **Fones Technique** is easiest to teach and learn.

Conclusion

Proper brushing technique is essential for maintaining oral health and preventing dental disease. Educating patients about appropriate brushing methods—based on their age, anatomy, periodontal condition, and dexterity—is a cornerstone of preventive dentistry. Regular reinforcement and demonstration during dental visits significantly enhance long-term oral hygiene outcomes.

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Chapter 10: Maintenance of Oral Hygiene in Patients with Prosthetic Restorations (Removable and Fixed)

1. Introduction

The maintenance of adequate oral hygiene in patients with prosthetic restorations represents a fundamental component of long-term oral health and prosthetic success.

Prosthetic appliances, whether removable or fixed, alter the natural oral environment by introducing additional surfaces and retention areas that favor biofilm accumulation. If oral hygiene is inadequate, these areas become predisposed to plaque retention, microbial colonization, inflammation of surrounding tissues, secondary caries, periodontal and peri-implant diseases, and prosthetic failure.

For dental practitioners, particularly prosthodontists and general dentists, it is essential to understand the biological implications of prosthetic restorations and to educate patients on appropriate hygiene measures tailored to the type of prosthetic appliance. This chapter provides a comprehensive overview of oral hygiene maintenance in patients with removable and fixed prosthetic restorations, emphasizing preventive strategies, patient education, and professional maintenance protocols.

2. Biological Considerations in Prosthetic Patients

2.1 Plaque Accumulation and Biofilm Formation

Dental plaque is a structured microbial biofilm that adheres to both natural tooth surfaces and artificial prosthetic materials. Prosthetic restorations often present irregularities, marginal discrepancies, and undercuts that enhance plaque retention. Materials such as acrylic resin, metal alloys, ceramics, and composite resins differ in surface roughness and surface energy, influencing bacterial adhesion and biofilm maturation.

The accumulation of plaque around prosthetic restorations can lead to:

- Gingival inflammation and bleeding
- Periodontal attachment loss
- Secondary caries at restoration margins
- Denture stomatitis
- Peri-implant mucositis and peri-implantitis



Figure 1. Secondary caries at the crown margin (black arrow) caused by accumulation of biofilm in the crevice between crown and tooth. Hyperplastic gingiva (white arrows) due to increased plaque accumulation in the connector area of the fixed partial denture. The connector area of the bridge has a bulky design which complicates interdental hygiene (photo: Marit Øilo).

2.2 Microbiological and Host Response Changes

The presence of prosthetic appliances may compromise self-cleansing mechanisms, reduce salivary flow in localized areas, and exert mechanical pressure on oral tissues. These factors can alter the host immune response and promote inflammatory conditions if hygiene is insufficient. Elderly patients and medically compromised individuals are particularly vulnerable to these effects.

Prosthetic restorations can alter the composition of the oral microbiota. Increased proportions of *Streptococcus mutans*, *Lactobacillus* species, periodontal pathogens, and *Candida albicans* have been reported in patients with inadequate prosthetic hygiene. The host response may be further compromised by reduced salivary clearance, mechanical irritation, and age-related or systemic factors.

3. Oral Hygiene Maintenance in Patients with Removable Prosthetic Restorations

3.1 Types of Removable Protheses

Removable prosthetic restorations include:

- Complete dentures
- Removable partial dentures (RPDs)
- Implant-supported overdentures

Each type requires specific hygiene measures due to differences in design, materials, and tissue contact. Removable Partial Dentures (RPDs) and Complete Dentures (CDs) introduce acrylic and metallic surfaces into the oral environment, which are prone to colonization by *Candida albicans* and other pathogens.

3.2 Denture Hygiene Principles

Effective denture hygiene involves the removal of microbial deposits from both the prosthesis and the supporting oral tissues. Key principles include:

- Daily mechanical cleaning using a denture brush
- Avoidance of abrasive toothpaste that may damage acrylic surfaces
- Use of non-abrasive denture cleansers
- Thorough rinsing after meals

3.3. Mechanical Cleaning

Patients must be cautioned against using standard abrasive toothpastes on acrylic surfaces, as they create microscopic scratches that harbor bacteria.

- **Denture Brushes:** Use of a dual-headed brush with mild soap or non-abrasive denture paste.



- **Procedure:** Cleaning should be performed over a sink filled with water or a soft towel to prevent fracture if the prosthesis is dropped.

Denture cleaning should be performed outside the oral cavity to prevent accidental aspiration or damage.

3.4 Chemical Denture Cleansers

Chemical cleansing agents, such as alkaline hypochlorites, alkaline peroxides, and enzymatic cleaners, can complement mechanical cleaning. These agents help reduce microbial load, remove stains, and decrease the risk of denture-related infections, particularly denture stomatitis caused by *Candida albicans*.

However, prolonged or improper use may adversely affect denture materials, especially metal components in RPDs.

Removable Partial Dentures (RPDs) and Complete Dentures (CDs) introduce acrylic and metallic surfaces into the oral environment, which are prone to colonization by *Candida albicans* and other pathogens.

To address the porosity of polymethyl methacrylate (PMMA), chemical soaking is required:

- **Alkaline Peroxides:** Effective for daily effervescent cleaning.
- **Sodium Hypochlorite (0.5%):** Highly effective disinfectant, but contraindicated for RPDs with metal frameworks (cobalt-chrome) due to the risk of corrosion and oxidation.

3.5 Oral Tissue Hygiene and Denture-Free Periods

Patients should be instructed to clean the oral mucosa, tongue, and residual ridges daily using a soft toothbrush or gauze. Removal of dentures during sleep is recommended to allow tissue recovery, improve salivary flow, and reduce fungal colonization. Continuous wear of removable prostheses reduces mucosal blood flow and increases the risk of **Denture Stomatitis**.

- **The 8-Hour Rule:** Patients must remove the prosthesis for at least 6–8 hours daily (usually overnight) to allow for tissue recovery.

- **Storage:** Prostheses should be stored in water to prevent dimensional instability caused by dehydration.

4. Oral Hygiene Maintenance in Patients with Fixed Prosthetic Restorations

4.1 Types of Fixed Prostheses

Fixed prosthetic restorations include:

- Crowns
- Fixed partial dentures (bridges)
- Veneers
- Implant-supported fixed restorations

These restorations pose specific challenges due to limited access for routine cleaning, particularly at margins and pontic areas.

