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Chapter 35

Mechanical Supragingival Plaque Control

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Importance of supragingival plaque removal

Dental plaque is a bacterial biofilm that is not easily removed from the surface of teeth. Biofilms consist of complex communities of bacterial species that reside on tooth surfaces or soft tissues. It has been estimated that between 400 and 1000 species may, at some time, colonize oral biofilms. In these microbial communities, there are observable associations between specific bacteria due in part to synergistic or antagonistic relationships and in part to the nature of the available surfaces for colonization or nutrient availability (Chapter 9). The products of biofilm bacteria are known to initiate a chain of reactions leading to host protection but also to tissue destruction (Chapter 11).

The dental biofilm is a complex configuration leading many to speculate that traditional plaque indices are inadequate because they fail to evaluate qualitative features. Furthermore, the term *plaque* is not precise. Plaque may be supragingival or subgingival and may be adherent or non-adherent to tooth or tissue. In addition the microbial composition of plaque varies from person to person and from site to site within the same mouth (Thomas 2004).

Supragingival plaque is exposed to saliva and to the natural self-cleansing mechanisms existing in the oral cavity. Friction through mastication may have a limiting effect on occlusal and incisal extensions of plaque. However, in most populations natural cleaning of the human dentition appears unimportant (Löe 2000). Therefore, in order to maintain oral health, regular personal plaque removal measures must be undertaken. The most widespread means of actively removing plaque at home is toothbrushing. There is substantial evidence which shows that plaque and gingivitis/periodontitis can be controlled most reliably through toothbrushing supported by other mechanical cleansing procedures. Thus, evidence stemming from large cohort studies demonstrated that high standards of oral hygiene will ensure the stability of periodontal tissue support (Hujoel *et al.* 1998; Axelsson *et al.* 2004).

As meaningful as oral hygiene measures are for disease prevention, they are relatively ineffective when used *alone* for treatment of moderate and severe forms of periodontitis (Loos *et al.* 1988; Lindhe *et al.* 1989). On the other hand, without an adequate level of oral hygiene in periodontitis-susceptible subjects, periodontal health tends to deteriorate once periodontitis is established and further loss of attachment may occur (Lindhe & Nyman 1984).

Meticulous, self-performed plaque removal measures can modify both the quantity and composition of subgingival plaque (Dahlén *et al.* 1992). The Socransky group (Haffajee 2001) confirmed this finding and reported that a permanent optimal supragingival plaque control regimen can alter the composition of the pocket microbiota and lower the percentage of periodontopathic bacteria.

At present both primary prevention of gingivitis and primary and secondary prevention of periodontitis are based on the achievement of sufficient plaque removal. Almost 50 years of experimental research, clinical trials in different geographical and social settings, have confirmed that effective removal of dental plaque is essential to dental and periodontal health (Löe 2000). The concept of the primary prevention of gingivitis derives from the assumption that gingivitis is the precursor of periodontitis and that maintenance of a healthy gingiva will prevent periodontitis.

Consequently, preventing gingivitis could have a major impact on expenditure for periodontal care (Baehni & Takeuchi 2003). Primary prevention of periodontal diseases includes educational interventions on periodontal diseases and related risk factors as well as regular self-performed plaque removal and professional mechanical removal of plaque and calculus. Optimal oral hygiene requires appropriate motivation of the patient, adequate tools, and professional oral hygiene instruction.

Self-performed plaque control

Personal oral hygiene refers to the effort of the patient to remove supragingival plaque. Procedures used to remove supragingival plaque are as old as recorded history. The earliest record of the chewstick which has been considered the primitive toothbrush dates back in the Chinese literature to about 1600 BC (Carranza & Shklar 2003). In his writings, Hippocrates (460–377 BC) included commentaries on the importance of removing deposits from the tooth surfaces. The observation that self-performed plaque removal is one of the foundations of periodontal health was clearly described by Antonie van Leeuwenhoek in 1683, who wrote (Carranza & Shklar 2003):

"Tis my wont of a morning to rub my teeth with salt and then swill my mouth out with water; and often, after eating, to clean my back teeth with a toothpick, as well as rubbing them hard with a cloth; wherefore my teeth, back and front, remain as clean and white as falleth to the lot of few men of my years, **and my gums never start bleeding**."

The Chinese are given credit for developing the first bristle toothbrush which was introduced in the Western world in the sixteenth century. Currently, toothbrushes of various kinds are important aids for mechanical plaque removal. Furthermore, a fluoridated dentifrice is an integral component of daily home care. The use of toothbrush and dentifrices is almost universal. The use of interdental cleaning devices, mouthrinses, and other oral hygiene aids is less well documented, but available evidence tends to suggest that only a small percentage of the population use such additional measures on a regular basis (Bakdash 1995).

There is an increasing public awareness of the value of good oral health practices. This fact is proven by a recorded increase in both public spending on oral hygiene products (over $3.2 billion a year in the US) and industry spending on consumer-related advertising (over $272 million a year in the US) (Bakdash 1995).

Brushing

Different cleaning devices have been used in different cultures (toothbrushes, chewing sticks, chewing sponges, etc.). Toothbrushing is currently the most commonly used measure in oral hygiene practice. Toothbrushing alone, however, does not provide adequate interdental cleaning since a toothbrush may only reach the facial, oral, and occlusal tooth surfaces. It was suggested (Frandsen 1986) that the outcome of toothbrushing is dependent on: (1) the design of the brush, (2) the skill of the individual using the brush, and (3) the frequency and (4) duration of brushing.

Dental professionals must become familiar with the variety in shapes, sizes, textures, and other characteristics of available toothbrushes in order to provide their patients with proper advice. From the numerous products present on the market only a few should be selected for the individual patient. It is important that the dental care provider understands the advantages and disadvantages of the various toothbrushes (and other aids) to provide the patient with proper information during the oral hygiene instruction session.

For the most part, studies that have compared the effectiveness of different manual brushes have found relatively little difference among designs (see below). It is quite possible that a given patient may obtain better results with one particular toothbrush than with another. Providing oral hygiene information should therefore be tailored to the individual.

Motivation

Oral hygiene education is essential in primary prevention of gingivitis. Improvement in a patient's oral hygiene is often accomplished through cooperative interaction between the patient and the dental professional. The role of the patient is to seek education regarding efficient self-performed plaque removal and accept regular check-ups to ensure a high level of oral hygiene. The patient must be interested in maintaining the health of the tissues, interested in a proposed treatment plan, and motivated to participate. Without compliance, which has been described as the degree to which a patient follows a regimen prescribed by a dental professional, a good treatment outcome will not be achieved. In this context it should be realized that compliance with treatment recommendations is generally poor, particularly in patients with chronic diseases in which the risk of complications is not immediate or life threatening. Also compliance with oral hygiene recommendations is generally poor (Thomas 2004).

So, however effective any toothbrushing method is, it will only be of any real value if the patient is prepared to use the technique on a regular basis (Warren & Chater 1996a). Merely the patient's positive attitude to treatment may have a positive long-term effect on her/his tooth cleaning efforts. Thus, well motivated patients who are compliant with professional advice and instruction are likely to achieve and sustain ideal levels of plaque control.

There is an increasing public awareness of the value of personal oral hygiene. Good oral hygiene should form an integral part of overall health practices, such as regular exercise, stress management, diet and weight control, smoking cessation, and moderation in alcohol consumption. If the clinician can establish the link between oral health and general health for the patient, this individual may be more willing to establish proper oral hygiene measures as part of her/his lifestyle.

The issue of changing a patient's lifestyle is the more difficult part of motivational sessions (Chapter 34). The principles of brushing and flossing are easy to learn. Integrating them into one's daily routine is far more difficult. This can form a source of frustration for the clinician who has provided a patient with information about the necessity of personal oral hygiene measures.

Toothbrush (see Procedure 1)

It is believed that the first toothbrush made of hog's bristles was mentioned in the early Chinese literature. In 1698 Cornelis van Solingen, a doctor from The Hague, published a book in which he presented the first illustration of a toothbrush in Europe (Fig. 35-1). Nylon filaments were introduced in 1938 since complications of World War II prevented the Chinese export of wild boar bristles. Nearly all current toothbrushes are made exclusively of synthetic materials (Wilkins, 1999). Such nylon filaments and plastic handle are easy to manufacture, and therefore more affordable. This has made toothbrushing a common practice in most societies.

During toothbrushing the removal of dental plaque is achieved primarily through direct contact between the filaments of the toothbrush and the surfaces of teeth and soft tissues. At the European Workshop on Mechanical Plaque Control, it was agreed that the features of an ideal manual toothbrush should include (Egelberg & Claffey 1998):

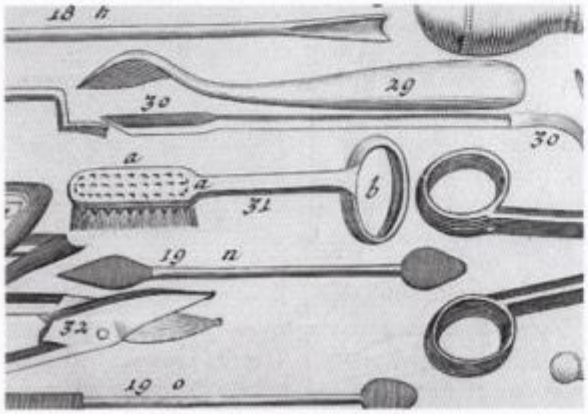


Fig. 35-1 Illustration of a toothbrush and tongue scraper from the book of Cornelis van Solingen with special thanks to the University Museum of Dentistry in Utrecht, The Netherlands.

1. Handle size appropriate to user age and dexterity so that the brush can easily and efficiently be manipulated
2. Head size appropriate to the size of the individual patient's requirements
3. Use of end-rounded nylon or polyester filaments not larger than 0.23 mm (0.009 inches) in diameter
4. Use of soft filament configurations as defined by the acceptable international industry standards (ISO)
5. Filament patterns which enhance plaque removal in the approximal spaces and along the gum line.

Additional characteristics could be: inexpensive, durable, impervious to moisture, and easily cleaned.

Modern toothbrushes have filament patterns designed to enhance plaque removal from hard-to-reach areas of the dentition, in particular from proximal areas. Cross-placed filaments, crimped, and tapered filaments are the most recent improvements. Such designs are based on the premise that the majority of subjects in any population use a simple horizontal brushing action. In order to improve patient comfort brush head shape, filament shape, and placement of filaments into the handles also have been subject to change over time. Multiple tufts of filaments, sometimes angled in different directions, are currently used (Jepsen 1998). Thus, when the head of the toothbrush is located horizontal to the tooth surface, there are filaments angled in the direction of the approximal tooth surfaces. Toothbrushes with this design facilitate more plaque removal in such difficult-to-reach areas when compared with flat-headed brushes (Cugini & Warren 2006).

