Introduction to preventive dentistry

Health is what we want to preserve, and it is defined as *a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity*. For instance, some individuals may actually be in excellent health but believe, for some reason logical to them, that they have oral cancer. Such individuals do not have an optimum mental well-being and will continue to worry until they are somehow convinced otherwise that they are indeed healthy. Another person may be functionally healthy, although facially disfigured, and as such be socially shunned throughout life. Thus, health can at times be what the patient thinks and not the actual condition of the body. Even the terminology "preventive dentistry" has different connotations to different people. As a result, **preventive dentistry** can be arbitrarily classified into three different levels.

1. *Primary* prevention employs strategies and agents to *forestall* the onset of disease, to *reverse* the progress of the disease, or to *arrest* the disease process before secondary preventive treatment becomes necessary.

2. *Secondary prevention* employs routine treatment methods to *terminate* a disease process and/or to *restore* tissues to as near normal as possible.

3. *Tertiary prevention* employs measures necessary to *replace* lost tissues and to *rehabilitate* patients to the point that physical capabilities and/or mental attitudes are as near normal as possible after the failure of secondary prevention (Figure 1-1).

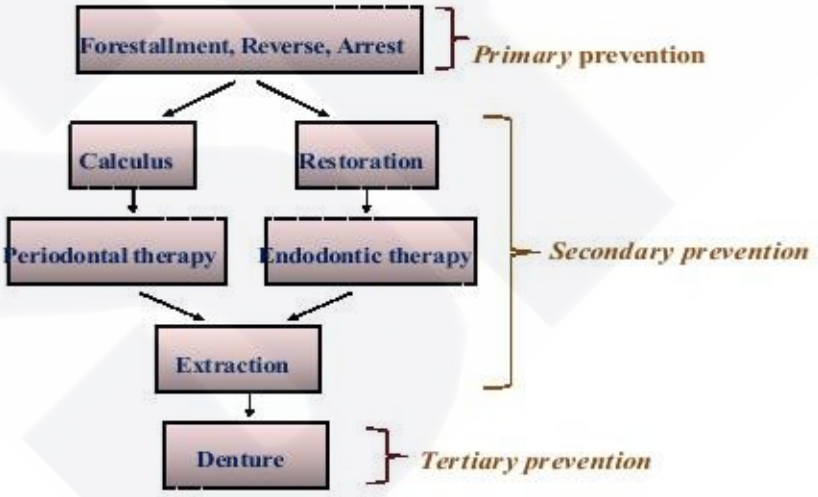


Figure 1-1 From natural teeth to denture teeth in three not-so-easy stages.

This text emphasizes primary prevention, and specifically focuses on primary prevention as it applies to the control of dental caries and periodontal disease. On the other hand, it must be recognized that primary prevention often fails for many reasons. When such failure occurs, *two actions* are essential

to contain the damage: (1) *early identification* of the disease (diagnosis) and (2) *immediate treatment* of the disease.

Categories of Oral Disease

For planning purposes, dental diseases and abnormalities can be conveniently grouped into three categories: (1) dental caries and periodontal disease, *both* of which are acquired conditions, (2) acquired oral conditions *other than* dental caries and periodontal disease (opportunistic infections, oral cancer, HIV/AIDS), and (3) craniofacial disorders which would include a wide variety of conditions ranging from heredity to accidents. For instance, the ordinary seat belt and the air bags in a car exemplify how a simple preventive measure can greatly reduce the facial injuries of car accidents.

Strategies to Prevent the Plaque Diseases.

Dental plaque is composed of *salivary proteins* that adhere to the teeth, plus *bacteria and end-products* of bacterial metabolism. Both cariogenic and periodontopathogens accumulate in the plaque located along the gingival margin, interproximally, and in the pits and fissures. To control the *plaque diseases* with *available* methods and techniques, strong emphasis has been directed to four general strategies to reduce caries and two administrative requirements:

General Strategies

1. Diet modification.

2. Mechanical (toothbrushing, flossing, or rinse).

3. Chemical plaque control. Use of *fluorides* to inhibit *demineralization* and to enhance *remineralization;* use of mouthrinses containing antimicrobial agents that effectively help control the plaque bacteria involved in causing *both* caries and gingivitis. For helping to control gingivitis, a popular and economical over-the-counter product is Listerine; the most effective *prescription* rinse is *chlorhexidine*.

4. Use of pit and fissure sealants, when indicated, on posterior occlusal surfaces.

Administrative Strategies

5. Education and health promotion.

6. Establish access to dental facilities where diagnostic, restorative, and preventive services are rendered, and where planned recalls based on risk are routine.

Prognostic and Diagnostic Tests.

Several methods for preventing the onset or progress of caries and periodontal disease have been discussed. Because it is impossible to apply vigorously *all* the preventive procedures to *all* the people *all* the time, it would be desirable to have some tests to indicate the extent of caries and periodontal

disease *risk* of an individual at any given time. This need is highlighted by the fact that an estimated *60%* of all carious lesions in schoolchildren *occur in 20%* of the stu-dents. It would save much time to be able to identify this 20% group of high-risk students without having to examine an entire school population. Although no tests are 100% correlated with the extent of caries activity or periodontal disease, several test procedures are sufficiently well correlated with either condition to be of interest. To be successful, such screening tests should be simple to accomplish, valid, economical, require a minimum of equipment, be easy to evaluate, and be compatible with mass-handling techniques.

Laboratory methods exist for counting the number of bacteria in the saliva. If the caries-causing mutans streptococci or lactobacilli counts are high, the individual from whom the sample was derived can be presumed to have a higher risk for dental caries, whereas a low count permits the opposite assumption. A second general method for estimating caries susceptibility is by use of a refined-carbohydrate dietary analysis to (1) evaluate the patient's overall diet with special attention to food preferences and amounts consumed and (2) to determine if the intake of refined carbohydrates is excessive in quantity or frequency. A well-balanced diet is assumed to *raise host resistance* to all disease processes, whereas a frequent and excessive intake of refined carbohydrates (i.e., sugar) has been associated with a high risk of caries development. The dietary analysis is very effective when used as a guide for patient education.

The onset of *gingivitis* is much more visible than the early demineralization that occurs in caries. The sign of impending periodontal disease is an inflammation of the gingiva that can be localized at one site, or generalized around all the teeth. Red, bleeding, swollen, and a sore gingiva are readily apparent to dentist and patient alike.

If at the time of the clinical and roentgenographic examinations, emphasis was placed on searching out the incipient lesions ("white spots") and early periodontal disease (gingivitis), preventive strategies could be applied that would result in a reversal or control of either/or both of the plaque diseases. It is essential that both the profession and the public realize that biologic "repair" of incipient lesions, and "cure" of gingivitis is a preferred alternative to restorations or periodontal treatment.

Even if these primary preventive **dentistry** procedures fail, tooth loss can still be avoided. In practice, the early identification and expeditious treatment of caries and periodontal disease greatly minimizes the loss of teeth. When such routine diagnostic and treatment services are linked with a dynamic preventive-**dentistry** program that includes an annual dental examination and recall program based on risk assessment, tooth loss can realistically be expected to be reduced to zero or near-zero.

Nutrition, Diet, and Oral health

Oral health, diet, and nutritional status are closely linked (Table 2-1). Nutrition is an essential for the growth, development, and maintenance of oral structures and tissues. During periods of rapid cellular growth, nutrient deficiencies can have an *irreversible* effect on the developing oral tissues. Prior to tooth eruption, nutritional status can influence tooth enamel maturation and chemical composition as well as tooth morphology and size. Early malnutrition increases a child's susceptibility to dental caries in the deciduous teeth.

Malnutrition *after* initial organ and tissue development is *usually reversible,* but can still compromise tissue regeneration and healing and increase susceptibility to oral diseases.