4.2 Mechanical Cleaning

Patients must be cautioned against using standard abrasive toothpastes on acrylic surfaces, as they create microscopic scratches that harbor bacteria.

- **Denture Brushes:** Use of a dual-headed brush with mild soap or non-abrasive denture paste.
- **Procedure:** Cleaning should be performed over a sink filled with water or a soft towel to prevent fracture if the prosthesis is dropped.

Patients with fixed prostheses should use:

- Soft-bristled manual or electric toothbrushes



- Modified Bass or sulcular brushing techniques
- Fluoridated toothpaste to prevent secondary caries.

Special attention must be given to restoration margins, where plaque accumulation is most pronounced.

4.3 The Gingival Margin and Pontic Design

The interface between the restoration margin and the tooth structure is the most critical site for biofilm accumulation.

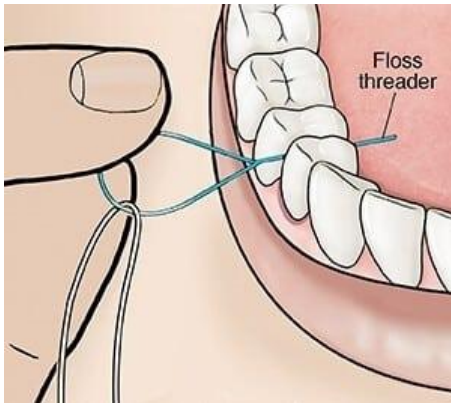
- **Crevicular Cleaning:** Patients must be instructed in the **Modified Bass Technique** to ensure sulcular debridement.
- **Pontic Hygiene:** In FPDs (bridges), the area beneath the pontic is inaccessible to conventional brushing. The use of **super-floss** or **interdental brushes** with a plastic-coated wire is mandatory to prevent mucosal hyperplasia and "bridge-itis."



4.4 Interdental Cleaning Aids

Interdental hygiene is critical in patients with fixed prostheses. Recommended aids include:

- **Dental floss with floss threaders**



- **Super floss for bridge pontics**



- **Interdental brushes** of appropriate size: These are more effective than traditional floss for cleaning wide embrasures and concave root surfaces.



- **Oral irrigators** as adjunctive tools: Hydrodynamic cleaning can be a useful adjunct for removing debris from hard-to-reach sub-pontic spaces, though it does not replace mechanical friction.



Improper or neglected interdental cleaning significantly increases the risk of periodontal inflammation and prosthetic complications.

5. Peri-implant Hygiene and Maintenance Protocols

5.1. Biological Rationale

Unlike natural teeth, dental implants are not protected by a periodontal ligament. The attachment of the soft tissue to the titanium or zirconia surface (the hemidesmosomal attachment) is more fragile and less vascularized. This makes the peri-implant tissues more susceptible to rapid destruction if biofilm is not managed, leading to **Peri-implant Mucositis** (reversible) or **Peri-implantitis** (irreversible bone loss).

5.2. Home Care Protocol for Implant Patients

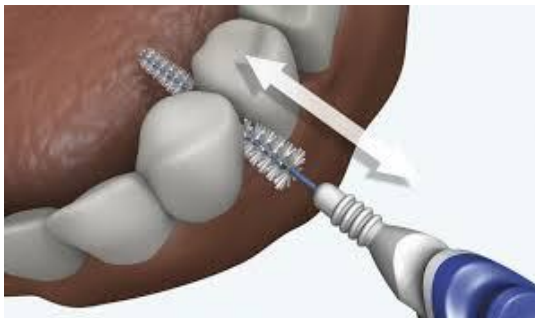
The goal is the complete disruption of the peri-implant biofilm without scratching the abutment surface.

5.3. Mechanical Cleaning Tools

- **Soft/Extra-Soft Toothbrushes:** High-stiffness bristles can cause gingival recession around the implant collar.
- **Implant-Specific Floss:** Use of thick, "spongy" floss (similar to Super-floss) is recommended to clean the circumferential anatomy of the abutment.



- **Interdental Brushes:** These must be **plastic-coated**. Exposed metal wires can create galvanic currents or microscopic scratches on the titanium surface, which increases surface roughness and future plaque retention.



5.4. Single Implants vs. Implant-Supported Overdentures

- **Fixed Crowns:** Cleaned similarly to natural teeth but with extra focus on the sub-gingival transition zone.
- **Overdentures (Bar or Ball Attachments):** The patient must clean the removable prosthesis *and* the intra-oral attachments (the bar or locators). A "tufted" brush is ideal for cleaning under the metal bars.

5.5. Professional Maintenance (Clinical Protocol)

During recall appointments, the clinician must follow a specific "implant-safe" workflow to avoid iatrogenic damage.

5.6. Instrumentation

- **Avoid Steel Scalers:** Conventional stainless steel instruments will contaminate the titanium surface and leave scratches.
- **Approved Materials:** Use only **carbon-fiber, plastic, or titanium-tipped scalers.**
- **Ultrasonic Scalers:** Only use with specialized plastic or PEEK (Polyether ether ketone) tips.

5.7. Air-Polishing

The use of **Glycine-based** or **Erythritol-based** powders is now considered the gold standard for peri-implant biofilm removal. Unlike Sodium Bicarbonate, these powders are non-abrasive to the implant surface and highly effective at decontaminating the micro-grooves of the abutment.

Summary Table: Natural Tooth vs. Implant Maintenance

Feature	Natural Tooth	Dental Implant
Attachment	Periodontal Ligament (PDL)	Osseointegration / Hemidesmosomes
Flossing Technique	"C-Shape" Flossing	Circumferential (360°) Flossing
Scaling Material	Stainless Steel	Plastic, Carbon, or Titanium

Feature	Natural Tooth	Dental Implant
Air-Polishing Powder	Sodium Bicarbonate / Glycine	Glycine or Erythritol (Safe for Soft Tissue)
Probing	Standard Pressure (25g)	Light Pressure; specialized plastic probe

6. Role of the Dental Professional

6.1 Patient Education and Motivation

Effective oral hygiene maintenance requires continuous patient education and motivation. Instructions should include:

- Visual demonstration
- Hands-on training
- Written and verbal instructions
- Reinforced during follow-up visits

6.2 Professional Maintenance and Recall

Regular professional care includes:

- Professional cleaning of prosthetic restorations
- Assessment of prosthesis fit and function
- Evaluation of oral tissues and periodontal status
- Reinforcement of hygiene instructions

Regular recall appointments allow:

- Professional biofilm removal
- Early detection of complications
- Adjustment of hygiene protocols

Recall intervals should be customized based on patient risk factors, prosthesis type, and oral hygiene performance.