Double- and triple-headed toothbrushes have been proposed in order to reach lingual surfaces more easily, especially in molar areas, which are normally the tooth surfaces hardest to reach with a regular toothbrush. Although some studies have indicated that the use of such multi-headed toothbrushes may improve plaque control in lingual areas (Agerholm 1991; Yankell *et al.* 1996), their use is not widespread.

Where handles used to be straight and flat, nowadays round and curved handles are more common. Today, a modern toothbrush has a handle size that is appropriate to the hand size of the prospective user, and much emphasis has been placed on new ergonomic designs (Löe 2002). Several studies have investigated differences in plaque removal between brushes with different handle design. In such studies brushes with long and contoured handles appeared to remove more plaque than brushes with traditional handles (Saxer & Yankell 1997).

When brushes with hard, soft, multi-tufted, and space-tufted filaments were compared, no significant clinical differences were found with respect to plaque removal. It is worth considering that most of such

toothbrush studies involved highly motivated participants such as dental students, who do not represent the general population. Most studies on manual brushes are 'single-use' tests. Although such short-term trials may be useful as pilot experiments, they need to be supplemented with studies of longer duration. Numerous manual toothbrushes are available on the market. There is still, however, insufficient evidence that one specific toothbrush design is superior to another. In 1994, two well performed clinical trials which assessed the efficacy of two toothbrushes came to entirely different conclusions (Grossman *et al.* 1994; Sharma *et al.* 1994). In the one trial toothbrush A was more effective than brush B while in the other trial brush B was superior to brush A. The trial which proved that brush A was most effective was sponsored by the manufacturer of brush A. The finances of the other trial which proved that brush B was more effective came from the manufacturer of brush B. As with many other aspects of oral hygiene aids, there is insufficient information to make evidence-based recommendations. Thus, in absence of this evidence, the best toothbrush continues to be the one that is (properly) used by the patient (Cancro & Fischman 1995; Jepsen 1998).

Efficacy of toothbrushing

The enthusiastic use of the toothbrush is not synonymous with a high standard of oral hygiene. Adults, despite their apparent efforts, appear not to be as effective in their plaque removal as might be expected. Most individuals only remove about 50% of plaque by toothbrushing (Jepsen 1998). De la Rosa and coworkers (1979) studied the pattern of plaque accumulation and removal with daily toothbrushing during a 28-day period following a dental prophylaxis. On average about 60% of the plaque was left after the self-performed brushing. Morris *et al.* (2001) reported on the 1998 UK Adult Dental Health survey and observed that the mean proportion of teeth with plaque deposits was 30% in the 25–34-year age group and 44% in those aged 65 years and above. At the Academic Centre for Dentistry Amsterdam (ACTA) a study was conducted which assessed the efficacy of a single 1-minute brushing exercise in subjects adhering to their customary brushing method (Van der Weijden *et al.* 1998a). It was observed that after 1 minute of brushing, approximately 39% of the plaque had been removed. The results of the studies described above indicate that most subjects are not effective brushers and that they probably live with large amounts of plaque on their teeth, even though they brush once every day.

Methods of toothbrushing

There is no single oral hygiene method that is correct for all patients. The morphology of the dentition (crowding, spacing, gingival phenotype etc.), the type and severity of the periodontal tissue destruction, as well as the patient's own manual dexterity determine what kind of hygiene aids and cleaning techniques are to be recommended. It should also be realized that during the course of periodontitis therapy, the techniques may have to be changed or adapted to the morphologic situation (longer teeth, open interdental spaces, exposed dentin).

The ideal brushing technique is the one that allows complete plaque removal in the least possible time, without causing any damage to the tissues (Hansen & Gjermo 1971). Different toothbrushing methods have been recommended over time, but also been abandoned. Such methods can be classified based on the position and motion of the brush.

Horizontal brushing is probably the most commonly used toothbrushing method. It is most frequently used by individuals who never had instruction in oral hygiene techniques. Despite the efforts of the dental profession to instruct patients to adopt other more efficient brushing techniques, most individuals use horizontal brushing since it is simple. The head of the brush is positioned perpendicular to the tooth surface and then a horizontal back and forth movement is applied. The occlusal, lingual, and palatal surfaces of the teeth are brushed with open mouth. In order to reduce pressure of the cheek on the brush head the vestibular surfaces are cleaned with the mouth closed.

Vertical brushing (Leonard (1939) technique) is similar to the horizontal brushing technique, but the movement is applied in vertical direction using up and down strokes.

Circular brushing (Fones (1934) method): with the teeth closed the brush is placed inside the cheek and a fast circular motion is applied that extends from the maxillary gingiva to the mandibular gingiva using light pressure. Back and forth strokes are used on the lingual and palatal tooth surfaces. The *scrubbing method* includes a combination of horizontal, vertical, and circular strokes.

Sulcular brushing (Bass (1948) technique): this method emphasizes cleaning of the area directly beneath the gingival margin. The head of the brush is positioned in an oblique direction towards the apex. Filament tips are directed into the sulcus at approximately 45° to the long axis of the tooth. The brush is moved in a back and forth direction using short strokes without disengaging the tips of the filaments from the sulci. On the lingual surfaces in the anterior tooth regions the brush head is kept in the vertical direction. The Bass technique is widely accepted as an effective method for removing plaque not only at the gingival margin, but also subgingivally. A few studies have been carried out on teeth affected with periodontal disease and scheduled for extraction, where the gingival margin was marked with a groove and the depth of subgingival cleaning was measured. These studies showed that with the use of this brushing method the plaque removal could reach a depth of approximately 1 mm subgingivally (Waerhaug 1981a).

Vibratory technique (Stillman (1932) method): as originally described by Stillman the method was designed for massage and stimulation of the gingiva as well as for cleaning the cervical areas of the teeth. The head of the brush is positioned in an oblique direction toward the apex, with the filaments placed partly in the gingival margin and partly on the tooth surface. Light pressure together with a vibratory (slight rotary) movement is then applied to the handle, while the filament tips are maintained in position on the tooth surface.

Vibratory technique (Charters (1948) method): this method was originally developed to increase cleansing effectiveness and gingival stimulation in the interproximal areas. It uses a reverse position of the brushhead as compared to the Stillman technique. The head of the brush is positioned in an oblique direction with the filament tips directed towards the occlusal or incisal surfaces. Light pressure is used to flex the filaments and gently force the tips into the interproximal embrassures. A vibratory (slight rotary) movement is then applied to the handle while the filament tips are maintained in position on the tooth surface. This method is particularly effective in cases with receded interdental papillae because the filament tips can easily penetrate the interdental space (Fig. 35-2).

Roll technique: the head of the brush is positioned in an oblique direction toward the apex of the teeth, with the filaments placed partly in the gingival margin and partly on the tooth surface. The sides of the filaments are pressed lightly against the gingiva. Next the head of the brush is rolled over the gingiva and tooth in occlusal direction.

Modified Bass/Stillman technique: the Bass and Stillman methods were designed to concentrate on the cervical portion of the teeth and adjacent gingival tissues. Each of these methods can be modified to add a roll stroke. The brush is positioned similarly to the Bass/Stillman technique. After activation of the brushhead in a back and forth direction, the head of the brush is rolled over the gingiva and tooth in occlusal direction making it possible for some of the filaments to reach interdentally.

In the 1970s several investigators compared various methods of brushing. Because of varying experimental conditions the outcomes of such studies are difficult to compare. To date no methods of toothbrushing have been shown to be clearly superior to others. As early as 1986, Frandsen commented on this issue by stating: "Researchers have realized that improvement in oral hygiene is not as dependent upon the development of better brushing methods as upon improved performance by the persons using any one of the accepted methods." Therefore, since no particular toothbrushing method has been found to be clearly superior to another, there is no reason to introduce a specific toothbrushing technique in each new periodontal patient. In most cases, small changes in the patient's own method of toothbrushing will suffice, always bearing in mind that more important than the selection of a certain method of

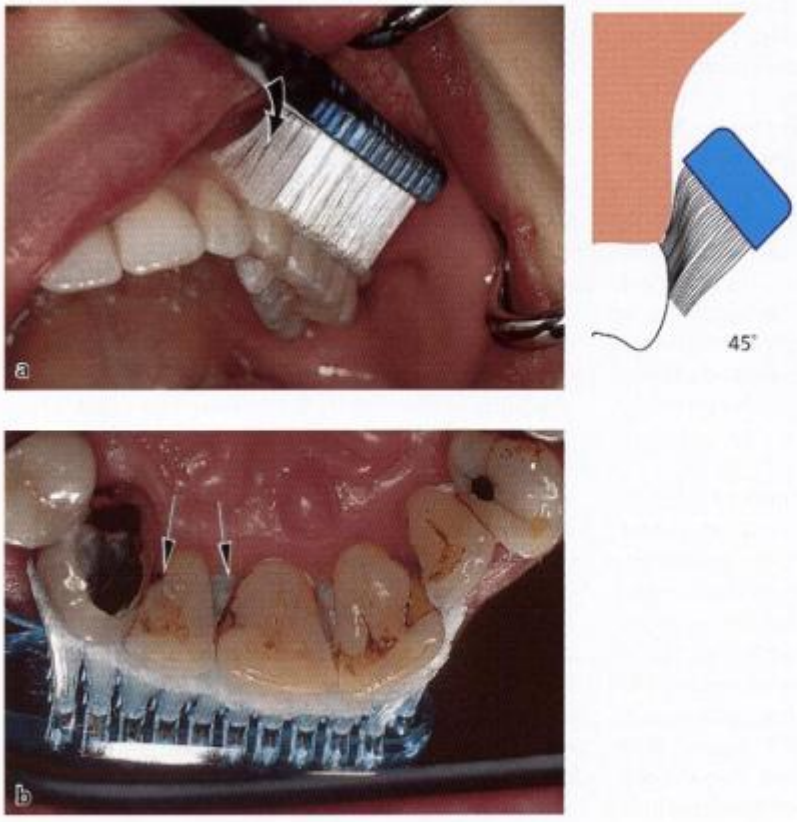


Fig. 35-2 (a) The Charters method of toothbrushing. The head of the toothbrush is placed in the left maxilla. Note the angulation of the bristles against the buccal tooth surfaces. The bristles are forced into the interproximal areas. (b) The palatal aspect of the incisor region in the maxilla illustrating the penetration of the bristles through the interproximal spaces (arrows).

toothbrushing is the willingness and thoroughness on the part of the patients to effectively clean their teeth. Implementation of the toothbrushing methods described above must be made according to patient's needs. For example, since the Bass method has been associated with gingival recession (O'Leary 1980), it would be hardly indicated in individuals with energetic toothbrushing habits who have a thin gingival biotype.