After tooth eruption, the effects of diet on the dentition are topical rather than systemic. Dietary factors and eating patterns can initiate exacerbate or minimize dental decay. Fermentable carbohydrates are *essential* for the implantation, colonization, and metabolism of bacteria in dental plaque. Factors such as eating frequency and retentiveness of carbohydrates influence the progression of carious lesions, while foods containing calcium and phosphorus, such as cheese, enhance remineralization. Frequent intake of *acidic foods* or beverages can cause enamel erosion.

Nutrition in the Development and Integrity of Oral Tissues and Structures	
Protein deficiency	• Delayed eruption. • Decreased radicular osteocementum.
Vitamin A deficiency	• Calcification of teeth is affected • Retarded eruption • Periodontal tissues
Vitamin B complex deficiency	• Periodontal tissues might be disturbed • General growth is slow • salivary gland dysfunction
Vitamin C deficiency	• Lossening of teeth • Disturbed collagen fibre formation • Bleeding gum
Vitamin D deficiency	• Early loss of deciduous teeth • Disturbed calcification of teeth • Poor quality of enamel • Retarded eruption • Narrow maxilla • Short mandible
Hypervitaminosis D	• Poorly calcified teeth • Decalcification of bones • Increased osteoclastic activity
Iron deficiency	• Glossitis and fissures at the corners of the mouth (angular cheilitis) • The papillae of the tongue may be atrophied, which gives the tongue a smooth, shiny, red appearance.
Calcium deficiency	• Osteoporosis .

Table 2-1 Nutrition in the Development and Integrity of Oral Tissues and Structures

The Basis for a Healthy Diet

Dietary Reference Intakes

Daily food intake must be sufficient to meet metabolic requirements for energy and provide the essential nutrients that the body cannot synthesize in sufficient quantities to meet physiologic needs.

Food Guide Pyramid

To help people select nutrient-rich foods, the *Food Guide Pyramid* was developed by the U.S. Department of Agriculture. The Food Guide Pyramid displays foods in five categories based on their nutrient composition (Figure 2-1). Whole grains, such as rice, pasta, cereals, and breads, found at the broad base of the Pyramid should form the foundation of a healthful diet. They are good sources of carbohydrate (including fiber) and minerals. Fruits and vegetables form the next level of the Pyramid. The meat group contains good sources of protein, vitamins, and minerals. Meat alternates, legumes, eggs, nuts, and tofu, are included in the meat group. The dairy group is comprised primarily of good calcium sources. The small triangle at the top of the Pyramid is for the fats, oils, and sweets that provide primarily added calories and, thus, should be eaten in small amounts. No single food group is more important than another; each group provides some, but not all, of the essential nutrients.

Standardized serving sizes and the recommended number of servings for various age groups are specified. However, the caloric content of foods varies widely within a food group. The desirable number of servings from each food group depends not only upon age and sex, but also activity level. For example, if 1,600 calories were the daily energy goal, an individual would choose the minimum number of servings of low-fat food choices from each group. If additional calories are needed, increased servings should come from the grain, fruit, and vegetable groups, rather than the top of the pyramid.

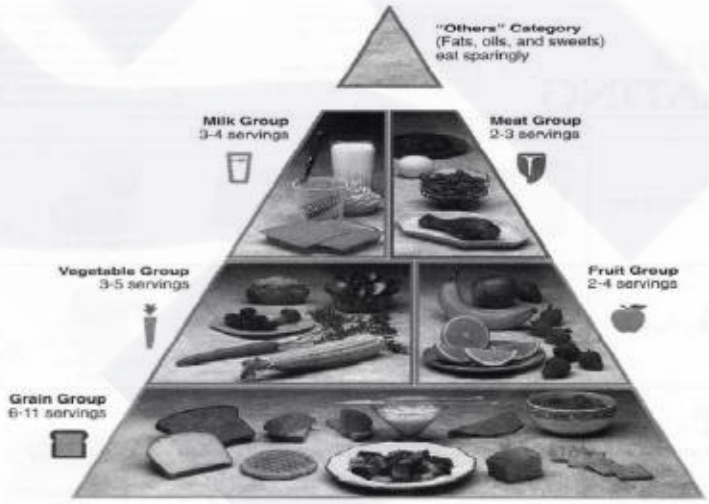


Figure 2-1 Food Guide Pyramid.

The National Academy of Sciences recommends the following calorie categories:

- 1,600 calories - Many sedentary women and some old adults
- 2,200 calories - Children, teenage girls, active women and many sedentary men. Women who are pregnant may need around 500 calories more per day and an additional 300 calories for breast-feeding.

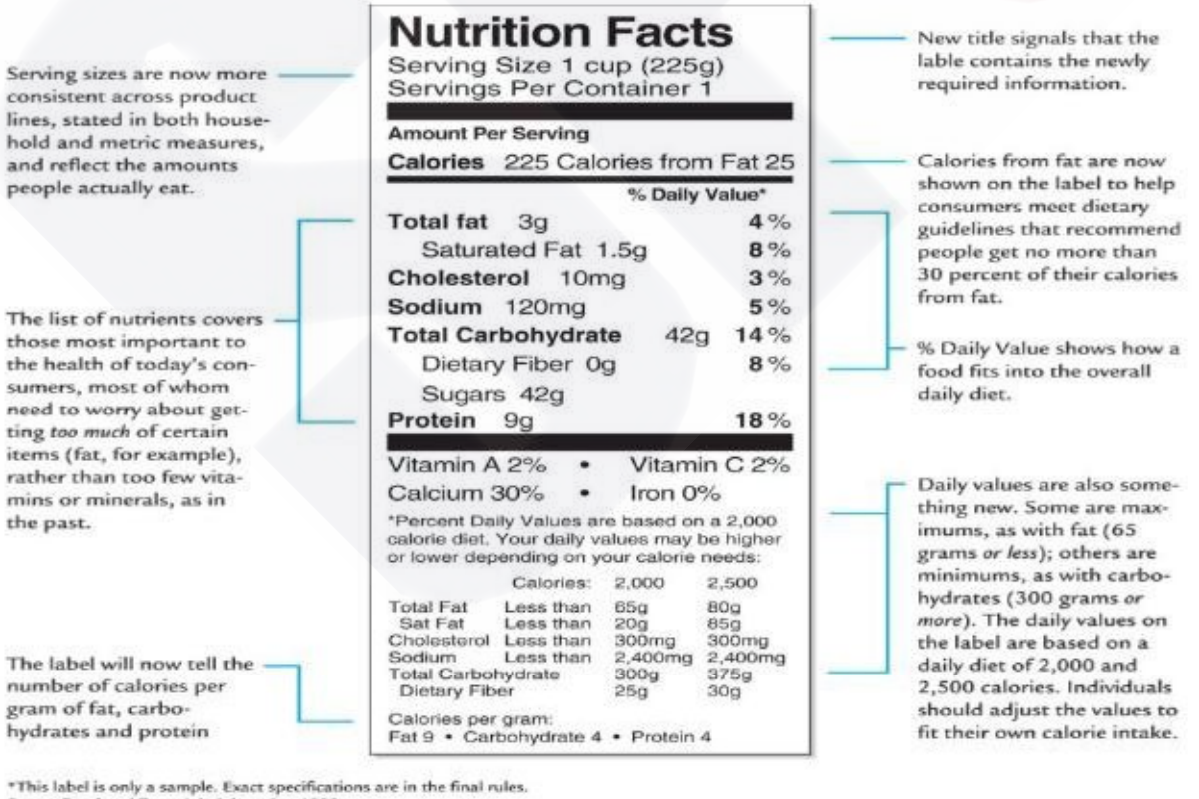
• 2,800 calories - Teenage boys, active men and very active women

Food Labels

The Nutrition Facts panel found on most processed food packages helps the consumer select foods that meet the Dietary Guidelines (Figure 2-2). In accord with the mandatory food labeling regulations published by the Food and Drug Administration in 1994, the nutrition panel on processed foods must include the following:

- *A standardized portion size* (designed to make nutritional comparisons of similar products easier, and reflects the serving sizes that people actually eat).
- The number of *servings per container.*
- The amounts of *total calories* and *calories from fat* per serving.
- The *number of grams* per serving of total fat, saturated fat, cholesterol, sodium, total carbohydrates, dietary fiber, sugars, and protein. In addition, the nutritional contribution of *one* serving of the product must be stated as a *percentage of the Daily Values.* The Daily Values are based on the RDA for protein, vitamins, and minerals and on standards designed especially for food labels for nutrients not covered in the RDA such as fat, cholesterol, total carbohydrates, dietary fiber, and sodium. The calculations to determine the percents of Daily Values are based on a *2,000-calorie diet.* Depending on a person's age, gender, and activity level, a person may need more or less than 100% of a Daily Value. The Daily Value also helps consumers see how a food fits into an overall daily diet.