Regular follow-up (recall) appointments are essential for the professional assessment of the prosthesis:

1. **Fixed Restorations:** Evaluation of marginal integrity and removal of calculus using specialized curettes (plastic or titanium-tipped if implants are present).
2. **Removable Restorations:** Professional ultrasonic cleaning to remove stubborn calculus and polishing to restore surface smoothness.

Summary Table for Patient Instruction

Restoration Type	Primary Tool	Adjunct Tool	Key Concern
Crowns/Veneers	Soft Toothbrush	Interdental Brush	Marginal Integrity
Bridges (FPDs)	Super-floss	Oral Irrigator	Sub-pontic Biofilm
Removable (RPDs/CDs)	Denture Brush	Chemical Soaks	<i>Candida</i> & Mucosal Health

7. Common Complications Related to Poor Prosthetic Hygiene

Inadequate hygiene in prosthetic patients may result in:

- Gingivitis and periodontitis
- Secondary caries
- Halitosis
- Denture stomatitis
- Peri-implant mucositis and peri-implantitis
- Reduced longevity of prosthetic restorations

Early identification and intervention are essential to prevent irreversible tissue damage and prosthetic failure.

8. Conclusion

The maintenance of oral hygiene in patients with removable and fixed prosthetic restorations is a critical determinant of oral health, prosthetic longevity, and patient quality of life. Dental professionals must possess a thorough understanding of hygiene principles specific to prosthetic appliances and actively engage patients in preventive care. Through proper education, motivation, and professional maintenance, the adverse effects associated with prosthetic restorations can be significantly minimized.

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Chapter 11: Oral Hygiene Management in Orthodontic Patients

1. Introduction

The initiation of orthodontic treatment, whether through **fixed appliances** (brackets and wires) or **removable appliances** (plates and aligners), significantly alters the oral ecosystem. These appliances create new retentive areas for dental plaque, increase the rate of food entrapment, and may impede the natural self-cleansing mechanisms of the lips and tongue.

Mechanical therapy is crucial. Failure to maintain rigorous oral hygiene leads to white spot lesions, gingival hyperplasia, and in severe cases, periodontitis or premature termination of treatment (Fig.1; Fig.2).



Figure 1.



Figure 2.

2. Challenges in Fixed Orthodontic Appliances

Fixed appliances consist of brackets, archwires, ligatures, and sometimes molar bands. These components create complex architectural niches that are inaccessible to standard brushing techniques.

2.1 Biofilm Accumulation

In patients with fixed appliances, the volume of dental plaque can increase significantly within days of bonding. Furthermore, the pH of the plaque tends to drop, favoring the growth of acidogenic bacteria like *Streptococcus mutans* and *Lactobacillus*. This acidic environment dissolves the mineral content of the enamel.

2.2 Clinical Risks

- **Decalcification:** Permanent enamel demineralization around bracket margins.
- **Gingivitis:** Inflammatory response to plaque at the gingival margin.
- **Hypertrophy:** Overgrowth of gingival tissue, which can cover the brackets and complicate adjustments.

3. Hygiene Protocols for Fixed Appliances

A. Mechanical Plaque Control - Mechanical removal of plaque remains the gold standard. Specialized tools are mandatory to manage the challenges posed by wires and brackets.

- **Specialized Brushes:** Orthodontic toothbrushes are designed specifically for use over brackets. They feature a "V-shaped" or "U-shaped" groove in the bristles that is shaped to accommodate the bracket line. Other styles have

middle rows of bristles that are shorter to facilitate their use directly over the brackets (Fig.3)



Figure 3.

- **A single-tuft brush** is a toothbrush with a very small, pointed head consisting of a single bunch of bristles. It is perfect for:
 - ✓ Precision cleaning of individual brackets.
 - ✓ Cleaning the "blind spots" behind the last molars where the wire ends (Fig.4).



Figure 4.

- **Interdental Brushes:** Essential for cleaning the vertical surfaces of the brackets and the crucial area underneath the archwire. Interdental brushes are effective because they are tiny, cone-shaped, or cylindrical brushes designed to fit into the small gaps created by the appliances (Fig.5). They are the most effective tool for:

- ✓ Cleaning **under the archwire**.
- ✓ Scrubbing the sides of the **brackets**.
- ✓ Reaching spaces between teeth where food gets stuck.



Figure 5.

- **Modified Brushing Technique:** Clients' plaque removal efforts should be directed to the cervical and incisal or occlusal aspects of the brackets. The **modified Bass technique** is often used for directing cleaning efforts toward the gingival margin.
- **Flossing with Threaders:** Standard floss cannot pass through the contact points due to the wire; therefore, a floss threader or specialized orthodontic floss (e.g., Superfloss) is mandatory.

Here is a breakdown of how these aids assist fixed appliances:

- **Floss Threader:** Standard dental floss cannot pass through the contact points between teeth because the archwire blocks the path. Therefore, a floss threader must be used to place the floss interproximally (between the teeth). This tool works by acting as a rigid guide, allowing the floss to be inserted under the orthodontic wire to reach the area between the teeth (Fig.6).

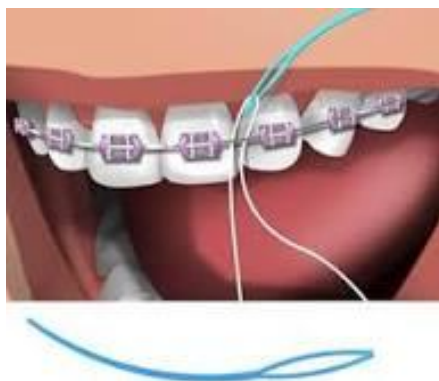


Figure 6.