Frequency of toothbrushing

There is no consensus as to the optimum frequency of toothbrushing. How often and how much plaque has to be removed in order to prevent dental disease from developing is not known. The majority of individuals, including periodontal patients, are usually not able to remove dental plaque completely as a result of daily brushing. However complete plaque removal does not seem to be necessary. A proper level of oral hygiene theoretically is the extent of plaque removal that prevents gingivitis/periodontal disease and tooth decay in the individual patient. Prevention of gingival inflammation is important because the inflammatory condition of soft tissues also favors plaque accumulation (Ramberg *et al.* 1994; Rowshani *et al.* 2004).

Results in cross-sectional studies have been equivocal when the self-reported frequency of tooth cleaning has been related to caries and periodontal disease. Disease appears to be more related to quality of cleaning than to its frequency (Bjertness 1991). Kressin and co-workers (2003) evaluated the effect of oral hygiene practices on tooth retention in a longitudinal study with a 26-year follow-up. They observed that consistent brushing (at least once a day) resulted in a 49% reduction of the risk of tooth loss compared to a lack of consistent oral hygiene habits.

If plaque is allowed to accumulate freely in the dentogingival region, subclinical signs of gingival inflammation (gingival fluid) appear within 4 days (Egelberg 1964). The minimum frequency of tooth cleaning to reverse experimentally induced gingivitis is once every day or every second day. Bosman and Powell (1977) induced experimental gingivitis in a group of students. The signs of gingival inflammation persisted in those students who removed plaque only every third or fifth day. In groups who properly cleaned their teeth once a day or every second day, the gingivae healed within 7–10 days.

Based on the observation that the onset of gingivitis appears to be more related to the maturation and age of the plaque than to its amount, the minimum frequency needed to prevent the development of gingivitis has been investigated in a prospective study. Dental students and young dental faculty members with healthy periodontal conditions were assigned to study groups with different cleaning frequencies over periods of 4–6 weeks. The results showed that that students who thoroughly removed plaque once daily or even every second day, did not develop clinical signs of gingival inflammation over a 6-week period. This tooth cleaning included the use of interproximal aids (dental floss and woodsticks) as well as the toothbrush (Lang *et al.* 1973). Caution should be excercised in extrapolating the results obtained from studies including dentally aware subjects to the average patient.

From a practical standpoint, it is generally recommended that patients brush their teeth at least twice daily, not only to remove plaque but also to apply fluoride through the use of dentifrice in order to prevent caries. This advice is also conceivable based on reasons of practibility and feeling of oral freshness. For most patients, it may be desirable to perform all necessary procedures (e.g. brushing and interdental cleaning) at the same time and in the same manner each day. Unfortunately, with subjects who live busy, stressful lives, this may be difficult to achive (Thomas 2004). Despite the fact that most individuals claim to brush their teeth at least twice a day, it is clear from both epidemiologic and clinical studies that mechanical oral hygiene procedures as performed by most subjects are insufficient to control supragingival plaque formation and to prevent gingivitis and more severe forms of periodontal disease (Sheiham & Netuveli 2002).

Brushing duration

Patients usually believe that they spend more time on toothbrushing than they actually do (Saxer *et al.* 1998). The least time spent on brushing was observed in a study carried out on English schoolchildren; in the 13 years age group, the children spent approximately 33 seconds on brushing (Macgregor & Rugg-Gunn 1985). About one third of the studies that were reviewed reported an average brushing time of less than 56 seconds whereas two thirds of the studies reported a brushing time of ≥56 seconds and <70 seconds. One investigation which used dental students as study population reported an average of 90 seconds (Ayer *et al.* 1965). The best estimate of actual manual brushing time seems to range between 30 and 60 seconds (Van der Weijden *et al.* 1993).

In reviewing the literature for studies that addressed the question whether in adult patients the duration of toothbrushing is correlated with efficacy of plaque removal five studies were identified. Three of these evaluated the use of electric toothbrushes (Van der Weijden *et al.* 1996a; McCracken *et al.* 2003, 2005). One study compared a manual toothbrush with an electric toothbrush (Preber *et al.* 1991), while one study included only manual toothbrushes (Hawkins *et al.* 1986). Results from all five studies indicate that duration of brushing is consistently correlated with the amount of plaque that is removed. In one study, toothbrushing was delivered by a dentist/dental hygienist. This study compared the effect of brushing time on plaque removal using manual and electric toothbrushes utilizing five different brushing times (30, 60, 120, 180, and 360 seconds).

This study showed that 2 minutes of electric toothbrushing can be as effective as 6 minutes of manual toothbrushing. The authors furthermore observed that at 2 minutes an optimum in plaque-removing efficacy was reached with both a manual and electric toothbrushes (Van der Weijden *et al.* 1993). Based on these observations the duration of toothbrushing should also be stressed during the toothbrushing instruction session.

Brushing filaments

Most current toothbrushes have nylon filaments. The degree of hardness and stiffness of a toothbrush depends on the filament characteristics, such as material, diameter, and length. Also the density of filaments in a tuft influences stiffness, since each filament gives support to the adjacent fiaments and each tuft gives support to adjacent tufts. Toothbrushes with thinner filaments are softer while thicker filament diameters are stiffer and less flexible. This increased stiffness will prevent the filament ends from bending back during brushing, avoiding the potential risk of damaging the gums. However, the filament must be sufficiently stiff so that during brushing enough pressure is exerted to allow proper plaque removal. Consider that a rod represents a filament of a toothbrush. Whilst brushing, a vertical upward load is exerted, which in turn exerts an effect of the same order of magnitude on the oral mucosa. The force of the brush, acting on the individual filament, is thus always as great as the load exercised by the filament on the mucosa. If the load is increased then the load on the mucosa increases to the same extent. Consequently the risk of soft tissue damage increases in that the filament's tip can penetrate into the mucosa. However, elastic rods demonstrate a peculiarity in their behavior. They suddenly fold back laterally when a certain limit load is reached. When folding back, the rod suddenly gives way elastically (without breaking) and the load on the oral mucosa diminishes abruptly. A load higher than this fold-back limit can thus not be transferred to the mucosa by the rod, via its tip. Tapered filaments (Fig. 35-3) have endings with the shape of an extreme rotational ellipsoid instead of a hemisphere. This is suggested to give the filaments very soft endings combined with a good stability of the filament corpus. Curved filaments may be more flexible and less stiff than straight filaments of equal length and diameter.

As late as 1967, most people were buying hard brushes (Fanning & Henning 1967). The shift in preference to soft brushes of specific design paralleled the change that occurred in oral health care when calculus was the prime etiologic agent in periodontal disease (Mandell 1990). The concentration on plaque, especially in the crevicular area and the attention to intrasulcular brushing strongly influenced the change from hard to soft filaments, primarily because of the concern of trauma to the gingival tissues (Niemi *et al.* 1984). The cleaning performance of a toothbrush is influenced by its degree of hardness. The toothbrush must not be too hard, to avoid damaging the gums when positioning the toothbrush. The harder the toothbrush filaments are the greater is risk of gingival abrasion (Khocht *et al.* 1993). But there is no point in using a brush with very thin filaments that merely strokes across the tooth and, as a result of the lack of load, no longer cleans the tooth surface.

Filament end-rounding

The end of a toothbrush filament can be cut bluntly or rounded. End-rounding has become increasingly common in the manufacturing process to reduce gingival abrasion (Fig. 35-4). The logic that smooth filament tips would cause less trauma than filament tips with sharp edges or jagged projections has been validated with both animal and clinical studies (Breitenmoser *et al.* 1979). Danser *et al.* (1998) evaluated two types of end-rounding, and saw an effect of end-rounding on the incidence of abrasion. The form to which the ends were rounded, however, had no effect on the level of plaque removal.

Toothbrush wear and replacement

It is generally recommended that toothbrushes be replaced before the first signs of the filaments

Fig. 35-3 Tapered toothbrush filaments.

Fig. 35-4 Filament end-rounding.

becoming worn. The useful life of an average toothbrush has been estimated to be 2–3 months. Not all patients take this advice, and evidence indicates that the average age at which a toothbrush is replaced ranges from 2.5–6 months (Bergström 1973). Common sense would suggest that a worn toothbrush with splayed or frayed filaments loses resilience and is less likely to be as effective in removing plaque than a new brush. This is why dental professionals often recommend that toothbrushes are used for a maximum of 3 months before they are they are replaced. Whilst this advice would seem reasonable, there is little actual clinical proof that this recommendation is correct. Because of variability in subjects' brushing techniques and the force applied to the teeth whilst brushing, the degree of wear varies significantly from subject to subject. It is also likely that different brushes, made from various materials, would exhibit differences in longevity. Some commercially available brushes have filaments that change color after a certain amount of use. This serves as a reminder to the patients that it is time to replace the brush.

Kreifeldt and co-workers (1980) showed that new brushes were more efficient in removing dental plaque than old brushes. They examined worn toothbrushes and observed that, as a result of wear, the filaments showed a taper, proceeding from the insertion to the free end. For example filaments were seen which tapered from 0.28 mm at one end to 0.020–0.015 mm at the free end. They concluded that among other wear factors, tapering contributed the most to loss of effectiveness. Their explanation for this observation was that as the tapering will result in a reduction of filament diameter, the brush will become softer and remove less plaque.

Since many patients use a brush for periods significantly longer than the recommended time of 3 months, it is important to know whether excessive wear is of clinical relevance. Several studies have examined this question but there is inconclusive evidence about the relationship between toothbrush wear and plaque removal. Studies with laboratory-worn toothbrushes reported that such used toothbrushes had inferior plaque removal efficacy as compared to new brushes (Kreifeldt *et al.* 1980; Warren *et al.* 2002). However, artificially worn toothbrushes may not mimic the characteristics of a naturally worn brush. In a laboratory study of the wear of toothbrushes, wear will inevitably be highly uniform and not reflect the variation in wear seen in normal toothbrush use. Most studies in which naturally worn toothbrushes were used reported no statistically significant decrease in reduction of whole-mouth plaque scores after brushing when compared to using new toothbrushes (Daly *et al.* 1996; Sforza *et al.* 2000; Tan & Daly 2002; Conforti *et al.* 2003; Van Palenstein Helderman *et al.* 2006). From this brief review of the literature it may be concluded that in contrast to what is generally thought, the wear status of a toothbrush might be less critical for maintaining good plaque control.

Electric toothbrushes (see Procedure 2)

In well motivated and properly instructed individuals who are willing to invest the necessary time and effort, mechanical measures, using traditional toothbrushes and adjunctive manual (interdental) devices, are effective in removing plaque. Maintaining a dentition close to plaque-free is, however, not easy. The electric toothbrush represents an advance that has the potential to both enhance plaque removal and patient motivation. Electric toothbrushes were introduced to the market more than 50 years ago. The first toothbrush powered by electricity was developed by Bemann & Woog in Switzerland and was introduced in the United States in 1960 as the Broxodent. In 1961 a cordless rechargeable model was introduced by General Electric (Darby & Walsh 2003). Studies of the use of these early electric tootbrushes showed that there was no difference in plaque removal when compared with a manual toothbrush and they had mixed effects on gingivitis. The consensus of the research reports on toothbrushing of the World Workshop in Periodontics in 1966 states: "*in non-dentally oriented persons, in persons not high motivated to oral health care, or in those who have difficulty in mastering suitable hand brushing technique the use of an electric brush with its standard movements may result in more frequent and better cleansing of the teeth*".