Other information, such as the amounts of polyunsaturated or monounsaturated fats or other vitamins and minerals, is optional.



*This label is only a sample. Exact specifications are in the final rules.
Source: Food and Drug Administration 1992.

Figure 2-2 Food Label.

Dental Caries: Role of Carbohydrates in Caries Development.

The development of dental caries depends on four interrelated factors: (1) diet, (2) inherent factors of host resistance, (3) the number of challenge bacteria located in the dental plaque, and (4) time.

Mutans streptococci are the predominant oral bacteria that initiate the caries process. Newly erupted teeth with a thin enamel layer are very caries susceptible. Tooth morphology, especially the presence of deep pits and fissures, influences the likelihood that mutans streptococci will attach to and colonize the tooth's surface. Plaque bacteria ferment starches and sugars, producing organic acids. These acids demineralize dental enamel (There is no exact pH at which the demineralization begins, only a general range of 5.5 to 5.0).

Other dietary factors *counteract* the damaging effects of carbohydrates. The presence of protective minerals and ions such as *fluoride, calcium, and phosphorus* in *plaque and saliva,* promote remineralization of incipient lesions. In addition to transporting minerals, saliva contains *buffering agents, bicarbonate and phosphates,* that neutralize organic acids. Thus, the amount and composition of saliva affect the caries process. Other host factors that influence caries risk include: genetic predisposition, immune status, malnutrition during tooth formation, education level, and income status.

The causal relationship between sugar consumption and dental caries has been established. Animal studies suggest that an increase in the concentration of sucrose in the diet reduces dental plaque formation and increases the incidence of dental caries. People with very low sugar intakes have low-caries scores. People in nations that have high sugar intakes have high rates of caries. It is unclear if this is primarily the topical effect of sugar consumption or systemic effects on dentin formation. However, the amount of sugar consumed is not the sole dietary variable associated with caries development. Sucrose plays a more dominant role than other sugars in the development of smooth surface caries. One of sucrose's metabolic by-products, an extracellular polysaccharide called *glucan,* enables the mutans streptococci to adhere to the smooth enamel surfaces. However, the amount of sucrose necessary for the implantation of mutans streptococci is very low.

The use of *sugar alcohols and alternative sweeteners* in foods also has had a role in *reducing* caries. Perhaps one of the most promising sugar substitutes to be studied is *xylitol,* a sugar alcohol that has been demonstrated to be non-cariogenic as well as promoting remineralization. Xylitol's ability to inhibit metabolic acid production by mutans streptococci results in minimal depression of plaque pH.

Effects of Eating Patterns and Physical Form of Foods

Other dietary factors that may hinder or enhance caries development include: the frequency of eating, the *physical form* of the carbohydrate (liquid vs. solid), *retentiveness* of a food on the tooth surface, the *sequence* in which foods are consumed (e.g., cheese eaten before a sweet food limits the pH drop), and the presence of minerals in a food. Frequent between-meal snacking on sugar or processed starch-containing foods increases plaque formation and extends the length of time that bacterial acid production can occur.

Some components of foods *are protective* against dental caries. Protein, fat, phosphorus, and calcium inhibit caries in rats. Aged natural cheeses have been shown to be cariostatic. When cheese is eaten following a sucrose rinse, the plaque pH remains higher than when no cheese follows a sucrose rinse. In addition, enamel demineralization, measured using the intraoral cariogenicity test, is reduced. The protective effect of cheeses is attributed to *their texture* that *stimulates salivary flow,* and their protein, calcium, and phosphate content that *neutralizes plaque acids.* Fluoride found in drinking water, foods, and dentifrices increases a tooth's resistance to decay and enhances remineralization of carious lesions.

Nutrition and Periodontal Disease

The nutritional factors related to *preventing infection* and *enhancing wound healing* in general applies to the prevention and management of periodontal disease as well. Defense in the gingival crevice and connective tissue all require an adequate intake of all nutrients to ensure adequate production and function of defense and supporting cells.

Diet Guidelines

These include:

- Eat a *nutritionally adequate diet* following the food pyramid guidelines.
- Increase the use of saliva-stimulating fibrous foods.
- Multivitamin/mineral supplements should be in doses *no higher* than one to two times Recommended Dietary Allowance levels.
- *Avoid fad diets* which could be deficient in nutrients.
- Avoid *single* vitamin supplements.
- *Avoid potentially detrimental megadoses* of vitamins and minerals (10× RDA or higher).

Eating Disorders

Eating disorders, especially *bulimia,* are often first diagnosed in the dental office. Bulimia is characterized by recurrent episodes of *binge eating* (consumption of large amounts of foods at a time) followed by self-induced regurgitation (purging). The regurgitated acid in combination with xerostomia, results in rapid and extensive destruction of tooth enamel.The patient must be cautioned that for dental rehabilitation to be successful, the underlying problem (the eating disorder and its causes) must be resolved.

The Aging Patient

Impaired dental function may lead to poor nutritional health. Older adults with loose or missing teeth, or ill-fitting dentures often reduce their intake of foods that require chewing, such as fresh fruits, vegetables, meats, and breads. When the variety of foods in a diet is reduced, there is greater risk of nutrient inadequacies.

Older patients should be carefully screened for nutritional risk factors, and should be educated about the importance of good nutrition to general and oral health. When new dentures are provided, patients should be counseled on how to adapt their usual diet to a softer consistency for the first few days after denture insertion.

The Diabetic Patient

The *diabetic* dental patient is at *greater risk* for developing oral infections and periodontal disease than the nondiabetic patient. The dental team needs to be aware of current approaches to diabetes management and carefully monitor the patient's health status prior to initiating dental treatment.

The nutrition care plan generally requires that patients have meals and snacks of specific nutrient composition *at regularly scheduled intervals,* coordinated with medications (insulin or oral agents) and exercise. *In the dental office, quickly assimilated carbohydrate sources such as juices, milk, and crackers, should be kept readily available in the event that a diabetic patient develops symptoms of hypoglycemia.*

Patients with Immunocompromising Conditions (Cancer, AIDS)

The nutrition care plan initially focuses on providing *high caloric intake in frequent small meals.* Liquid supplements may be used if optimal nutriture cannot be achieved via food alone. In more serious cases, patients may need enteral (tube) feedings or more advanced nutritional support. The dental team should *not* caution patients to reduce the frequency of eating, since this will contradict nutritional management goals. Rather, thorough cleaning after each eating period, and use of fluoride mouth rinses and topical fluoride trays before bed should be stressed.