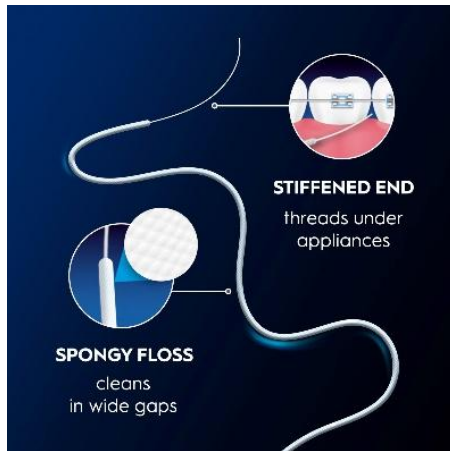


Figure 7.



Figure 8.

- **Specialized Orthodontic Floss** (e.g., Superfloss): This type of floss is specifically designed to manage fixed appliances (Fig.7; Fig.8). It features three distinct sections:
 - ✓ **A Stiffened End:** This acts as a built-in threader, allowing the user to easily slide the floss under the wire.
 - ✓ **A Spongy Middle Section:** This part is used to effectively clean around the appliances and wide spaces.
 - ✓ **Regular Floss:** This portion cleans beneath the gumline.
- **Water Flosser:** A water flosser (or oral irrigator) is highly recommended for orthodontic patients because it uses a pressurized stream of fluid to flush away debris from hard-to-reach areas. It is highly recommended for orthodontic patients because it reaches areas that are physically difficult or impossible to clean with a brush. Also, the use of a water flosser has been reported to reduce plaque biofilm, bleeding, and gingivitis at least as effectively as dental floss in orthodontic care. Orthodontic clients might prefer a water flosser for daily use over flossing with a floss threader due to the difficulty of threading the floss under the orthodontic wire. However, the water flosser is often recommended as an excellent addition to, but not a replacement for, manual flossing for the best results.

It is highly recommended for orthodontic patients because:

- ✓ It reaches areas that are physically impossible to hit with a brush.

- ✓ It is gentler on inflamed or swollen gums.
- ✓ *Note:* It is a great addition, but should ideally be used alongside manual flossing for the best results.
- **Ultrasonic or Air-Powder Devices:** These tools can be especially effective during professional dental hygiene appointments for removing stains that develop under archwires and between brackets (Fig.9).



Figure 9.

In summary, for routine home care, using an interdental brush to scrub the sides of the brackets and an orthodontic toothbrush or single-tuft brush for precision cleaning are the primary mechanical techniques for removing plaque around the brackets.

Additionally, for clients undergoing surgical orthodontic procedures, oral hygiene often involves frequent **saline irrigation** using a 30-mL syringe and a blunt needle, especially for the first 2 weeks after surgery, to ensure thorough oral debridement and prevent infection.

B. Chemical Adjuvants

- **Fluoride Therapy:** Daily use of high-concentration fluoride toothpaste (>1,450 ppm) or neutral sodium fluoride mouthrinses to promote remineralization.

- Agents like **Stannous Fluoride** (SnF₂) are used because they offer both fluoride for remineralization and an antimicrobial tin ion (Sn) against S. mutans.
- **Chlorhexidine (CHX)**: Recommended for short-term use (0.12%) if acute gingival inflammation is present.
- **Orthodontic Wax**
While not a cleaning tool, wax is essential for maintenance. Applying wax to sharp brackets or poking wires prevents cuts and ulcers. A healthy mouth (without sores) makes it much easier to maintain a thorough cleaning routine.

Summary Table: Oral Hygiene Aids for Orthodontic Cleaning Routine

Oral hygiene aid	Purpose	Indications in orthodontics	Frequency of use
Interdental brushes	Removal of plaque from interproximal areas and around brackets	Fixed orthodontic appliances, wide interdental spaces	Once daily, After every meal
Water flosser	Disruption of biofilm and flushing of food debris	Patients with poor manual dexterity or extensive appliances	Once daily (evening)
Super floss	Cleaning under archwires and around brackets	Fixed appliances, pontic areas	At least once daily
Fluoride rinse	Enhancement of enamel remineralization and caries prevention	High caries risk during orthodontic treatment	Once daily (0.05% NaF) before bad

4. Hygiene Management for Removable Appliances

Maintenance focuses both on the teeth and the appliance itself.

4.1 Care of the Dentition

Patients must brush and floss their teeth normally before reinserting the appliance to prevent trapping sugars and acids against the enamel. Patients wearing aligners must be instructed to consume only plain water while the aligners are in their mouths.

4.2 Appliance Maintenance

Removable appliances, including Clear Aligner Therapy (e.g., Invisalign), presents a unique clinical paradox: while the aligners are removable (facilitating hygiene), they cover the clinical crowns for extended period, eliminating the natural "lavage" or rinsing effect of saliva. The appliances allow for easier brushing of the teeth, but they act as reservoirs for bacteria and fungi (notably *Candida albicans*).

Maintenance of Aligner Transparency and Integrity

Because aligners are changed every 1–2 weeks, the focus is on preventing odor and staining:

Mechanical Cleaning: Appliances should be brushed with a soft brush and non-abrasive soap. **Note:** Avoid regular toothpaste as its abrasives can scratch the plastic, creating micro-fissures for bacterial colonization.

- **Chemical Disinfection:** Periodic soaking in effervescent orthodontic cleaning tablets or a mild vinegar-water solution to remove calculus (tartar) buildup.
- **Rinsing and Storage:** Aligners should be rinsed with lukewarm water every time they are removed. They should never be stored in tissue paper; they must be placed in a ventilated protective case to prevent the growth of anaerobic bacteria.
- **Temperature Caution:** Patients must never use boiling water, as thermoplastic materials can warp.
- **Ultrasonic Cleaning:** For patients with high mineralization rates, the use of a home ultrasonic cleaner with plain water or a mild orthodontic solution is the most effective way to remove biofilm without damaging the material.

Management of Attachments

Aligner therapy often requires "attachments" (composite resin buttons bonded to the teeth). These create small shelves that act similarly to fixed brackets.

- Clinical Note: Students should emphasize brushing around the geometry of these attachments, as they are primary sites for localized gingivitis in orthodontic patients.