Since the 1980s, tremendous advances have been made in the technology of electrically powered toothbrushes. Various electric toothbrushes have been developed to improve the efficiency of plaque removal using increased filament velocity, brush stroke frequency, and various filament patterns and motions. Where old electric toothbrushes were using a combination of horizontal and vertical movements mimicking closely the back-and-forth motion of the traditional brushing methods, the more recent designs apply rotary motion or oscillating/rotating motion with pulsation, or have brush heads which move at high frequencies.

After reviewing many of the published reports over the past decades, it may be concluded that certain newer types of rechargeable electric toothbrushes have become more effective in removing supragingival plaque and controlling gingivitis. It is also clear that the effectiveness of particularly the low-cost battery-operated brushes are not well documented. To some extent, power brushes have overcome the limitations of the manual dexterity and skill of the user. Modern design features appear to be responsible for this (Fig. 35-5). These newer designed toothbrushes remove plaque in a shorter time than a standard manual brush (Van der Weijden *et al.* 1993, 1996a). The new generation of electric brushes have better plaque removal efficacy and gingival inflammation control in the approximal tooth surfaces

Fig. 35-5 Overview of the development of electric toothbrushes from brushes mimicking a manual toothbrush to high-frequency brushhead movement. From left to right: the Braun D3®, Rotadent®, Interplak®, Braun/Oral-B Triumph®, Sonicare Elite®.

(Egelberg & Claffey 1998). This superiority was clearly demonstrated in a study carried out on extracted teeth (Rapley & Killoy 1994). The electric toothbrush should not be considered a substitute for a specific interdental cleaning method, such as flossing, but it may offer advantages in terms of an overall approach to improved oral hygiene.

Two independent systematic reviews confirmed that oscillating rotating toothbrushes have superior efficacy over manual toothbrushes in reducing plaque and gingivitis (Sicilia *et al.* 2002; Robinson *et al.* 2005). Toothbrushes with this mode of action reduced plaque by 7% and gingival bleeding by 17% when compared with manual brushes (Robinson *et al.* 2005).

One electric toothbrush that has consistently been shown to be more effective than a manual toothbrush, both with respect to plaque removal and improvement of the gingival condition, is the original Braun Oral-B Plaque Remover (D7) (Warren & Chater 1996b). This toothbrush features a small round brush head that makes rotating and oscillating movements at a speed of 2800 oscillating rotations per minute. A further development of this brush, the Braun Oral-B Ultra Plaque Remover (D9) maintained the oscillating rotating action but at an increased speed (3600 rotations per minute). A clinical study with the D9 demonstrated equivalence in safety and a trend towards greater plaque removal when compared with the D7 (Van der Weijden *et al.* 1996b). Newer developments in the oscillating rotating brush technology add the additional high-frequency vibrations in the direction of the bristles creating three-dimensional movements during brushing. This modification was developed to enhance penetration and removal of plaque from approximal spaces of the dentition. Studies have shown the three-dimensional movements carried out by the brush are safe to use and more efficient regarding plaque removal (Danser *et al.* 1998).

Another approach in this technology was the development of sonic toothbrushes that have a high frequency of filament movement in excess of approximately 30 000 strokes per minute. Two recently introduced sonic toothbrushes are the Oral-B Sonic Complete® (SC; Oral-B Laboratories, Boston, MA, USA) rechargeable toothbrush with a side-to-side filament operating at 260 Hz, and the Philips Sonicare® Elite (SE; Philips Oral Healthcare, Snoqualmie, WA, US) based on a different technology, with a side-to-side motion also operating at a frequency of 260 Hz. Some clinical studies have shown sonic technology to be comparable or more effective than a manual toothbrush in removing plaque and reducing gingival inflammation (Johnson & McInnes 1994; Tritten & Armitage 1996; Zimmer *et al.* 2000; Moritis *et al.* 2002). Two studies using the same experimental gingivitis model compared an earlier Sonicare device and the Oral-B oscillating rotating toothbrush. In both studies the oscillating rotating brush was more effective in improving the level of gingival health (Putt *et al.* 2001; Van der Weijden *et al.* 2002a,b). This confirmed the findings of an earlier 6-week crossover study (Isaacs *et al.* 1998) where improvement in gingival condition was 8.6% greater with the oscillating rotating brush. Rosema and co-workers (2005) compared the Sonicare Elite to the Oral-B Professional Care 7000 and again found the oscillating rotating pulsation brush to be more effective. On the other hand, Tritten & Armitage (1996) compared the Sonicare advance to a traditional manual toothbrush in a 12-week parallel group study and concluded that both brushes were equally effective in reducing gingival inflammation.

Modern power toothbrushes are known to enhance long-term compliance. In a study involving periodontitis patients with persistent poor compliance, Hellstadius and co-workers (1993) found that switching from a manual to a power toothbrush reduced plaque levels and that the reduced levels were maintained over a period of between 12 and 36 months. The power brush significantly improved compliance, and patients expressed a positive attitude to the new brush. In a survey carried out in Germany most dentists stated that the time their patients spent on toothbrushing was too small (Warren 1998). Approximately half of the dentists stated that they recommend their patients to use a power toothbrush, and the vast majority of the dentists believed that changing to a power toothbrush would improve the condition of their patients' teeth and gums. Findings from a recent US practice-based study, involving a large number of subjects who switched from a manual toothbrush to the Braun Oral-B Ultra Plaque Remover (D9), confirmed the findings from the German study (Warren *et al.* 2000).

Electrically active (ionic) toothbrush

Several toothbrushes have been marketed over the years, which are designed to send a small

imperceptible electronic current through the brush head, presumedly to enhance the efficacy of the brush in plaque elimination. The electrons should reduce the H^+ ions from the organic acid in the plaque which may result in a decomposition of the bacterial plaque (Hoover *et al.* 1992). The first record of a charged toothbrush, the "Dr. Scott's Electric Toothbrush" was found in the February 1886 issue of Harper's weekly magazine. The handle of Dr. Scott's toothbrush was purportedly "charged with an electromagnetic current which acts without any shock, immediately upon the nerves and tissues of the teeth and gums . . . arresting decay . . . and restoring the natural whiteness of the enamel."

Short-term clinical studies with the use of these kinds of brushes documented a beneficial effect in terms of plaque reduction and gingivitis resolution (Hoover *et al.* 1992; Weiger 1998). Hotta and Aono (1992) studied an electrically active manual toothbrush that was designed with a piezo-electric element in the handle. This brush generates a voltage potential corresponding to the bending motion of the handle as the teeth are brushed. In this study no difference in the amount of remaining plaque after brushing was observed between the placebo and the electrically active brush. Other toothbrushes, which have a claimed 'electrochemical' effect on dental plaque, have a semiconductor of TiO_2 incorporated in the brush handle. In the presence of light, saturated low energy electrons in the wet semiconductor are transformed into high-energy electrons. An electron current of approximately 10 nA was measured to run from the semiconductor to the tooth (Weiger 1988).

Interdental cleaning

There is confusion in the literature with respect to the definitions of approximal, interproximal, interdental, and proximal sites. Commonly used indices are not suitable for assessing interdental plaque (directly under the contact area), and thereby limit interpretation of interdental plaque removal. The European Workshop on Mechanical Plaque Control in 1999 proposed the following definitions: *approximal* (proximal) areas are the visible spaces between teeth that are not under the contact area. In health these areas are small, although they may increase after periodontal attachment loss. The terms *interproximal* and *interdental* may be used interchangeably and refer to the area under and related to the contact point.

As stated above, the toothbrush does not reach the approximal surfaces of teeth as efficiently as it does for the facial, lingual, and ooclusal aspects nor does it reach into the interproximal area between adjacent teeth. Therefore measures for interdental plaque control should be selected to complement plaque control by toothbrushing (Lang *et al.* 1977; Hugoson & Koch 1979).

The interdental gingiva fills the embrasure between two teeth apical to their contact point. This is a 'sheltered' area, difficult to access, when teeth are in normal position. In populations that use a toothbrush, the interproximal surfaces of the molars and premolars are the predominant sites of residual plaque. The removal of plaque from these surfaces remains a valid objective, since in patients susceptible to periodontal diseases, gingivitis and periodontitis are usually more pronounced in this interdental area than on oral or facial aspects (Löe 1979). Dental caries also occurs more frequently in the interdental region than on oral or facial smooth surfaces. A fundamental principle of prevention is that the effect is greatest where the risk of disease is greatest. Therefore, interdental plaque removal, which cannot be achieved with the toothbrush, is of critical importance for most patients. A number of interdental cleaning methods have been developed, ranging from floss to the more recently introduced electrically powered cleaning aids. Flossing is the most universally applicable method, since it may be used effectively in nearly all clinical situations. However, not all interdental cleaning devices suit all patients or all types of dentitions. Factors such as the contour and consistency of gingival tissues, the size of the interproximal embrasure, tooth position and alignment, and the ability and motivation of the patient should be taken into consideration when recommending an interdental cleaning method. The most appropriate interdental hygiene aids must be selected for each individual patient. The selection made from the numerous commercially available devices is dependent for the most part on the size and shape of the interdental space as well as on the morphology of the proximal tooth surface. In subjects with normal gingival contours and embrasures, dental floss or tape should be recommended. At sites where soft tissue recession has become pronounced, flossing becomes progressively less effective. Then an alternative method (either woodsticks or interdental brushes) should be recommended. A review on interdental cleaning methods (Warren & Chater 1996a) concluded that all conventional devices are effective, but each method should be suited to a particular patient but also to a particular situation in the mouth (Table 35-1).

The use of dental floss, interproximal brushes, and woodsticks may also induce soft tissue damage. In most cases, however, this damage is limited to acute lesions, such as lacerations and gingival erosions (Gillette & Van House 1980). Gingival bleeding during interdental cleaning can be a result of trauma or an indication of inflammation. Patients must be aware that bleeding *per se* is not a sign that interdental cleaning should be avoided but more likely an indicator of inflammation that needs to be treated.