Oral Surgery and Intermaxillary Fixation

An adequate diet *before surgery is needed to support adequate post-surgical response.* If food consumption will be impaired for a short period of time, the risk of nutritional deficiency is low. The risk of deficiency increases with length of eating impairment. The surgery itself can result in an anorexia, inability to chew, and increased metabolic requirements. After surgery, a patient may need a *liquid diet for 1 or 2 days,* but should progress as soon as possible to a soft diet of high nutritional quality, until a normal diet can be resumed. In some cases, nutritionally complete liquid supplements may be appropriate and should be prescribed in consultation with the patient's dietitian and physician. Often patients prefer purees of normal foods over commercial liquid supplements. Multivitamin/ mineral supplements may be appropriate as well.

Toothbrushes and Toothbrushing Methods

The Manual Toothbrush

History

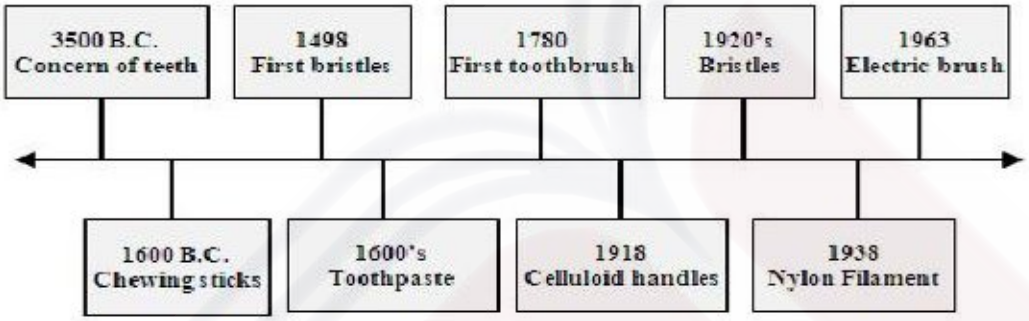


Figure 3-1 Timeline

Manual Toothbrush Designs

Manual toothbrushes vary in size, shape, texture, and design more than any other category of dental products.[5] A manual toothbrush consists of a head with bristles and a handle (Figure 3-2). When the bristles are bunched together, they are known as tufts. The head is arbitrarily divided into the toe, which is at the extreme end of the head, and the heel, which is closest to the handle. A constriction, termed the shank, usually occurs between the handle and the head. Many toothbrushes are manufactured in different sizes—large, medium, and small (or compact)—to adapt better to the oral anatomy of different individuals. Toothbrushes also differ in their defined hardness or texture, usually being classified as hard, medium, soft or extra soft.

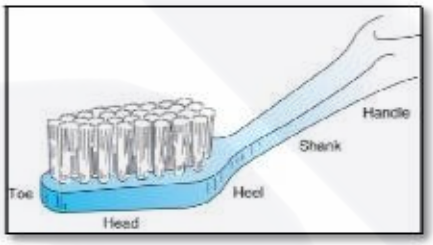


Figure 3-2 Parts of a toothbrush

Profiles

When viewed from the side, toothbrushes have four basic lateral profiles: concave, convex, flat, and multileveled (rippled or scalloped). The concave shape can be useful for improved cleaning of facial surfaces, whereas convex shapes appear more useful for improved cleaning of lingual surfaces. In laboratory and clinical studies, toothbrushes with multilevel profiles were consistently more effective than flat toothbrushes, especially when interproximal efficacy was monitored.

Bristle Shapes

Originally, individual toothbrush bristles were cut bluntly and often had sharp end configurations. In 1948, Bass reported that these bristle tips could damage the soft tissues and that rounded, tapered, or smooth bristle tips were less abrasive.

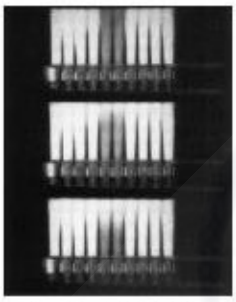


Figure 3-3 Blue dye in the center bristle tufts of this brush fades down from the end with use. When the dye reaches the half-way point (bottom brush), the manufacturer suggests replacing the brush.

Handle Designs

Many of the new toothbrushes in the United States have a styled-handle design. Modifications, such as triangular extrusions or indentations along the sides for a better grasp, a "thumb position" on the back of the handle for more comfort, and various angle bends to permit better access into and around the mouth, have been introduced. Four toothbrush-handle designs are shown in Figure 3-4. with a handle on the same plane as the bristle tips, as are dental instruments used for caries evaluations and prophylaxes. With both the offset and angled-offset designs, points of bristle contact are in line with the longitudinal axis of the handle during brushing.

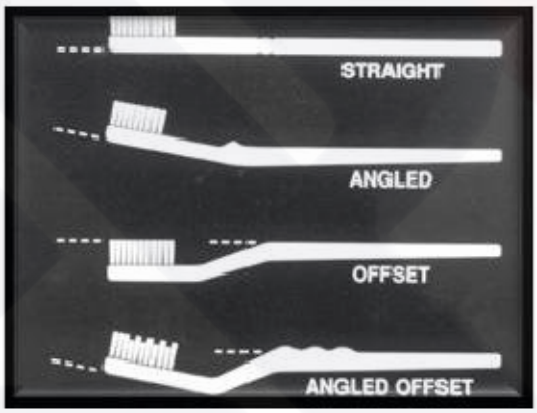


Figure 3-4 Four basic shapes of toothbrush handles.

Texture

Nylon bristles have a uniform diameter and a wide range of predictable textures. Texture is defined as bristle resistance to pressure and is also referred to as firmness, stiffness, and hardness. The firmness or texture of a bristle is related to its (1) composition, (2) diameter, (3) length, and (4) number of individual bristles per tuft. In the manufacturing process, the diameter of nylon bristles can be well controlled. Because the majority of toothbrushes contain bristles 10- to 12-millimeters long, the diameter of the bristle becomes the critical determinant of texture. The usual range of diameters for adult toothbrush bristles is from 0.007 to 0.015 inches. Factors such as temperature, uptake of water (hydration), and toothbrush-use frequency affect texture.

Texture labeling is not standardized. Individual manufacturers label their brushes according to their testing criteria. Thus one manufacturer's "soft" grade may be stiffer than another manufacturer's "medium" grade. The International Organization for Standardization (ISO) has formulated testing procedures that permit manufacturers to label their brushes in a consistent manner.

Nylon Versus Natural Bristles

The nylon bristle is superior to the natural (hog) bristle in several aspects. Nylon bristles flex as many as 10 times more often than natural bristles before breaking; they do not split or abrade and are easier to clean. The configurations and hardness of nylon bristles can be standardized within specified and reproducible tolerances. Natural bristle diameters, since they are tapered, vary greatly in each filament. This can lead to wide variations in the resulting texture of the marketed toothbrush. As a result of the advantages of nylon, as well as its ease and economy of production, relatively few natural bristle toothbrushes are marketed.

Characteristics of a toothbrush according the American Dental Association (ADA)

- Length 1 – 1.25 inches
- Width 5 / 16 – 3 / 8 inches
- Surface area 2.54 – 3.2 cm
- No. of rows 2 – 4 rows of brushes
- No. of tufts 5 – 12 per row
- No. of bristles 80 – 85 per tuft

Powered Toothbrushes

The heads of most powered or mechanical toothbrushes are smaller than manual toothbrushes and are usually removable to allow for replacements (Figure 3-5). The head follows three basic patterns when the motor is started: (1) reciprocating, a back-and-forth movement; (2) arcuate, an up-and-down movement; and (3) elliptical, a combination of the reciprocating and arcuate motions. Powered toothbrushes are consistently superior to manual toothbrushes in plaque removal and gingivitis efficacy. Differences are most significant when tested against manual toothbrushes.

Figure 3-5 Powered toothbrush heads

Toothbrushing Methods

Natural Methods of Brushing

The most natural brushing methods used by patients are a reciprocating horizontal scrub technique, a rotary motion (Fones's technique) (Figure 3-6)., or a simple up-and-down motion over the maxillary and mandibular teeth (Leonard's technique). Patients managing effective toothbrushing with these methods without causing traumatic problems or disease should not alter their brushing methods just for the sake of change.