Summary Table: Comparison of Hygiene Requirements

Feature	Fixed Appliances	Clear Aligners (CAT)
Primary Risk	Enamel demineralization (WSLs)	Salivary stagnation & acid trapping
Main Tool	Interproximal brush & Floss threader	Standard brush & Soft soap for aligner
Dietary Restriction	Avoid hard/sticky foods	Avoid colored/sugary drinks with trays in
Chemical Aid	High-fluoride toothpaste/mouthwash	Effervescent cleaning crystals

5. The Role of the Clinician: Monitoring and Motivation

The success of orthodontic treatment is as much dependent on patient compliance as it is on biomechanics. Monitoring includes using disclosing agents to assess the Plaque Index, checking for Gingival Health by monitoring bleeding on probing (BOP), and frequent drying of the teeth to check for early-stage white spot lesions.

Feature	Assessment Method
Plaque Index	Use of disclosing agents to visualize biofilm for the patient.
Gingival Health	Monitoring for bleeding on probing (BOP).

Feature	Assessment Method
Enamel Integrity	Frequent drying of teeth to check for early-stage white spot lesions.

Clinical note: "Patient education must occur *before* the appliances are fitted. If a patient cannot demonstrate adequate hygiene on natural teeth, the risk of fixed appliance therapy may outweigh the benefits."

6. Conclusion

Effective oral hygiene for orthodontic patients requires a customized approach involving specialized tools, chemical prevention, and frequent professional prophylaxis. As future dentists, your goal is to ensure that at the end of treatment, the patient has not only straight teeth but also healthy supporting tissues and intact enamel.

7. Advanced Chemical Biofilm Control

While mechanical removal remains the gold standard, chemical agents are essential for managing the altered microbial flora in orthodontic patients.

7.1 Composition of Appliance Cleaning Agents

Removable appliances and retainers require specific chemical cleaners to prevent the accumulation of "orthodontic plaque" and mineralized deposits. These cleaners typically include:

- **Alkaline Peroxides:** The most common active ingredient in effervescent tablets. When dissolved in water, they release **active oxygen**, which provides a mechanical bubbling action to loosen debris and exert an antibacterial effect.
- **Alkaline Hypochlorites:** Effective at dissolving the organic matrix of plaque and removing stains. However, prolonged exposure can corrode metal components in Hawley retainers.
- **Chelating Agents (e.g., EDTA):** Used to prevent the formation of calculus on the appliance by binding to calcium ions.
- **Surfactants:** Reduce surface tension, allowing the cleaning solution to penetrate microscopic pores in the acrylic or thermoplastic material.

7.2 Fluoride Chemistry in Fixed Orthodontics

To combat the pH value associated with fixed brackets, specific fluoride delivery systems are utilized:

- **Stannous Fluoride (SnF₂):** Provides both fluoride for remineralization and a tin ion that exhibits antimicrobial properties against *S. mutans*.
- **Amorphous Calcium Phosphate (ACP):** Often added to toothpastes or sealants to provide a reservoir of calcium and phosphate ions, enhancing the natural remineralization process of the saliva.
- **Fluoride Mouthwash:** It helps: Strengthen tooth enamel (remineralization), prevent "white spots" (decalcification) around the brackets, kill bacteria in hard-to-reach areas.

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Chapter 12: Oral Hygiene Maintenance in Patients with Special Needs

1. Introduction

Patients with special needs represent a heterogeneous population characterized by physical, intellectual, developmental, sensory, medical, or behavioral conditions that may limit their ability to perform adequate oral hygiene independently. Maintaining optimal oral health in these individuals is essential, as poor oral hygiene is associated with an increased prevalence of dental caries, periodontal diseases, oral infections, halitosis, and a reduced quality of life. This chapter addresses the principles, challenges, and clinical strategies for maintaining oral hygiene in patients with

special needs, emphasizing individualized care, interdisciplinary collaboration, and caregiver involvement.

2. Definition and Classification of Patients with Special Needs

The term *patients with special needs* refers to individuals who require modified dental care due to limitations in physical, cognitive, emotional, or medical function. These patients may include:

- Individuals with intellectual and developmental disabilities (e.g., autism spectrum disorder, Down syndrome)
- Patients with physical disabilities (e.g., cerebral palsy, muscular dystrophy)
- Individuals with sensory impairments (visual or hearing impairment)
- Patients with chronic systemic diseases (e.g., diabetes mellitus, epilepsy, cardiovascular diseases)
- Geriatric patients with functional or cognitive decline
- Medically compromised or immunosuppressed patients

Each subgroup presents unique challenges that directly influence oral hygiene practices and outcomes.

3. Oral Health Challenges in Patients with Special Needs

Patients with special needs are at increased risk for oral diseases due to several interrelated factors:

- Limited manual dexterity and impaired motor coordination
- Cognitive deficits affecting understanding and compliance
- Behavioral problems and dental anxiety
- Long-term use of medications causing xerostomia, gingival enlargement, or altered oral microbiota
- Dependence on caregivers for daily oral hygiene
- Dietary habits rich in fermentable carbohydrates

These factors often lead to increased plaque accumulation, gingival inflammation, periodontal breakdown, and untreated dental caries.

4. Principles of Oral Hygiene Management

Oral hygiene care for patients with special needs should be guided by the following principles:

1. **Individualization of care** – Oral hygiene protocols must be tailored to the patient’s functional abilities, medical status, and cognitive level.
2. **Prevention-oriented approach** – Emphasis should be placed on preventive measures rather than solely on curative treatment.
3. **Simplification of techniques** – Oral hygiene methods should be adapted to ensure feasibility and sustainability.
4. **Caregiver education and involvement** – Caregivers play a crucial role in daily plaque control and long-term oral health maintenance.
5. **Regular professional supervision** – Frequent dental check-ups and professional cleanings are essential.

5. Mechanical Plaque Control

5.1 Toothbrushing

Toothbrushing remains the cornerstone of mechanical plaque control. Recommendations include:

- Use of a soft-bristled toothbrush to prevent soft tissue trauma
- Powered toothbrushes for patients with limited manual dexterity
- Modified toothbrush handles (enlarged, angled, or customized grips)
- Assisted or supervised toothbrushing by caregivers when necessary

Brushing should be performed at least twice daily using fluoridated toothpaste appropriate for the patient’s age and caries risk.