Dental floss and tape (see Procedure 3)

Of all the methods used for removing interproximal plaque, dental flossing is the most frequently recom-

Table 35-1 Interdental cleaning methods recommended for particular situations in the mouth

Situation	Interdental cleaning method
Intact interdental papillae; narrow interdental space	Dental floss or small woodstick
Moderate papillary recession; slightly open interdental space	Dental floss, woodstick or small interdental brush
Complete loss of papilla; wide open interdental space	Interdental brush
Wide embrassure space; diastema, extraction diastema, furcation or posterior surface of most distal molar, root concavities or grooves	Single-tufted/end-tufted brush or gauze strip

mended technique. Levi Spear Parmly, a dentist based in New Orleans, is credited as being the inventor of modern dental floss. As early as 1815 Parmly recommended teeth flossing with a piece of silk thread. Clinical studies clearly show that, when toothbrushing is used together with flossing, more plaque is removed from the proximal surfaces than by toothbrushing alone (Reitman *et al.* 1980; Kinane *et al.* 1992). Dental floss and tape – a type of broader dental floss – are most useful where the interdental papillae completely fill the embrasure space. When properly used, flossing effectively removes up to 80% of proximal plaque. Even subgingival plaque can be removed, since dental floss can be introduced 2–3.5 mm below the tip of the papilla (Waerhaug 1981b). Several types of floss (waxed, unwaxed) are available. Studies have shown no difference in the effectiveness of unwaxed versus waxed dental floss. Unwaxed dental floss is generally recommended for patients with normal tooth contacts because it slides through the contact area easily. It is the thinnest type of floss available, yet when it separates during use it covers a larger surface area of the tooth than waxed floss. Waxed floss is recommended for patients with tight proximal tooth contacts. *Ease of use* is the most important factor that influences whether patients will use floss on a daily basis. Recently, powered flossing devices have been introduced. In comparison with manual flossing no differences have been found in terms of plaque removal and gingivitis reduction, although patients preferred flossing with the automated device (Gordon *et al.* 1996).

Frequent reinstruction and reinforcement in the use of floss are necessary because flossing is a difficult skill to master. Flossing is also time-consuming. When a patient is unwilling to use dental floss alternative interdental hygiene aids should be recommended even if these are less efficient. If a patient finds a particular method or device more appealing to use, long-term compliance becomes an achievable goal. Although it is clear that flossing, when properly used, removes plaque in a very efficient manner, there is no evidence that flossing in adult patients with preserved interproximal periodontal tissues should be routinely indicated (Burt & Eklund 1999).

To facilitate flossing a special floss holder may be used. The holder may be re-used and is normally made of plastic material, durable, lightweight, and easily cleaned. Research reveals that reductions in bacterial plaque biofilm and gingivitis are equivalent with either the use of a hand flossing or flossholder. A Swedish national dental survey showed that approximately 46% of adults use woodsticks sporadically and only 12% use woodsticks daily. On the other hand, dental floss is used occasionally by 12% of adults and daily by only 2%. In other words, adults use woodsticks as an oral hygiene aid four to six times more frequently than dental floss (Axelsson 1994).

Woodsticks (see Procedure 4)

Picking our teeth may well be one of humanity's oldest habits and the toothpick one of the earliest tools. The evolution of the primitive toothpick took a second pathway in the more acquisitive societies. It became part of a personal care kit along with a depilatory tweezer and a ear wax scoop (Mandel 1990). In 1872, Silas Noble and J.P. Cooley patented the first toothpick-manufacturing machine.

The key difference between a toothpick and a woodstick (wooden stimulator/cleaner) relates to the triangular (wedge-like) design. Woodsticks should not be confused with toothpicks which are simply meant for removing food debris after a meal (Warren & Chater 1996a). Woodsticks are inserted interdentally with the base of the triangle resting on the gingival side. The tip should point occlusally or incisally and the triangles against the adjacent tooth surfaces. Triangular wedge-like woodsticks have been found to be superior in plaque removal when compared with round or rectangluar woodsticks since they fit the interdental area more snugly (Bergenholtz *et al.* 1980; Mandel 1990). Woodsticks are usually made of soft wood to prevent injury to the gingiva. The tapered form makes it possible for the patient to angle the woodstick interdentally and even clean the lingually localized interdental surfaces. Unlike floss they can be used on the concave surfaces of the tooth root. Some are hand held, while others are designed to be mounted in a handle, which helps gain access to the interdental areas in the posterior region of the mouth (Axelsson 2004).

The wood can store fluoride crystals both on the surface and in the porosities. These crystals readily dissolve when the woodstick is moistened with saliva (Axelsson 2004). During use the soft wood may become splayed. As soon as the first signs of splaying are evident the woodstick should be discarded. As stated above most patients prefer to use woodsticks

for the removal of interdental plaque. Woodsticks have the advantage that they are easy to use, and can be used throughout the day without the need for special facilities such as a bathroom or a mirror. Woodsticks may also be used in primary prevention, even in cases of poor manual dexterity, including posterior areas. To use woodsticks there must be sufficient interdental space available and in these cases woodsticks are an excellent substitute to dental floss. Although woodsticks have a good cleansing capacity in the center part of the interproximal surfaces of teeth in contact, their effect is reduced on the lingual side of these surfaces. The woodstick is somewhat difficult to use in the far posterior regions of the jaws because of the lack of accessibility and since the triangular cross section must pass into the embrassure space at a specific angle (Bassiouny & Grant 1981).

When used in healthy dentitions, woodsticks may depress the gingival margin and clean the toothsurface up to 2–3 mm subgingivally (Morch & Waerhaug 1956). Long-term use may cause a permanent loss of the papilla and opening of the embrasure which may have important esthetic implications in the anterior dentition. Woodsticks can clearly be recommended in patients with open interdental spaces as secondary prevention for periodontal diseases.

A review of the literature for studies that have addressed the question whether woodsticks used as adjunct to toothbrushing in adult patients have an effect on plaque and periodontal inflammation identified eight publications. In only one study a significant reduction in plaque scores was reported as result of the use of woodsticks (Schmid *et al.* 1976). In three studies the use of woodsticks resulted in reduction of gingival bleeding (Anaise 1976; Bassiouny & Grant 1981; Bouwsma *et al.* 1992).

Interdental brushes (see Procedure 5)

Interdental brushes were introduced in the 1960s as an alternative to woodsticks. They are effective in the removal of plaque from the proximal tooth surfaces (Bergenholtz & Olsson 1984). The interdental brush consists of soft nylon filaments twisted into a fine stainless steel wire. This 'metal' wire can prove uncomfortable for patients with sensitive root surfaces. For such patients the use of plastic-coated metal wires may be recommended. The support wire is continuous or inserted into a metal/plastic handle. Interdental brushes are manufactured in different sizes and forms The most common forms are cylindrical or conical/tapered (like a Christmas tree). The length of the bristles in cross section should be tailored to the interdental space. Appropriate interdental brushes are currently available for the smallest to the largest interdental space (Fig. 35-6). Although unconfirmed with scientific documentation, it is believed that the most effcient cleaning is achieved if the brush selected is slightly larger than the embrasure space. The brush is inserted obliquely into the interdental space, from an apical direction. Cleaning is performed with a back-and-forth motion. The interdental brush is the aid of choice when root surfaces with concavities or grooves have been exposed. The interdental brush is also the most suitable cleaning device in "through-and-through" furcation defects. Like woodsticks, interdental brushes are easy to use, although they may have some drawbacks, including the fact that different types may be needed to fit differently sized open interproximal spaces. When not properly used, interdental brushes may elicit dentin hypersensitivity. In order to minimize the risk of hard tissue abrasion interdental brushes should be used without dentifrice except in special cases and then only short-term. They can also be regularly used as a carrier to apply fluoride or antimicrobial agents, e.g. chlorhexidine gel into the interdental space to prevent caries or the recolonization of residual pockets. The brush should be discarded when the filaments become loose or deformed.

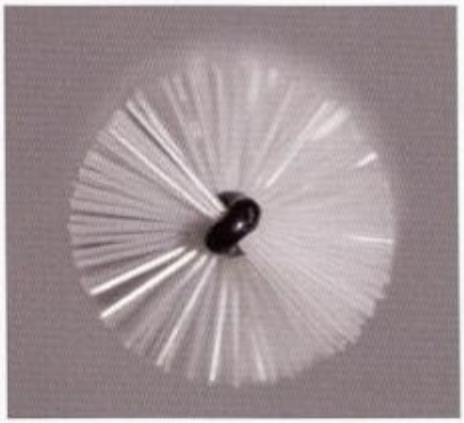


Fig. 35-6 With interdental brushes the diameter of the metal wire core is a detemining factor with respect to access. A close fit of the brushing filaments influences the cleaning ability.

Interdental brushes represent the ideal interdental cleaning tool, especially for periodontitis patients. Waerhaug (1976) showed that individuals who habitually used an interdental brush were able to maintain supragingival proximal surfaces free of plaque and to remove some subgingival plaque below the gingival margin. In a more recent study in patients with moderate to severe periodontitis Christou and coworkers (1998) showed the interdental brush to be more effective than dental floss in the removal of plaque and in promoting pocket reduction. Patients reported that the use of interdental brushes was easier than the use of dental floss. This is in agreement with previous studies (e.g. Wolffe 1976). Also the perception of efficacy was better for the interdental brushes. Significantly less patients reported problems with the use of interdental brushes. Even if efficacy of interdental brushes were not better than that of floss, the long-term use of interdental brushes

might be more easily implemented in a patient's routine than that of floss.

Single-tufted/end-tufted brush (see Procedure 6)

Single-tufted brushes are designed with smaller brush heads that have a small group of tufts or a single tuft. The tuft may be 3–6 mm in diameter and can be flat or tapered. The handle can be straight or contra-angled. Angulated handles permit easier access to lingual and palatal aspects. The filaments are directed into the area to be cleaned and activated with a rotating motion. Single-tufted toothbrushes are designed to improve access to distal surfaces of posterior molars, tipped, rotated or displaced teeth, to clean around and under fixed partial dentures, pontic, orthodontic appliances, or precission attachment, and to clean teeth affected by gingival recession and irregular gingival margin or furcation involvement.

Adjunctive aids

Dental water jet

The dental water jet was introduced in 1962. This device, also called an oral irrigator, has been demonstrated to be safe and effective. Oral irrigation has been a source of controversy within the field of periodontology. The daily use of oral irrigation has been shown to reduce dental plaque, calculus, gingivitis, bleeding, probing depth, periodontal pathogens, and host inflammatory mediators (Cutler *et al.* 2000). The strongest and most consistent evidence for the benefit of daily use of a dental water jet is the ability of the device to reduce gingivitis and bleeding. It has been reported that a pulsating stream of water is better than a continuous flow. The pulsating, hydrodynamic forces produced by irrigators can rinse away food debris from interdental spaces and plaque-retentive areas. Irrigation is not, however, a monotherapy but an adjunct designed to supplement or enhance other home care methods (brushing and flossing) intended for mechanical plaque removal (Hugoson 1978; Cutler *et al.* 2000).