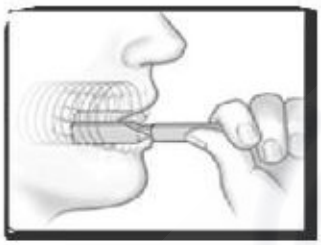


Figure 3-6 Fones's technique

Stillman's method was originally developed to provide gingival stimulation. The toothbrush is positioned with the bristles inclined at a 45-degree angle to the apex of the tooth, with part of the brush resting on the gingiva and the other part on the tooth (Figure 3-7). A vibratory motion is used with a slight pressure to stimulate the gingiva. The brush is lifted and then replaced in the same area, and pulsing is repeated.

Figure 3-7 Stillman technique.

Charters advocated a pressure-vibratory technique to clean interproximal areas. The toothbrush should be placed at a 90-degree angle to the long axis of the teeth so that the bristles are gently forced between the teeth but do not rest on the gums. The brush is moved in several small rotary motions so that the sides of the bristles are in contact with the gum margin. After two or three such motions, the brush is removed and replaced in the same area and the motions are repeated.

It is important to note that the Bass technique was the first to focus on the removal of plaque and debris from the gingival sulcus by the combined use of a soft toothbrush and dental floss. The method is effective for removing plaque adjacent to and directly beneath the gingival margins as part of the self-care regimen for controlling periodontal disease and caries. In the Bass technique, the toothbrush is positioned in the gingival sulcus at a 45-degree angle to the tooth apex. The bristles are then gently pressed to enter the sulcus. A vibratory action, described as a back-and-forth horizontal jiggle, causes a pulsing of the bristles to clean the sulci (Figure 3-8). Ten strokes are advised for each area.

Figure 3-8 Bass technique

In the rolling-stroke method (Figure 3-9), the toothbrush bristles are positioned parallel to and against the attached gingiva, with the toothbrush head level with the occlusal plane. The wrist is then turned to flex the toothbrush bristles first against the gingiva and then the facial surface. A sweeping motion is continued until the occlusal or incisal surface is reached. The toothbrush bristles are at right angles to the tooth surface as the brush passes over the crown. The press roll action is repeated at least five times before proceeding to the next site.

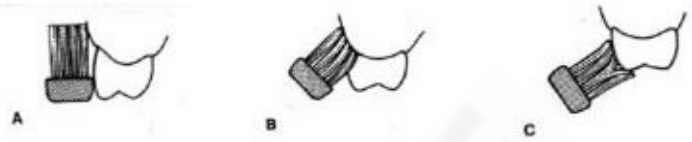


Figure 3-9 Rolling stroke technique.

Modified Brushing Methods

In attempts to enhance brushing of the entire facial and lingual tooth surfaces, the original techniques have been modified. Some modifications like the Bass method may induce a more pronounced gingival trauma with standard brushes. New toothbrush designs such as multilevel and cross-section bristles that have been tested are not only more effective but can be also less harmful.

The following considerations are important when teaching patients a particular toothbrushing technique: (1) the patient's oral health status, including number of teeth, their alignment, patient's mouth size, presence of removable prostheses, orthodontic appliances, periodontal pockets, and gingival condition; (2) the patient's systemic health status, including muscular and joint diseases, and mental retardation; (3) the patient's age; (4) the patient's interest and motivation; (5) the patient's manual dexterity; and (6) the ease and effectiveness with which the professional can explain and demonstrate proper toothbrushing procedures.

Recommended Powered Toothbrushing Methods

Most powered toothbrush manufacturers do not recommend a specific brushing method, however, the electric brushes should be used in a specified manner. The Swiss Dental Society, in 2001 developed an instruction manual. Instructions for brushes with a sweeping and /or oscillating rotary motion are as follows:

1. The brushes are positioned on the tooth surfaces in a 45- or 90-degree angle to the incisal plane. Only when positioned should the brush be switched to "on." The mouth should be almost closed.

2. The brush should be moved slowly over and around each tooth for 3 to 5 seconds, making sure that the bristles clean the crevices between the teeth.

3. The brush head can be lifted distally and mesially into the interproximal areas to reach the interdental area; the brush always remains on a single tooth.

4. After a period of approximately 5 seconds, the brush is moved to the next tooth surface and repositioned.

5. Experienced individuals can use the brush also in a perpendicular angle to the teeth and gums, but the applied force has to be gentle. In this way, each tooth in the upper and lower arch is cleaned on the buccal and lingual surfaces.

6. It is best to divide the mouth into four quadrants (upper-right, upper-left, lower-right, and lower-left) and to start brushing on a tooth in the upper rear and then clean one surface after the other very systematically.

7. It is an easy way, gives good control for the individual, and does not omit any tooth surface. This method takes more time, because at a single time interval, only one tooth surface can be cleaned.

Toothbrushing Time and Frequency

For many years the dental professional advised patients to brush their teeth after every meal. Thorough toothbrushing requires a different amount of time for each individual. Often a compromise is made by suggesting 5 to 10 strokes in each area or by advocating the use of a timer.

Toothbrushing Procedures

Occlusal Surfaces

The occlusal surfaces may be cleaned by either (1) short vibratory strokes, with pressure being maintained to accomplish as deep a penetration of the pits and fissures as possible; or (2) a rapid back-and-forth vibrating motion to force the bristles into the pits and fissures, followed by a sweeping motion to expel the dislodged debris (Figure 3-10).

Figure 3-10 Toothbrushing of occlusal surfaces

The Anterior Lingual Areas

Access to the lingual surfaces of the mandible and maxilla is difficult. Brushing in these areas can be facilitated by cutting off all tufts on a brush, except the first four or five rows in the toe.

Brushing Sequence

patients are taught to begin with the distal surface of the most posterior tooth and to continue brushing the occlusal and incisal surfaces around the arch until the last molar on the other side of the arch has been reached. The lower arch is then brushed in a similar manner.

Clinical Assessments of Toothbrushing

Whatever techniques are recommended, the main purpose of tooth brushing is to remove dental plaque from the teeth, including the gingival crevice, with the minimum amount of damage to the teeth and surrounding structures. Disclosing agents provide the means of evaluating the thoroughness of cleaning the teeth. The most widely marketed red disclosing products contain FD&C Red #28.

Disclosing agents may be in either a liquid or tablet form. The chewable tablet or the liquid disclosant should be swished around in the mouth for 15 to 30 seconds and then expectorated. Home use of disclosants by the patient should be encouraged to permit self-evaluation of the effectiveness of plaque-control programs.

Toothbrush Replacement

Toothbrush wear (splayed, bent, or broken bristles) is influenced more by brushing methods than by the length of time or number of brushings per day. The average "life" of a manual toothbrush is

approximately 3 months. This estimate can vary greatly, however, because of differences in brushing habits. It is also sound advice for patients to have several toothbrushes and to rotate their daily use, to assure drying between brushings. If toothbrushes need to be replaced more frequently than every three months, the patient's brushing technique should be checked. Even if the brushing technique is acceptable or has been corrected, toothbrushes should still be replaced frequently. Indeed, after every oral or contagious medical illness, it is imperative that patients be made aware of the importance of having a new toothbrush.

Special Needs

Tongue Brushing

Malodor from the mouth most often has its origin on the tongue. Tongue cleansing can be accomplished by placing the side of the toothbrush near the middle of the tongue, with the bristles pointed toward the throat. The brush is swept forward, and this motion is repeated six to eight times in each area. The palate should also be cleansed with a sweeping motion. A dentifrice should be used with this brushing of soft tissues to improve cleansing action.