5.2 Interdental Cleaning

Interdental plaque control may be challenging in this population. Alternatives include:

- Interdental brushes with appropriate size selection
- Floss holders or pre-threaded floss aids
- Water-based oral irrigators for selected patients

The choice of interdental aids should be based on patient tolerance, periodontal status, and caregiver capability.

6. Chemical Plaque Control

Chemical adjuncts are particularly valuable in patients who are unable to achieve effective mechanical plaque removal. Commonly used agents include:

- Chlorhexidine gluconate (short-term use due to side effects)
- Essential oil mouthrinses
- Cetylpyridinium chloride-containing formulations
- Fluoride mouthrinses and gels for caries prevention

In patients with swallowing difficulties or limited cooperation, gels, sprays, or swab-applied agents may be preferred over mouthrinses.

7. Role of Caregivers and Education

Caregivers are central to successful oral hygiene maintenance in patients with special needs. Education programs should focus on:

- Proper toothbrushing and interdental cleaning techniques
- Recognition of early signs of oral disease
- Importance of routine dental visits
- Dietary counseling and medication-related oral side effects

Visual aids, demonstrations, and written instructions can enhance caregiver compliance and confidence.

8. Professional Preventive Care

Professional oral hygiene measures should be provided at shorter recall intervals, depending on individual risk assessment. These measures include:

- Professional plaque and calculus removal
- Topical fluoride applications
- Pit and fissure sealants where indicated
- Monitoring of periodontal and mucosal health

Behavior management techniques and, when necessary, pharmacological support may be required to ensure safe and effective dental care.

9. Interdisciplinary Approach

Optimal oral health outcomes in patients with special needs require collaboration between dental professionals, physicians, speech therapists, occupational therapists,

nurses, and caregivers. Integration of oral health into general health care plans is essential for comprehensive patient management.

10. Conclusion

Maintaining oral hygiene in patients with special needs is a complex but essential component of comprehensive health care. Through individualized strategies, preventive-focused protocols, caregiver involvement, and interdisciplinary collaboration, dental professionals can significantly improve oral health outcomes and quality of life for this vulnerable population. Continuous education and adaptation of clinical approaches are fundamental to meeting the evolving needs of these patients.

Clinical Protocols for Oral Hygiene Maintenance in Patients with Special Needs

1. Initial Assessment and Risk Evaluation Protocol

Objective: To establish an individualized oral hygiene plan based on functional ability, medical status, and oral disease risk.

Clinical Steps:

1. Obtain a comprehensive medical and dental history, including:
 - Primary diagnosis and comorbidities
 - Current medications and their oral side effects
 - History of aspiration risk, seizures, or immunosuppression
2. Assess functional capacity:
 - Manual dexterity
 - Cognitive and communication abilities
 - Level of independence in daily oral care
3. Perform oral examination:
 - Plaque index, gingival index, bleeding on probing
 - Caries risk assessment
 - Periodontal status
 - Mucosal integrity and salivary flow
4. Classify patient risk level:
 - Low, moderate, or high risk for caries and periodontal disease

5. Determine need for caregiver-assisted or fully dependent oral hygiene.

2. Daily Home Oral Hygiene Protocol

Objective: To ensure effective daily plaque control adapted to patient abilities.

2.1 Toothbrushing Protocol

- Frequency: **Twice daily minimum**
- Toothbrush selection:
 - Soft or ultra-soft bristles
 - Powered toothbrush for patients with impaired motor control
 - Modified handles (enlarged, angled, or custom-made)
- Toothpaste:
 - Fluoridated toothpaste (1,000–1,450 ppm for children; $\geq 1,450$ ppm for adults)
 - Low-foaming formulations for patients with swallowing difficulties
- Technique:
 - Gentle circular or modified Bass technique
 - Caregiver-assisted brushing when plaque control is inadequate

Chairside Reinforcement: Demonstrate brushing on a model and directly train caregivers using “tell–show–do” methodology.

2.2 Interdental Cleaning Protocol

- Indications: Patients with open interdental spaces or periodontal disease
- Recommended aids:
 - Interdental brushes (size individually selected)
 - Floss holders or pre-threaded floss
 - Oral irrigators as adjuncts (not substitutes)
- Frequency: **Once daily**

3. Chemical Plaque Control Protocol

Objective: To supplement mechanical plaque removal in patients with limited oral hygiene capacity.

Recommended Agents:

- Chlorhexidine gluconate 0.12–0.2%:

- Short-term use (7–14 days)
- Applied as rinse, gel, or swab
- Cetylpyridinium chloride mouthrinses
- Essential oil–based formulations
- Fluoride gels or mouthrinses for high caries risk

Special Considerations:

- Avoid alcohol-containing products
- Use gels or sprays in patients with dysphagia
- Monitor for adverse effects (staining, taste alteration)

4. Caregiver-Assisted Oral Hygiene Protocol

Objective: To provide safe and effective oral care for dependent patients.

Positioning:

- Seated upright or semi-reclined
- Head supported to reduce aspiration risk

Clinical Steps:

1. Use adequate lighting and protective equipment
2. Stabilize the patient’s head gently
3. Brush systematically (quadrant-by-quadrant approach)
4. Minimize water use; suction if necessary
5. Inspect oral tissues daily for:
 - Ulcerations
 - Gingival bleeding
 - Signs of infection

Documentation: Caregivers should maintain a daily oral hygiene log when applicable.

5. Professional Preventive Care Protocol

Objective: To maintain oral health through regular professional intervention.

Recall Intervals:

- High-risk patients: every **3–4 months**
- Moderate risk: every **6 months**

Professional Measures:

- Professional plaque and calculus removal
- Topical fluoride application
- Antimicrobial therapy as indicated
- Sealants for caries-prone teeth
- Periodontal monitoring and maintenance

6. Behavior Management and Safety Protocol

Objective: To ensure patient comfort and procedural safety.

Non-Pharmacological Techniques:

- Tell–show–do
- Desensitization
- Positive reinforcement
- Short, structured appointments

When Necessary:

- Protective stabilization (ethically and legally justified)
- Referral for pharmacological management (conscious sedation or general anesthesia)

7. Emergency and Special Considerations Protocol

- Seizure disorders: Avoid triggers, use mouth props cautiously
- Aspiration risk: Minimize water, use suction
- Immunocompromised patients: Emphasize infection control and oral lesion surveillance
- Xerostomia: Saliva substitutes, frequent hydration, sugar-free xylitol products

8. Evaluation and Outcome Monitoring Protocol

Outcome Indicators:

- Reduction in plaque and gingival indices

- Decreased bleeding on probing
- Reduced caries incidence
- Improved caregiver compliance

Reassessment: Modify oral hygiene protocols based on disease progression, functional changes, or caregiver feedback.