Irrigation devices may be used with water or with disinfective ingredients (Lang & Raber 1982). In a study by Flemmig and co-workers (1990) it was observed that the addition of water irrigation to regular oral hygiene reduced bleeding on probing by 50% over a 6-month timeframe. The use of chlorhexidine in suboptimum concentrations (e.g. 0.06%) led to improved plaque inhibition and had an anti-inflammatory effect (Lang & Räber 1982; Flemmig *et al.* 1990). The success of pulsating irrigators with regular tips is limited in the subgingival area, and in periodontal pockets (Wennström *et al.* 1987). With specially designed tips (PikPocket: Waterpik Technologies, Inc.; Newport Beach, CA, USA), the pulsating stream of fluid may penetrate more deeply into the pocket areas (Cobb *et al.* 1988).

Tongue cleaners (see Procedure 7)

The dorsum of the tongue, with its papillary structure and furrows, harbors a great number of microorganisms (Chapter 60). It forms a unique ecologic oral site with a large surface area (Danser *et al.* 2003). The tongue is said to act as a reservoir which permits the accumulation and stagnation of bacteria and food residues (Outhouse *et al.* 2006). The tongue bacteria may serve as a source of bacterial dissemination to other parts of the oral cavity, e.g. the tooth surfaces and may contribute to dental plaque formation. Therefore, tongue brushing has been advocated as part of daily home oral hygiene together with toothbrushing and flossing (Christen & Swanson 1978). Tongue brushing has also been advocated as a component of the so-called "full-mouth disinfection" approach in the treatment of periodontitis, with the aim of reducing possible reservoirs of pathogenic bacteria (Quirynen *et al.* 2000).

Regular tongue cleaning has been used since ancient times and is still used by natives of Africa, Arabic countries, India, and South America. Many ancient religions emphasized cleanliness of the entire mouth, including the tongue. Indian people's daily ritual of oral hygiene was not only confined to brushing of the teeth but also the tongue was scraped and the mouth was rinsed with concoctions of betel leaves, cardamom, camphor or other herbs.

A large variety of tongue cleaners is commercially available. A modern tongue-scraping instrument may consist of a long strip of plastic ribbon. This is held in both hands and bent so that the edge can be pulled down over the dorsal surface of the tongue. Brushing also appears to be an easy method of cleaning the tongue providing that the gagging reflex can be controlled. In a recent systematic review it was concluded that scrapers or cleaners are more effective than toothbrushes for tongue cleaning (Outhouse *et al.* 2006). Patients should be informed that it is most important to clean the posterior portion of the tongue dorsum.

Tongue cleaning is a simple and fast procedure that helps to remove microorganisms and debris from the tongue. When tongue cleaning is practiced on a daily basis, the process becomes easier. Eventually, the patient may indeed feel "unclean" when tongue debris is not removed on a regular basis. In a study by Gross and co-workers (1975) the test group was instructed to brush their tongues as an adjunct to their normal oral hygiene measures. The members of a control group were not instructed to clean the tongue. A reduction in the presence of tongue coating was found of 40% in the test group as compared to the control group.

Some studies have shown that tongue brushing in combination with other methods of oral hygiene is

an effective method in reducing the formation of dental plaque. In contrast, Badersten and co-workers (1975) found no difference in *de novo* plaque accumulation between a 4-day period of tongue brushing and a 4-day period of no oral hygiene procedures. The authors suggested that the majority of the important plaque-forming bacteria might not originate from the tongue. Another reason for not finding an effect of tongue brushing on plaque formation may be that brushing of the posterior part of the dorsum of the tongue is difficult due to inaccesibility and discomfort.

Dentifrices

The use of a toothbrush is usually combined with a dentifrice (sold as *toothpaste*) with the purpose of facilitating plaque removal and applying agents to the tooth surfaces for therapeutic or preventive reasons (Chapter 36). In 1824, a dentist named Peabody was the first person to add soap to toothpaste. John Harris first added chalk as an ingredient to toothpaste in the 1850s. Colgate mass-produced the first toothpaste in a jar. In 1892, Dr. Washington Sheffield of Connecticut manufactured toothpaste into a collapsible tube. The traditional role of dentifrice is primarily cosmetic, in aiding the cleaning of teeth and producing fresh breath. It also makes toothbrushing more pleasant.

The studies by de la Rosa and co-workers (1979) and Stean and Forward (1980) validated the use of dentifrice since they found that there was a reduction in plaque growth after brushing with a dentifrice as opposed to brushing with water. In the course of the years many dentifrice formulations were tested and became well established because of their anti-plaque and/or anti-gingivitis properties. For additional information see Chapter 36.

Foam brushes, swabs or tooth towelettes

Tooth towelettes are being marketed as a method of plaque removal when toothbrushing is not possible. Their use is not meant to replace a daily toothbrushing regimen. Recently the I-Brush® has been introduced. This swab is mounted on the index finger of the brushing hand. It uses the agility and sensitivity of the finger. Consequently it could permit a better control over the finger pressure because the finger can actually feel the tooth and gingival surfaces and help positioning the brush for more effective scrubbing. During a 3-week clinical trial, no adverse effects were found. The results show that the finger brush removed less plaque than a regular manual toothbrush. In particular approximal plaque reduction was poor in comparison with the manual toothbrush. Based on these results, it is concluded that there is no beneficial effect of the finger brush in comparison with a regular manual toothbrush (Graveland *et al.* 2004).

Foam brushes resemble a disposable soft sponge on a stick and have been dispensed to hospital patients for intraoral cleansing and refreshing as early as the 1970s. They are particularly used for oral care in medically compromised and immunocompromised patients, to reduce the risk of oral and systemic infection (Pearson & Hutton 2002). Lefkoff and co-workers (1995) studied the effectiveness of such a disposable foam brush on plaque. In this study the regular manual toothbrush was found to be significantly more effective in retarding the accumulation of plaque from a plaque-free baseline on both facial and lingual surfaces. The foam brush did, however, show some plaque-preventive capabilities by maintaining plaque formation below 2 mm at the cervical margin of the tooth. Nevertheless, according to most authors, foam brushes should not be considered as a substitute for a regular toothbrush. In a study by Ransier and co-workers (1995) foam brushes were saturated with a chlorhexidine solution. They found the foam brush which had been soaked in chlorhexidine to be as effective as a regular toothbrush in controlling plaque and gingivitis levels. Therefore, if a toothbrush cannot be used in hospitalized patients, an alternative may be the use of chlorhexidine applied with a foam brush.

Side effects

Brushing force

Studies have shown brushing force with powered toothbrushes to be lower than that of a manual toothbrush (Van der Weijden *et al.* 1996c). This appears to be a consistent finding. There is an approximately 1.0 N difference between manual and powered toothbrushes. Recently McCracken and co-workers (2003) observed, in a range from 0.75–3.0 N, that the improvement in plaque removal, using a power toothbrush with forces in excess of 1.5 N was negligible. In a feedback study a professional brusher was asked to brush at 1.0 N, 1.5 N, 2.0 N, 2.5 N, and 3.0 N, during which the efficacy in relation of brushing force to brushing was determined. An increase in efficacy was observed with raising brushing force from 1.0 N to 3.0 N (Van der Weijden *et al.* 1996c). Hasegawa and co-workers (1992) evaluated the effect of different toothbrushing forces on plaque reduction by brushing with 100 g intervals on a scale from 100–500 g. The results of their study corroborate the findings of earlier studies that with increasing force more plaque is removed. In addition they observed that 300 g seems to be the most effective brushing force when using a manual toothbrush for both children and adults. Forces exceeding 300 g caused pain and gingival bleeding in the test patients. As shown in a manual brushing study in which efficacy was plotted against brushing force the relationship between force and efficacy appears not to be linear (Van der Weijden *et al.* 1998a). Using this particular manual toothbrush a positive correlation between efficacy and force up to 4.0 N was found. The more force was used, the more effective was the plaque removal. However

efficacy was reduced when forces above 4.0 N were used. Indeed there appeared to be a negative correlation. The hypothesis is that this negative correlation had to do with distortion of the brushing filaments. Above 4.0 N the brushing was no longer performed with the tip of the filament, but due to bending, with its side. This indicates that brushing force is not the sole factor which determines efficacy. Other factors such as action of the brush, size of the brushhead, brushing time, and manual dexterity may be of greater importance.

Excessive brushing force has been mentioned as a factor which is partly responsible for the origin of toothbrush trauma (gingival abrasion). In response to patients that use excessive force, manual and electric toothbrush manufacturers have introduced toothbrush designs, which can limit the amount of force used and thus reduce the chance of damage to soft and hard tissues. However there is no linear correlation between brushing force and abrasion. Mierau and Spindler (1989) performed a quantitative assessment of habit patterns of toothbrushing in 28 subjects and nine sessions. Least variations within each individual were observed with regard to brushing force. Brushing force ranged from 1.0–7.4 N between individuals. They did not observe any (visual) lesions from brushing in those individuals using a brushing force <2 N. If the brushing force was >2 N, co-factors such as brushing time, brushing method, and frequency of brushing appeared to be associated with acute brushing lesions. Burgett & Ash (1974) argued that the potential detrimental effect of brushing is related to the force applied at a particular point, i.e. pressure. it must be recognized that the head of a manual brush is larger than the head of the electric brush. Since the forces are given as a total of the force over the entire brush it may be that the unit pressure was less for the manual than for the electric brushes. They observed no difference in pressure between a soft manual (11.32 g/mm^2) and an electric toothbrush (11.29 g/mm^2). These data which show that the pressure for the electric and the manual brush are similar are also in agreement with findings presented by Van der Weijden and co-workers (1996c).

Toothbrush abrasion

Since various mechanical products are used in personal control of supragingival plaque, the possibility exists that some deleterious effects may appear as a consequence of these oral hygiene practices (Echeverría 1998). It has already been known for a long time that toothbrushing may have some unwanted effects on the gingiva and hard tooth tissues (Kitchin 1941). Trauma to hard tissues leads to cervical abrasion of the tooth surface. These lesions have been associated with toothbrush stiffness, the method of brushing, and brushing frequency. Cervical tooth abrasion has a multifactorial etiology, but in most cases it is the consequence of toothbrushing due to an excessive pressure of the brush and an excessive number of toothbrushing episodes/time. Both situations are probably linked to personality traits (*compulsive brushers*). Tooth wear has also been associated with toothbrush characteristics, especially related to the finishing and hardness of the filaments (Fishman 1997). It has been stated that hard tissue damage is mainly caused by the abrasives in the dentifrice, whereas lesions of the gingival tissues are caused by the toothbrush (Axelsson *et al.* 1997; Meyers *et al.* 2000).