Abutment Teeth and Orthodontic Appliances

Abutment teeth, implants, fixed bridgework and fixed orthodontic appliances require special emphasis on sulcular brushing to prevent gingivitis. Thorough cleansing between orthodontic appliances and gingiva will prevent dental caries. The effectiveness of a new toothbrush design in orthodontic patients has been documented in different publications. At the end of a 4-month study, a three-sided manual toothbrush significantly decreased gingivitis and was more effective in plaque removal compared to a flat multitufted toothbrush.

Dentures and Removable Orthodontic Appliances

Patients with full dentures can meet their oral hygiene needs with a soft nylon brush for the oral tissues and a denture brush that cleans all areas of the denture. The denture brush with a nonabrasive cleaner should reach into the recessed alveolar ridge area of the denture to ensure maximum cleansing. The oral tissues should be brushed at least once a day using a gentle vibration and long, straight strokes from the posterior to anterior mouth regions.

Patients with removable partial dentures and removable orthodontic appliances need at least three toothbrushes, one for the natural teeth, another for the appliance, and a third for clasps. Brushing clasps, wires, and other metal parts can wear out a regular toothbrush. A clasp brush—2 or 3 inches long, narrow, and tapered—can be obtained as a third brush. Special care is needed to carefully clean all plaque from the clasps as a preventive measure for the supporting teeth.

Handicapped Patients

A manual brush with an enlarged handle, elastic cuff, or small strap attached to the brush or a long-handled holder for patients who cannot raise their arms or do not have hands, permits the patient to brush. Mentally retarded patients can often brush using a soft toothbrush with the plastic handle bent for better grasping. A horizontal scrub is often the best that these patients can manage. A three-headed toothbrush or a powered toothbrush assisted by a caregiver can be useful.

Special Uses for Powered Toothbrushes.

Powered toothbrushes can be beneficial for parental brushing of children's teeth; for children and adults who are physically handicapped, mentally retarded, aged, arthritic, or otherwise with poor dexterity; and for those patients who are poorly motivated. These brushes are especially recommended for patients who require a larger handle, because powered models are easier to grasp.

Dental Floss

Dental floss is best indicated for plaque and debris removal from interproximal areas where the papilla fills the interproximal space and the teeth are in contact. Several types of floss are available. These vary from thin unwaxed varieties, to thicker waxed tapes and include variable thickness floss (Figure 3-11).

Figure 3-11 Several different types of dental floss are available:
thin (top), tape (middle), and meshwork (bottom).

Waxed dental tape, unlike round dental floss, is broad and flat, and may be effective in an interproximal space without tight contact points. Additional types of floss, such as those made of *polytetrafluoroethylene* (PTFE, teflon-like), are stronger and more shred-resistant. They have been shown to be preferred by those who have tight contacts or rough proximal tooth surfaces. Other varieties, such as tufted floss increments alternated with standard floss, and floss which stretches for insertion are alternatives.

Some brands of dental floss and tape are colored and flavored. Flosses impregnated with a variety of agents have been introduced; examples of these include floss treated with baking soda, fluoride, herbal extracts, antimicrobial agents, or abrasives agents.

One type of variable-thickness floss has a stiff end to allow for threading under bridges, beneath tight contact areas, under pontics, through exposed furcations, and around orthodontic wires. This floss combines a section of unwaxed floss with an area of thicker nylon meshwork to clean larger surface areas. Variable thickness floss may be recommended for use in cleaning implant abutments, areas with open contacts, wide embrasures. When recommending a type of floss, the specific oral conditions, patient preference, and ability are all factors that need to be considered.

Dental Flossing Methods

Two frequently used flossing methods are the spool method and the circle, or loop, method. Both facilitate control of the floss and ease of handling. The spool method is particularly suited for teenagers and adults who have acquired the necessary neuromuscular coordination required to use floss. The loop method is suited for children as well as adults with less nimble hands or physical limitations caused by conditions such as poor muscular coordination or arthritis. Flossing is a complex skill, so until children develop adequate dexterity, usually around the age of 10 to 12 years, an adult should perform flossing on the child. Younger children whose teeth still exhibit primate spaces (no interproximal contact) will not require flossing.

When using the spool method, a piece of floss approximately 18 inches long is utilized. The bulk of the floss is lightly wound around the middle finger. Space should be left between wraps to avoid impairing circulation to the fingers. The rest of the floss is similarly wound around the same finger of the opposite hand. This finger can wind, or "take up," the floss as it becomes soiled or frayed to permit access to an unused portion. The last three fingers are clenched and the hands are moved apart, pulling the floss taut, thus leaving the thumb and index finger of each hand free. The floss is then secured with the index finger and thumb of each hand by grasping a section three quarters to 1 inch long between the hands (Figure 3-12).

For the loop method, the ends of the 18-inch piece of floss are tied in a knot. All of the fingers, but not the thumbs of the two hands are placed close to one another within the loop. Whether using the spool or the loop method of flossing, the same basic procedures are followed. The thumb and index finger of each hand are used in various combinations to guide the floss between the teeth.

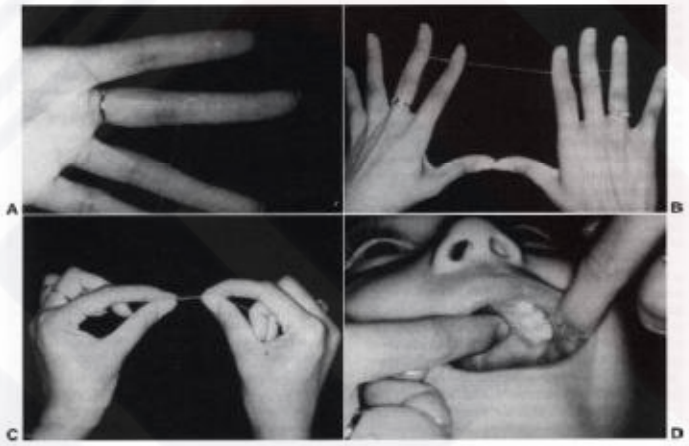


Figure 3-12 Flossing technique.

A, The length of floss is wrapped around the middle fingers of each hand. B, Enough floss should be left between the middle fingers to allow the thumbs to touch when the hands are laid flat. C, The index fingers and thumbs are used to manipulate the floss. D, The floss is carefully placed in a C shape between the interproximal contacts and gently sawed up and down until each tooth surface is clean.

When inserting, floss, it is gently eased between the teeth with a seesaw motion at the contact point. The gentle seesaw motion flattens the floss, making it possible to ease through the contact point and prevent snapping it through, thus avoiding trauma to the sulcular gingival. Once past the contact point, the floss is adapted to each interproximal surface by creating a C-shape. The floss is then directed apically into the sulcus and back to the contact area (up-and-down against the side of the tooth) several times or until the tooth surface is clean. The procedure is repeated on the adjacent tooth in the proximal area, using care to prevent damage to the papilla while readapting to the adjacent tooth. A clean, unused portion should be used for each interproximal area.

In general, flossing is best performed by cleaning each tooth in succession, including the distal surface of the last tooth in each quadrant. The individual should be assisted with problem areas and encouraged to utilize whichever method produces the best results. Criteria for evaluation are based on the efficacy of plaque removal and safety of the flossing method.

Dental Floss Holder

The floss holder is a device that eliminates the need for placing fingers in the mouth. It is recommended for individuals with:

- Physical disabilities,
- Poor manual dexterity,
- Large hands,
- Limited mouth opening,
- A strong gag reflex, and/or
- Low motivation for traditional flossing.

The floss holder may also be helpful when one person is assisting another with flossing. Limited scientific data comparing finger-manipulated flossing to the use of a floss holder shows no difference in plaque removal. Studies have found that, when compared, a significant majority of individuals preferred the floss holder over finger-manipulated flossing. It should be emphasized that effective initial education and reinforcement are necessary for proper use of the floss holder. Use of the floss holder may aid in developing a flossing habit and should be considered when individuals experience difficulty with manual flossing.