9. Summary

Clinical protocols for oral hygiene in patients with special needs must be **individualized, preventive-oriented, and caregiver-centered**. Systematic assessment, simplified techniques, appropriate adjunctive therapies, and regular professional follow-up are essential to achieving sustainable oral health outcomes in this vulnerable population.

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Chapter 13: Pharmacological Agents in Oral Hygiene: First- and Second-Generation Preparations

Effective control of dental plaque is a cornerstone of oral hygiene and the prevention of caries and periodontal diseases. While mechanical plaque removal remains the "gold standard," the application of **pharmacological agents** is essential for the chemical control of the biofilm and the reduction of pathogenic microflora. In addition to mechanical plaque control, various pharmacological agents have been incorporated into oral hygiene products to enhance antimicrobial efficacy. Based on their antiplaque effectiveness, substantivity, and clinical impact, these agents are traditionally classified into **first-generation** and **second-generation pharmacological preparations**.

1. First-Generation Pharmacological Preparations

First-generation agents are characterized by **limited antiplaque efficacy**, **low substantivity**, and a **short duration of antimicrobial action**. Although they can reduce the microbial load temporarily, their long-term clinical effects on plaque accumulation and gingival inflammation are modest. This group includes **phenolic compounds**, **ammonium peroxide compounds**, **iodine preparations**, and **fluorides**.

1.1 Phenolic Compounds

Phenolic agents (e.g., thymol, eucalyptol, menthol, methyl salicylate) exert their antimicrobial activity by **disrupting bacterial cell walls and denaturing proteins**. They demonstrate broad-spectrum activity against Gram-positive and Gram-negative bacteria.

Clinically, phenolic compounds are mainly used in **mouthrinses** and contribute to a **moderate reduction of plaque and gingivitis**. However, due to their **low substantivity**, their effects are short-lived, requiring repeated use. Their primary advantage lies in their **good tolerability and safety for long-term daily use**.

1.3 Ammonium Peroxide Compounds

Ammonium peroxide agents act through the **release of oxygen**, which creates an unfavorable environment for anaerobic microorganisms, that helps mechanically dislodge debris and reduce anaerobic bacterial populations. These agents are particularly useful in **acute inflammatory conditions**, such as necrotizing gingivitis, where oxygenation of the environment is beneficial. They are mainly effective in reducing **oral malodor** and superficial debris. Also they have **limited ability to inhibit plaque formation** compared with later-generation agents. Despite their cleansing action, ammonium peroxide compounds exhibit **minimal sustained antimicrobial activity** and therefore play a supportive rather than primary role in plaque control.

1.4 Iodine Compounds

Iodine-based preparations possess **strong antiseptic properties** and act by **oxidizing microbial proteins and enzymes**, leading to rapid bacterial cell death. They are effective against bacteria, fungi, viruses, and spores.

In dentistry, iodine compounds are mainly used for **short-term antisepsis**, such as pre-procedural rinsing or management of acute infections. Their routine use in daily oral hygiene is limited due to **unpleasant taste, potential hypersensitivity reactions, and the risk of tooth and mucosal staining**.

1.5 Fluoride Compounds

Although fluorides are not primarily antiplaque agents, they are included among first-generation pharmacological preparations due to their fundamental role in **caries**

prevention. Fluoride acts by **enhancing enamel remineralization, inhibiting demineralization, and interfering with bacterial metabolism**, particularly by inhibiting enolase in cariogenic bacteria.

Fluoride-containing toothpastes and rinses are considered essential components of daily oral hygiene. Their antimicrobial effect is modest, but their **proven cariostatic efficacy** makes them indispensable in preventive dentistry.

1.6 Essential oils

Essential oils (e.g., thymol, eucalyptol, menthol, methyl salicylate) have: antimicrobial and anti-inflammatory properties, **low substantivity, and limited plaque inhibition** when compared with second-generation agents.

2. Second-Generation Pharmacological Preparations

Second-generation agents demonstrate **significantly higher antiplaque efficacy**, primarily due to their **high substantivity**, which allows them to bind to oral tissues with longer duration of action, compared with first-generation agents and be released gradually over time. These agents produce **clinically significant reductions in plaque accumulation and gingival inflammation**.

2.1 Chlorhexidine (Chlorhexidine Digluconate)

Chlorhexidine is considered the most potent chemical agent in plaque control due to its property of **substantivity** (the ability to bind to hard and soft tissues and be released gradually over time). Chlorhexidine digluconate is considered the **gold standard** among antiplaque agents. It exhibits broad-spectrum antimicrobial activity by **disrupting bacterial cell membranes and precipitating intracellular components**. Its most important property is **high substantivity**, enabling prolonged antimicrobial action for up to 12 hours after application. Clinically, chlorhexidine is highly effective in reducing plaque, gingivitis, and bleeding on probing.

It is commonly indicated for **short-term use**, such as post-surgical care, acute periodontal infections, or in patients with limited mechanical plaque control ability. Long-term use is restricted due to **side effects**, including tooth staining, taste alteration, and increased calculus formation.

- **Mechanism of Action:** It acts as a cationic molecule that binds to the negatively charged bacterial cell walls, causing cytoplasmic precipitation and cell death.

Indications: Post-operative care, acute periodontal infections, patients with fixed orthodontic appliances or in patients with limited mechanical plaque control ability.

- **Side Effects:** Extrinsic tooth staining, taste disturbances (dysgeusia), and an increased rate of supragingival calculus formation during prolonged use.

2.2 Quaternary Ammonium Compounds (e.g., Cetylpyridinium chloride)

These compounds reduce surface tension and increase the permeability of the bacterial membrane. They possess lower substantivity than chlorhexidine but result in significantly less tissue staining.