In many instances, *tooth abrasion* is found in combination with *gingival recession*. Whereas gingival recession is associated with different etiologic/risk factors, e.g. periodontal inflammation, smoking, gingival biotype or repeated periodontal instrumentation, inadequate toothbrushing is probably the most significant one (Björn *et al.* 1981). Clinical experience does support the idea that, with improper use, toothbrushing can cause superficial damage to the gingival tissues. Patients with good oral hygiene have been found to have more gingival recession and more dental abrasion than those with poor oral hygiene. Unfortunately there are few studies in the dental literature concerning gingival lesions resulting from toothbrushing. Thus, to what extent oral hygiene procedures may traumatize the gingival tissues is not clear. Gingival abrasions as a result of brushing are often reversible localized superficial lesions. It is unlikely that gingival abrasion is induced by a single factor. One factor which has already been mentioned to be related to gingival abrasion is brushing force. In the literature, other factors have been suggested such as brushing method (e.g. Bass method), abusive toothbrush use, manual or powered toothbrushing, toothbrush grip, brush head shape, stiffness of filaments, end-rounding of toothbrush filaments, and toothbrushing frequency (Van der Weijden & Danser 2000).

Interestingly, there has been little debate on the role of dentifrice in the abrasion of soft tissues. This is somewhat surprising when abrasion of dental hard tissues is almost entirely a function of dentifrice. Detergents in dentifrice, agitated over a mucosal surface, could enhance the removal of the protective salivary glycoprotein layer and exert cytotoxic action on the overlying epithelial cells (Addy & Hunter 2003). No statistically significant difference in the incidence of gingival abrasion was found between brushing with dentifrice or without dentifrice (Versteeg *et al.* 2005) (Fig. 35-7).

Importance of instruction and motivation in mechanical plaque control

A fundamental principle for all preventive action is that the effect is greatest where the risk of development of disease is greatest. Needs-related instruction in oral hygiene should therefore intensify mechanical plaque removal on those individual teeth and surfaces that are at risk. A prerequisite for establishing needs-related toothcleaning habits is a well

Fig. 35-7 (a) Soft tissue damage as a result of extensive toothbrushing. Note gingival recession on the buccal gingival surface of tooth 13. (b) Note multiple ulcerations of the buccal gingival margin in the right maxilla. (c,d) Hard tissue damage has resulted after extensive use of interdental brushes.

motivated, well informed, and well instructed patient (Axelsson 2004). Mechanical plaque control demands active participation of the individual subject, and therefore the establishment of proper oral home care habits is a process that involves and depends on behavioral changes to a great extent. When implementing behavioral changes, dental professionals should try to ensure that the patient recognizes his/her oral health status and the role of his/her personal oral hygiene procedures in the prevention of caries and periodontal diseases. The patient should be informed about the casual relationship that led to the disease process and should be encouraged to take responsibility for his/her own oral health. The dental team has numerous possibilities to demonstrate soft tissue alterations elicited by inflammation to the patient, and the responsible etiologic factors. Most commonly, as with sports coaching, a one-to-one professional–patient approach should be employed.

Many patients spend too little time brushing or they brush haphazardly. The importance of thorough plaque removal should be stressed. Toothbrushing instruction for a patient involves teaching what, when, where, and how. In addition, instruction should also involve a description of specific toothbrushing methods, the grasp of the brush, the sequence and amount of brushing, the areas of limited access, supplementary brushing for occlusal surfaces and the tongue. The possible detrimental effects from improper toothbrushing and variations for special condition are described (Wilkins 1999). The design of toothbrushes or a specific toothbrushing method are of secondary importance to the skills of the individual in using the brush (Frandsen 1986). The simplest, least time-consuming procedures that will effectively remove bacterial plaque and maintain oral health should be recommended. If a patient prefers a specific oral hygiene strategy the clinician can evaluate this and modify the technique to maximize effectiveness, rather than changing it. Although it is necessary to give all patients honest feedback on their plaque removal efforts, it is also important to reward a positive performance and not entertain unrealistic expectations, so that the patient will not dread each maintenance visit.

Oral hygiene instruction should also include components such as self-assessment, self-examination, self-monitoring, and self-instruction. With this purpose, several devices and chemical agents have been used in order to make dental plaque more evident to the patient. The interested patient can be informed and motivated, for example, through use of disclosing agents to visualize plaque at the gingival margin or in the interdental spaces. Disclosing agents are chemical compounds such as erythrosine, fuchsin or a fluorescein-containing dye that stains dental plaque and thus makes it fully evident to the patient, either with regular or ultraviolet light. Erythrosine

Fig. 35-8 (a) Disclosing solution is often used to identify plaque. (b) Note remaining plaque on the buccal tooth surfaces after staining. (c) After self-performed tooth cleaning, remaining plaque can be identified by the patient following rinsing with a disclosing solution.

has already been used for many years and has received an FDA approval (Arnim 1963) (Fig. 35-8).

When applied immediately before toothbrushing, the patient can identify the amount of plaque formed after the last toothbrushing episode, thus receiving an immediate feedback about his/her cleaning performance. This procedure is useful during the early phase of plaque control. Later on, the disclosing agent should be applied after toothbrushing, which allows the patient to identify those areas needing additional cleaning efforts. Disclosing solution is available in either liquid or tablet form. The liquid may offer some advantages in that the operator can ensure that all surfaces are adequately covered. The red disclosing solution remains in the mouth for some time and may temporarily stain the lips and gingiva.

Disclosing of plaque in the patient's mouth is usually not enough to establish good oral hygiene habits, however. Other factors might influence the individual to modify or determine his or her behavior. These factors may be more or less beyond the control of the dental personnel (such as social and personal factors, environmental setting, and past dental experiences) or may lie within the control of dental personnel (such as conditions of treatment, instruction, and education of the patient). All of these should be considered in the design of an individualized oral hygiene program.

A variety of methods can be used to deliver advice and instruction. The effect of various oral hygiene instruction programs, administered individually or in groups, has been evaluated in a number of clinical studies. These studies have evaluated whether instruction given during one visit only is similar to step-by-step instruction provided during several visits, or whether the use of pamphlets or video tapes is superior to self-instruction manuals and to personal instruction given by a dental professional. In a study by Renton-Harper and co-workers (1999) an instructional video for an oscillating rotating electric toothbrush was evaluated. The subjects that followed the instructional video benefited significantly and considerably in terms of plaque removal compared to subjects receiving only written instructions. Different types and amounts of feedback to the patients using disclosed plaque scores and phase contrast demonstrations have also been investigated. These studies have usually reported similar improvements in plaque and gingivitis scores, irrespective of the mode of instruction. However, these results should be interpreted with caution since the subjects participating in these studies were examined at regular intervals, and therefore it is difficult to separate the effect of repeated examinations from the effect of the instructions (Renvert & Glavind 1998).

If oral hygiene motivation, information, and instruction are combined with professional tooth cleaning the effect in terms of reduction of plaque levels and levels of gingival inflammation may persist even after 6 months. A recent systematic review concluded, based on studies ≥6 months of duration, that a single oral hygiene instruction, describing the use of a mechanical toothbrush, in addition to a single

professional "oral prophylaxis" provided at baseline, had a significant, albeit small, positive effect on the reduction of gingivitis (Van der Weijden & Hioe 2005).

Rylander and Lindhe (1997) have recommended that oral hygiene instruction be given during a series of visits allowing the possibility of giving the patient immediate feedback and reinforcing the patient in his/her home care activities. The protocol below is based on the one used in several clinical trials by Lindhe and Nyman (1975), Rosling and co-workers (1976), and Lindhe and co-workers (1982), where the role of plaque control in preventing and arresting periodontal diseases was clearly proven.

First session

1. Apply a plaque-disclosing solution to the teeth and, with aid of a hand mirror, demonstrate all sites with plaque to the patient (Fig. 35-8b). The plaque score should be recorded using a plaque control record (Fig. 35-9).
2. Ask the patient to clean the teeth using his/her traditional technique. With the aid of a hand mirror, demonstrate the results of the toothbrushing to the patient, again identifying all sites with plaque (Fig. 35-8c).
3. Without changing the technique, ask the patient to clean the surfaces with plaque.

Depending on the plaque remaining after this second toothbrushing, the dental professional should either improve the technique or introduce an alternative system of toothbrushing. In order not to overload the patient with too much information during the first session, the use of adjunctive devices for interproximal cleaning can be introduced or improved in the second session.

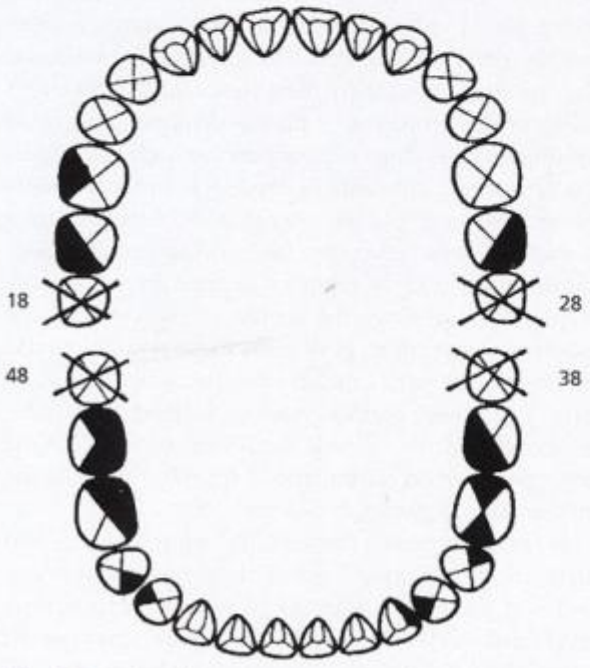


Fig. 35-9 A chart illustrating the teeth and tooth surfaces in the maxilla and mandible. The distribution of tooth surfaces with dental plaque (shadowed areas) is identified. In this case the plaque score is 17%.

Second session

1. A few days after the previous session, the disclosing solution is again applied. The results, in terms of plaque deposits, are identified in the mouth, recorded in the plaque control record, and discussed with the patient.
2. The patient is then invited to clean the teeth, according to the directions previously given in the first session, until all staining is removed. In many cases, toothbrushing instructions will need to be reinforced. Reinforcement and positive recognition should be given to the patient at the same time.

If necessary, the use of interproximal cleaning aids can now be introduced or improved.

Third and following sessions

1. One or two weeks later the same procedure used in the second session is repeated. However, the efficacy of self-performed plaque control should be evaluated and presented to the patient at each appointment. This repeated instruction, supervision, and evaluation aims to reinforce the necessary behavioral changes.

The long-term result of oral hygiene instruction is dependent on behavioral changes. Patients may fail to comply with given instructions for many reasons, ranging from unwillingness to perform oral self-care, poor understanding, lack of motivation, poor dental health beliefs, and unfavorable dental health values, to stressful life events or low socioeconomic status. Although the use of behavior-modification techniques may offer an advantage over traditional instruction techniques, there is limited research in this area to clarify the relationship between health beliefs and compliance.