A variety of different floss-holder designs are available (Figure 3-13). Most commonly, they consist of a yoke-like device with a 3/4- to 1-inch space between the two prongs of the yoke. The floss is secured tightly between the two prongs and the handle is grasped to guide the floss during use. Most floss holders require that floss be strung around various parts of the holder prior to each use.

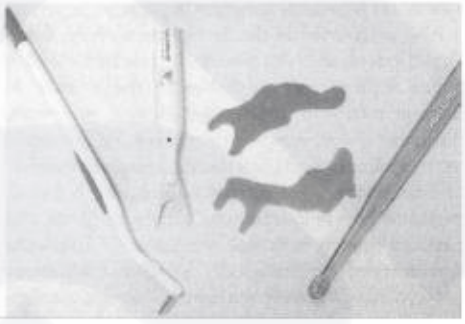


Figure 3-13 Several different methods for interproximal cleaning.
Left to right, Interdental brush, Y-shaped floss holder, disposable floss holders, and end tuft brush.

Dentifrices, Mouthrinses, and Chewing Gums

Dentifrices, mouthrinses, and chewing gums can be categorized as either cosmetic or therapeutic. Cosmetic products have traditionally been used to remove debris, provide a pleasant "mouth feel," and temporarily reduce halitosis. To improve on their marketability, flavors, stripes, sprinkles, and colors have been added to dentifrices and mouthrinses. Recently, other ingredients have also been added to temporarily depress the oral bacterial population or to prevent or moderate some disease process in the mouth.

Monitoring the Safety and Effectiveness of Therapeutic Dental Products

Caution is needed before introducing a new therapeutic product to the market. The process by which oral-care agents are evaluated and regulated in the United States has been reviewed by Trummel. Safety and efficacy standards apply not only to prescription medications but *also* to over-the-counter (OTC) drugs. There are three levels of regulation of oral chemotherapeutic agents. The government level includes the *Food and Drug Administration (FDA)* and the *United States Pharmacopoeia Convention.* The *professional or voluntary level* includes the Council on Scientific Affairs (CSA) of the *American Dental Association (ADA).* The *third* level of review includes *consumer advocacy organizations,* advertising standards review panels, and the Federal Trade Commission.

The FDA conducts an ongoing review of all OTC products. One aim of regulation is to protect the patient-consumer from *useless* or *harmful* products. All approval or disapproval decisions by the FDA have the *force of law.*

Over the years, the FDA has requested manufacturers of OTC products to submit a *listing* of the active and inactive ingredients in their products as a basis for helping to codify regulations governing OTC sales.

In addition to the FDA's regulation of OTC products, the American Dental Association's Council on Scientific Affairs (CSA) continually reviews dental products. Submission by a manufacturer to the ADA program is *voluntary.* If the product is *safe* and *effective,* the *Seal of Acceptance* is granted and *can be used by the manufacturer* in marketing the product. The Seal provides *assurance* to dental professionals and to the public. In addition to the traditional "print media," this information is available at the ADA website, www.ada.org.

Dentifrices

According to the dictionary, the term dentifrice is derived from dens (tooth) and fricare (to rub). A simple, contemporary definition of a dentifrice is a mixture used on the tooth in conjunction with a toothbrush. Dentifrices are marketed as toothpowders, toothpastes, and gels. All are sold as either cosmetic or therapeutic products.

Toothpastes contain several or all of the ingredients listed in Table 4-1. Gel dentifrices are also marketed. Gels contain the *same* components as toothpastes, except that gels have a *higher proportion* of the thickening agents. Both tooth gels and toothpastes are *equally* effective in plaque removal and in delivering active ingredients.

Name	Percentage
Abrasive	20 – 40 %
Binder	1- 2 %
Detergent	12 %
Preservative	0.05 – 0.5 %
Flavour	1 – 2%
Colouring	2 – 3%
Humectant	20 – 40 %
Theraputic	1 – 2%
Water	20 – 40 %

Table 4-1 Ideal dentifrice ingredients

Abrasives

The degree of dentifrice abrasiveness depends on the *inherent hardness* of the abrasive, *size* of the abrasive particle, and the *shape* of the particle. Several other variables can affect the abrasive potential of the dentifrice: the brushing technique, the pressure on the brush, the hardness of the bristles, the direction of the strokes, and the number of strokes.

Calcium carbonate and calcium phosphates were previously the most common abrasives used. These agents often reacted adversely with fluorides. Chalk (calcium carbonate) and baking soda (sodium bicarbonate) are also common dentifrice abrasives. New silicas, silicon oxides, and aluminum oxides are being introduced into dentifrice formulas, with additional efficacy claims.

When toothbrushing is done without toothpaste, there is little possibility of abrasion. When damage does occur, it usually appears as a V-shaped notch in the *cementum immediately below the cementoenamel junction*. This area is vulnerable, because enamel is about *20 times harder* than dentin or cementum.

Humectants

Humectants help maintain the consistency of toothpaste. Synthetic celluloses in *low* concentrations are also often used as humectants; in *higher* concentrations they function as gelling agents in the formulation of gel dentifrices. At *high* concentrations (> 40%), humectants also act as preservatives.

Soaps and Detergents

Because toothpastes were originally manufactured to keep the teeth clean, soap was the logical cleansing agent. When detergents appeared on the market, soaps largely disappeared from dentifrices. Today, *sodium lauryl sulfate (SLS) is the most widely used detergent.*

Flavoring and Sweetening Agents

For taste acceptance, the flavor must be pleasant, provide an immediate taste sensation, and be relatively long-lasting. Usually synthetic flavors are blended to provide the desired taste. Spearmint, peppermint, wintergreen, cinnamon, and other flavors give toothpaste a pleasant taste, aroma, and

refreshing aftertaste. Some manufacturers use essential oils such as thymol, menthol, etc., which may provide a "medicinal" taste to the product.

Sweetening Agents

In early toothpaste formulations, sugar, honey, and other sweeteners were used. They have been replaced with saccharin, cyclamate, sorbitol, and mannitol as primary *noncariogenic* sweetening agents. Sorbitol and mannitol serve a *dual role* as sweetening agents and humectants. Glycerin, which also serves as a humectant, adds to the sweet taste. A new sweetener in some dentifrices is *xylitol*.

Therapeutic Agents

The most commonly used therapeutic agent added to dentifrices is *fluoride,* which aids in the control of caries. In a series of papers published in 1998, antiplaque, gingivitis reduction, stain-removal, and odor-reducing efficacy were *documented* for sodium bicarbonate-containing dentifrices. These baking-soda dentifrices actually contain only a small amount of baking soda, in addition to the standard fluoride-compatible abrasives.

Antiplaque agents can act directly on the plaque bacteria or can disrupt different components of plaque to permit easier and more complete removal during toothbrushing and flossing. *Triclosan* is a broad-spectrum antibacterial agent.

Toothpastes containing potassium nitrate, strontium chloride, and sodium citrate have antihypersensitivity properties; other toothpastes with tetrasodium phosphate and disodium dihydrogen pyrophosphate retard the formation of calculus.

Surveys reveal a growing market share for dentifrices claiming "whitening" or "stain control." These dentifrices control stain via *physical methods* (abrasives) and *chemical mechanisms* (surface active agents or bleaching/oxidizing agents). These products usually contain *hydrogen peroxide* or *carbamide peroxide* as their bleaching or whitening ingredient.

Mouthrinses

Freshening bad breath has been the traditional purpose of mouthrinses. The claimed active ingredients of mouthrinses include *quaternary ammonium compounds, boric and benzoic acids, and phenolic compounds.* As with dentifrices, commercial sales of cosmetic rinses have been related to taste, color, smell, and the pleasant sensation that follows use. The pleasant sensation is often enhanced by the addition of astringents. Commonly used astringents are alum, zinc stearate, zinc citrate, and acetic or citric acids. Zinc sulfate has been added to mouth rinses as a claimed antiplaque ingredient.