Cetylpyridinium chloride (CPC):

- is a **cationic surfactant**,
- exerts its antimicrobial effect by **disrupting the bacterial cell membrane**,
- demonstrates activity against **Gram-positive and Gram-negative bacteria**, as well as certain fungi,
- is commonly incorporated into **mouthrinses and toothpastes** as an adjunct to mechanical plaque control.

2.3 Triclosan (with Copolymers or Zinc Salts)

Triclosan is a broad-spectrum antimicrobial agent that inhibits **fatty acid synthesis in bacteria**. When combined with copolymers or zinc salts, its substantivity and clinical effectiveness are significantly enhanced.

Triclosan-containing formulations have demonstrated **moderate to significant reductions in plaque and gingival inflammation**, along with anti-inflammatory properties. **Triclosan + copolymers or zinc salt** shows clinically significant reductions in **plaque accumulation and gingival inflammation**. Compared to chlorhexidine, triclosan shows **fewer adverse effects**, making it more suitable for longer-term use in daily oral hygiene products.

Clinical Relevance and Educational Implications

Understanding the classification and mechanisms of action of pharmacological agents is essential for dental students, as it enables rational selection of oral hygiene products tailored to individual patient needs. While **first-generation agents** provide supportive and preventive benefits, **second-generation agents** play a crucial role in therapeutic plaque control under professional guidance. Their use should always complement, not replace, effective mechanical plaque removal.

3. Desensitizing Agents

Desensitizing agents are **not primarily antiplaque or antimicrobial agents**. These agents are utilized to treat dentinal hypersensitivity through two primary mechanisms:

1. **Occlusion of Dentinal Tubules:** Compounds such as strontium chloride, potassium oxalate, arginine, calcium phosphates form precipitates that block the tubules, preventing the hydrodynamic movement of fluid.
2. **Depolarization of Nerve Endings:** Potassium nitrate acts directly on the nerve fibers by increasing the extracellular potassium ion concentration, thereby preventing repolarization and the transmission of pain impulses.

Conclusion for Clinical Practice

The selection of a pharmacological agent must be individualized based on:

- The patient's caries risk assessment.
- The presence of inflammatory changes in the gingiva.
- Systemic conditions (e.g., xerostomia).

4. Toothpastes (Dentifrices) in Oral Hygiene

Toothpastes, also referred to as dentifrices, are semi-solid formulations designed to be used in conjunction with a toothbrush to enhance mechanical plaque removal and deliver therapeutic agents to the oral cavity. Their regular use plays a fundamental role in the **prevention of dental caries, periodontal diseases, and extrinsic tooth discoloration**, as well as in the maintenance of overall oral health.

4.1 Composition of Toothpastes

Modern toothpastes are complex formulations composed of several functional ingredients, each serving a specific purpose:

Abrasive Agents

Abrasives constitute approximately 20–40% of toothpaste formulations and are responsible for **removing dental plaque and extrinsic stains**. Common abrasives include hydrated silica, calcium carbonate, dicalcium phosphate dihydrate, and alumina. An ideal abrasive should be sufficiently effective in cleaning while causing **minimal abrasion of enamel and dentin**. Abrasivity is commonly expressed as the **Relative Dentin Abrasivity (RDA)** value.

Humectants

Humectants prevent toothpaste from drying out and contribute to its smooth texture. Frequently used humectants include glycerin, sorbitol, and propylene glycol. These agents also enhance palatability and improve consumer acceptance.

Detergents (Surfactants)

Detergents reduce surface tension, promote foaming, and aid in the dispersion of toothpaste throughout the oral cavity. Sodium lauryl sulfate (SLS) is the most commonly used surfactant. While effective, SLS may cause **mucosal irritation or recurrent aphthous ulcers** in susceptible individuals, leading to the development of SLS-free formulations.

Binding Agents (Thickeners)

Binding agents stabilize the toothpaste formulation and prevent separation of ingredients. Common binders include cellulose derivatives (e.g., carboxymethyl cellulose), xanthan gum, and carrageenan.

Flavoring and Sweetening Agents

Flavoring agents such as mint oils enhance taste and freshness, while non-cariogenic sweeteners (e.g., sodium saccharin) improve acceptability without increasing caries risk.

4.2 Therapeutic Agents in Toothpastes

Fluorides

Fluoride is the most important therapeutic ingredient in toothpaste and is considered the **gold standard for caries prevention**. Common fluoride compounds include sodium fluoride, sodium monofluorophosphate, and stannous fluoride. Fluoride enhances **remineralization**, inhibits **demineralization**, and interferes with bacterial metabolism. For adults, fluoride concentrations typically range from **1,000 to 1,450 ppm**, while lower concentrations are recommended for children to reduce the risk of dental fluorosis.

Antiplaque and Antigingivitis Agents

Toothpastes may contain antimicrobial agents such as triclosan (often combined with copolymers or zinc salts), stannous fluoride, or zinc compounds. These agents help reduce plaque accumulation, gingival inflammation, and halitosis.

Desensitizing Agents

Desensitizing toothpastes are indicated for the management of **dentin hypersensitivity**. Active ingredients include potassium nitrate, potassium citrate, arginine, strontium salts, and calcium sodium phosphosilicate (bioactive glass). These agents act either by **depolarizing nerve endings** or by **occluding dentinal tubules**.

Whitening Agents

Whitening toothpastes primarily remove extrinsic stains through enhanced abrasivity or chemical agents such as enzymes and low concentrations of hydrogen peroxide. They do not significantly alter intrinsic tooth color and should be used cautiously to avoid excessive abrasion.

Herbal and Natural Ingredients

Herbal toothpastes may contain plant-derived extracts such as chamomile, sage, aloe vera, neem, or tea tree oil. While these formulations are popular, their **clinical efficacy varies**, and they should ideally be supported by evidence-based research.

Clinical Indications and Selection Criteria

The selection of an appropriate toothpaste should be individualized based on the patient's **age, caries risk, periodontal status, presence of hypersensitivity, and personal preferences**. Fluoride toothpaste is recommended for the majority of patients, while specialized formulations may be indicated for specific conditions such as gingivitis, hypersensitivity, or high caries risk.

Educational and Preventive Importance

For dental professionals, understanding the composition and mechanisms of action of toothpastes is essential for providing **evidence-based recommendations**. Toothpastes should be viewed as an adjunct to effective mechanical plaque control and regular professional care, rather than a substitute for proper brushing techniques.

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