Alcohol in mouthrinses is used as a *solvent, a taste enhancer,* and an agent providing an *aftertaste.* The alcohol content of commercial rinses, ranging *up to 27%,* may constitute a danger for children, especially those from 2 to 3 years of age. According to the National Poison Center Network, 5 to 10 ounces of a mouthrinse containing *alcohol can be lethal for a child* weighing 26 pounds. The American Academy of Pediatrics has recommended that OTC liquid preparations be *limited to 5% ethanol,* that safety closures be required, and that the packaged volume be kept to a "reasonable minimum to prevent the potential for lethal ingestion."

The FDA has approved prescription plaque-control rinses containing 0.12% chlorhexidine. Directions call for a twice daily, 30-second rinse with 1 oz of such solutions.

Fluorides and chlorhexidine are the most effective agents used by the profession to combat the plaque diseases. The fluorides help prevent demineralization and enhance remineralization, while chlorhexidine severely suppresses the mutans streptococci that cause the demineralization. Chlorhexidine also helps suppress bacteria causing the inflammation of periodontal disease. Following root planing, prophylaxis, or periodontal surgery, chlorhexidine irrigation may be effective in helping to control inflammation and subgingival plaque.

Some side effects are associated with chlorhexidine use, of which stain is the most common. Chlorhexidine is inactivated by most dentifrice surfactants and, therefore it is not included in dentifrices. Also, because of this inactivation, it is *critical for dental professionals* to alert patients not to use chlorhexidine mouthrinses within 30 minutes before or after regular toothbrushing.

Listerine antiseptic was the first OTC antiplaque and antigingivitis mouth rinse to be approved by the ADA. Patients are advised to rinse twice daily with 20 mL of Listerine for 30 seconds, in addition to their usual oral-hygiene regimen. The active ingredients are *thymol, menthol, eucalyptol, and methyl salicylate,* termed *essential oils.* The original formula contains *26.9% alcohol.*

Chewing Gum

Because gum chewing is pleasurable, people normally chew for long periods of time. During gum chewing, salivary flow rates increase, especially in the first few minutes, because of *both mechanical and gustatory stimulation.* Increased salivary stimulation can continue for periods of *5 to 20 minutes,* usually until the flavor(s) in the product dissipates. However, even with unflavored chewing gum, saliva flow, as evidenced by swallowing rates, increase over baseline. The beneficial effects of additional saliva in the mouth include increased *buffer capacity* and *mineral super saturation,* both of which help regulate or increase plaque pH, and increase plaque calcium levels (pCa). In addition, increased saliva flow can assist in loosening and removing debris from occlusal or interproximal sites, and can be beneficial to xerostomia patients.

The focus of chewing gum research to date has been on "sugar-free" products, which contain polyol sweeteners such *as sorbitol or xylitol.* These sweeteners are not broken down by plaque or oral microorganisms to produce acid. Plaque pH studies have documented reduction of plaque acidity and maintenance of plaque neutrality both during and, with xylitol, for periods of 2 to 3 weeks following, gum chewing. In addition, gums containing xylitol have shown *anticaries* activity in several *long-term studies.* Chewing a *sorbitol-based chewing gum* after meals significantly *reduced dental caries* incidence in a three-year study.

Studies have shown that a commercial chewing gum containing 5% sodium bicarbonate (Arm and Hammer Dental Care) is capable of removing significant amounts of plaque and reducing gingivitis when used as an adjunct to regular toothbrushing. Stain removal is also of interest to the consumer. Studies simulating a realistic situation (twice-daily brushing and unsupervised use of a baking soda chewing gum) demonstrated *reduction in stain* after four weeks.

Reynolds has proposed the introduction of *casein phosphopeptide* to chewing gum as a mechanism to *remineralize* early carious lesions. Compounds such as chlorhexidine and fluorides would appear to be

useful when delivered using chewing gum as the vehicle, since there would be a minimum of potentially interfering agents in the gum product, as well as a sustained time of release and availability in the oral cavity.

Xylitol is considered noncariogenic and cariostatic. Since the 1970s, one of the favorite ways to take advantage of xylitols unique anticaries property, has been to use it to sweeten chewing gum, a product that is a popular item among school children.

Two other dental uses of xylitol chewing gum have come out in Scandinavia:

1. Chlorhexidine can dramatically suppress the number of mutans streptococcus in the saliva. However, after discontinuing use of the product, there is a rapid repopulation of the bacteria. This repopulation can be arrested or greatly slowed by the use of xylitol chewing gum.

2. Previously it was mentioned that a child's flora often reflected that of the mother. To help minimize this mother-child transmission of cariogenic bacteria, mothers have been urged to chew xylitol gum.

The chewing of PH-neutral sugar-free gum increase salivary flow and assists in remineralization and the prevention of demineralization.

Topical Fluoride Therapy

Fluoride has been introduced into proprietary products such as dentifrices and mouthrinses. As a result, the caries decrement *directly attributable* to water fluoride in the mid-20th century has declined. Yet, the placement of fluoride into communal water supplies *still* results in an estimated 20 to 40% reduction in coronal caries, and a similar 20 to 40% decrease in root caries.

Approximately 126 million individuals in the United States consume fluoridated water through *communal water* supplies and another 9 million are drinking *naturally* fluoridated water. It is estimated that 65% of the U.S. population, therefore, is receiving fluoride through drinking water. Many times during the past years, it has not been possible to fluoridate city water supplies because of political, technical, or financial considerations. In such cases, it is still possible to receive the *systemic* benefits of fluoride by using *dietary supplements* in the form of fluoride tablets, drops, lozenges, and vitamin preparations. Some countries permit fluorides to be added to table salt. Elsewhere, ongoing research studies are being conducted to determine the anticariogenic effect of fluoride when placed in milk, and even sugar.

It is also possible to apply fluoride directly *to the surface* of the teeth by use of cotton pledgets, and/or by use of fluoride-containing dentifrices, gels, varnishes or mouth rinses. Such applications to the surface of the teeth are referred to as *topical applications*. The extent of caries control achieved through topical applications is directly related to the number of times the fluoride is applied and the length of time the fluoride is maintained in contact with the teeth. Research data also indicate that it is better to apply *lower* concentrations of fluoride to the teeth *more often* than to apply higher concentrations at longer intervals.

Neither the action of topically applied nor of systemic (ingested) fluoride in preventing dental caries is completely understood. It is believed that fluoride has several key actions: (1) it may enter the dental plaque and affect the bacteria by depressing their production of acid and thus reduce the possibility of demineralization of the teeth. fluoride may *accumulate in dental plaque in concentrations above 100 ppm*. (2) it facilitates the remineralization (repair) of teeth that have been demineralized by acid end-products. The latter is probably the most important of these three effects. The natural source of minerals such as calcium and phosphate, fluoride and others needed for this remineralization is the *saliva*; and (3) it reacts with the mineral elements on the surface of the tooth to make the enamel less soluble to the acid end-products of bacterial metabolism. Some of the applied fluoride readily penetrates the relatively permeable enamel surface to *depths of 20 to 30 millimeters* and readily reacts with the calcifying apatite to form a fluorhydroxyapatite. It is known the most efficient means of forming this reaction product occurs with *prolonged exposure* of the enamel to *low* concentrations of fluoride.

The continued deposition of fluoride into enamel during the later stages of enamel formation, and especially during the period of enamel maturation, results in a concentration gradient of fluoride in enamel. Invariably the *highest* concentration of fluoride occurs at the very outermost portion of the enamel surface, with the fluoride content *decreasing* as one progresses inward *toward the dentin*.