Conclusion

- Oral hygiene instruction should be tailored to each individual patient on the basis of his/her personal needs and other factors.
- The patient should be involved in the instructional process.
- An individualized maintenance program should follow the basic oral hygiene instruction.

All the illustrations for the following procedures are used with permission from *Paro Praktijk Utrecht*.

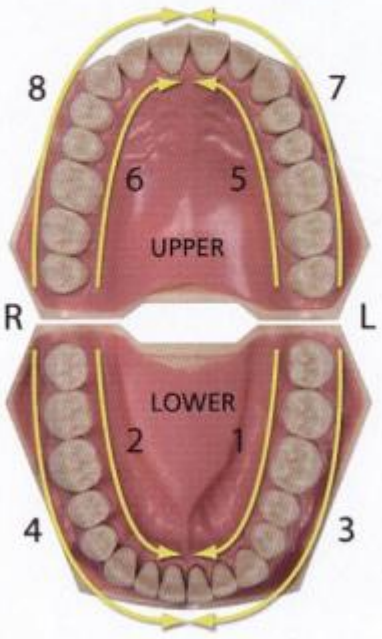
Procedure 1: Instruction for Manual Toothbrush

It is of utmost importance that in addition to using the correct toothpaste and also brushing for at least 2 minutes to brush the teeth in a set sequence. This prevents missing out certain areas. Areas untouched by the brush allow plaque to continue to grow. Try to choose a brush with medium or soft bristles and a small head.

Instruction

- Hold the brush firmly and place the bristles at an angle against the edge of your gums (use a 45° angle). Take care to ensure that the bristles are in contact with a small part of the gum margin.
- Place the brush against the molar or tooth at the back of the mouth and make short back and forth scrubbing movements. Brush from the back to the front of the mouth and try to overlap the strokes. Do not brush more than two teeth simultaneously. Always start at the back and work slowly forwards.
- Always hold the brush head horizontal when cleaning the outside surfaces of the teeth. It is easier to hold the head vertically when brushing the inside surfaces of the top and bottom teeth.
- Avoid too much pressure and fast movements and be aware of feeling contact with the gum margin. Also avoid brushing too vigorously thereby preventing damage to the gums.

When cleaning the teeth keep using the same sequence of brushing. For example, inside of bottom jaw left (15 seconds) inside right (15 seconds). Then left on the outside (15 seconds), followed by right on the outside (15 seconds). Repeat the same sequence in the top jaw. Finally, brush the chewing surfaces with small scrubbing movements. Replace the brush when the bristles start to splay.



Procedure 2: Instruction for the Electric Toothbrush

The importance of using a set sequence of brushing movements is also applicable when using an electric toothbrush. The question as to whether an electric brush is better than a manual one has been asked many times. Both allow to one achieve a high level of oral hygiene. However research has shown that electric toothbrushes are more efficient and many people report that they are easier to use.

Instruction

- Place the brush firmly on the hand piece. Grip the brush in the palm so that the bristles of the head are somewhat angled toward the gums (at an angle of approximately 70°). Try to allow the longer bristles to penetrate between the teeth and take care that the bristles contact your gums.
- Switch on the brush and place the head on the last tooth in the mouth (check the angle) and move the head gradually (in about 2 seconds) from the back to the front of this tooth.
- Try to follow the contour of both the tooth and the gums. Place the brush head on the next tooth and repeat this process.
- Allow the electric toothbrush to do the work. It is not necessary to press hard or make brushing movements.
- Use a timer! Many brushes will give some form of signal after 30 seconds (the apparatus stops for a moment). This is the point at which to move on to a new part of the mouth.

Remember to thoroughly clean the brush and its head when finished.

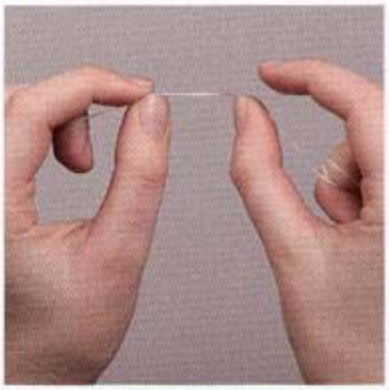
Procedure 3: Use of Dental Floss

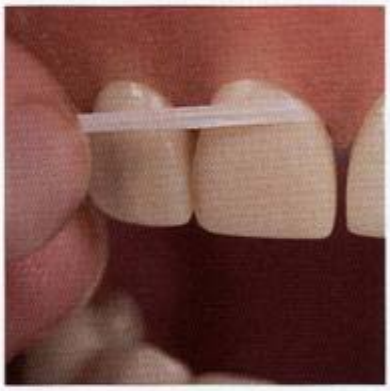
The use of dental floss has become part of oral care in addition to correct, more frequent and longer tooth brushing. Floss can be purchased in a variety of thicknesses and types and with or without a layer of wax. If there is sufficient space between the front and back teeth is it advisable to use the somewhat thicker tape than the thinner floss.

Instruction

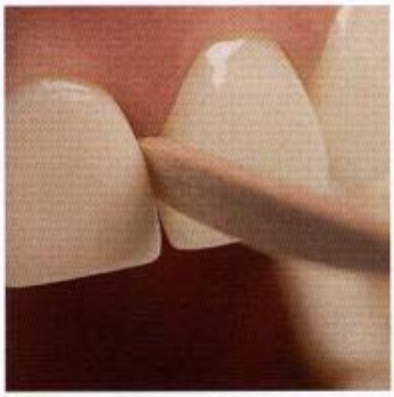
- Take approximately 40 cm of floss and wind the ends loosely around the middle finger. Allow for 10 cm between the middle fingers. Then hold the floss between the thumb and first finger so that about 3 cm remains between the thumbs.
- Using a sawing movement, allow the tightly stretched piece of floss to pass between the front and back teeth. This may be difficult where teeth are so close that the space between them is limited. Avoid allowing the floss to slip so fast between the teeth that the gums become damaged.
- Stretch the floss around one of the teeth and carefully allow it to pass just under the gum, once again with a sawing movement.
- Draw the floss up to the contact point with a sawing movement and then repeat the process on the other tooth bordering the space filled with gum tissue.
- Remove the floss from between the teeth, once again with a sawing movement and repeat this process for all the other spaces in the mouth.
- Use a clean piece of floss for each separate space by unwinding part of it from around one middle finger whilst winding it around the other middle finger.

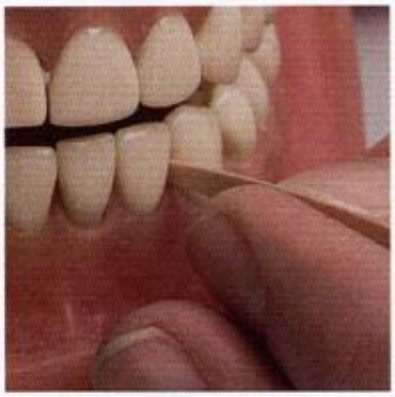
Do not worry if at first your gums bleed slightly. This will stop after using the floss a number of times. Don't give up!





Procedure 4: Woodsticks





Most adults have sufficient space available between the incisors and molars to allow woodsticks to be used. These come in differing thicknesses and are made from wood and have a triangular cross section, mimicking the shape of the space between the teeth. Woodsticks can only be used once and are ideal when you have a few spare moments – for example when sitting in a traffic queue!

Instruction

- Hold the woodstick firmly between the thumb and first finger about halfway along its length. When possible place the other fingers for support on the chin. Moisten the tip of the woodstick by sucking on the point of it, thus making it softer and more flexible.
- Place the flat side of the woodstick (i.e. not the sharp side) against the gum. In the upper jaw the flat surface will face upwards and in the lower jaw downwards.
- Push the woodstick firmly from the outer side of the space into it until it becomes just wedged. Then pull it back slightly and push it back once again, using a light sawing motion at right angles to the outer surfaces of the teeth. Light pressure can also be applied simultaneously to the gums. Repeat this a few times, angling the woodstick so as to contact the surfaces of the teeth enclosing the space.
- When using a woodstick between the premolars and molars, close the mouth slightly to reduce tension in the cheeks making the movements easier.

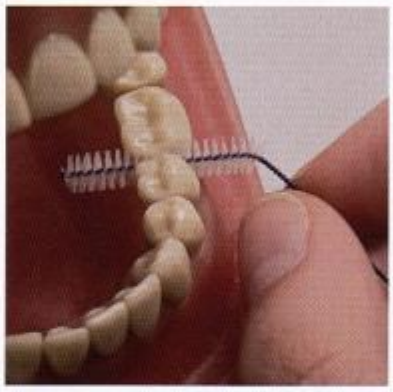
With this method, all spaces between the teeth throughout the mouth can be cleaned. Should the woodstick prick the surface of the gums with the point, angle it a little differently – in the upper jaw the point will face downwards and in the lower jaw upwards. Do not be concerned if your gums bleed a little at first – this will disappear after using the woodsticks repeatedly for a period of time.

Procedure 5: Interproximal Brushes

Interdental brushes are purchasable in a variety of sizes varying from small to very large. It is of importance to choose the correct diameter of the bristle part of the brush. The size of the space between the teeth determines the size of the diameter of the bristles on the brush. It is often necessary to use different size of brush within one mouth for optimal cleansing. In order to effectively remove dental plaque there should be a slight degree of resistance when the brush is moved back and forth between the teeth.

Instruction

- Always use the interdental brush *without* toothpaste
- Hold the interdental brush between the thumb and first finger just behind the bristles. Support can be achieved when necessary by placing your other fingers on your chin. Push, from the outer side of the space, the interdental brush carefully between the teeth, taking care that the brush remains at right angles to the teeth.
- Avoid scraping the centre (metal spiral part) of the brush against the teeth.
- Slide the brush in and out of the space using the full length of the bristle part of the brush. This will remove the dental plaque.
- The area of contact between the brush and the teeth can be somewhat increased by using differing angles of insertion.
- Slight pressure of the brush against the gums should be used as this will allow the bristles to penetrate a little underneath the gum margin.
- By slightly closing the mouth it will be easier to manipulate the brush as the tension in the cheeks is lessened. It may also be of help to slightly bend the brush to ease insertion.
- Cleanse all areas between the teeth where an interdental brush will fit. Rinse the interdental brushes thoroughly after use and allow them to dry out. It is often a good idea to combine the use if interdental brushes and woodsticks.

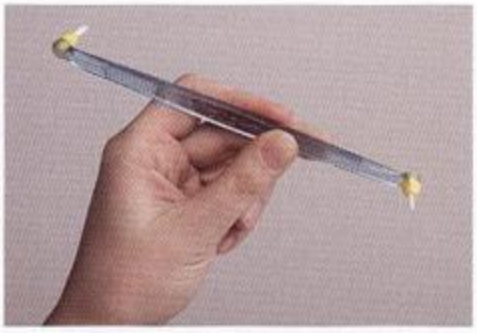


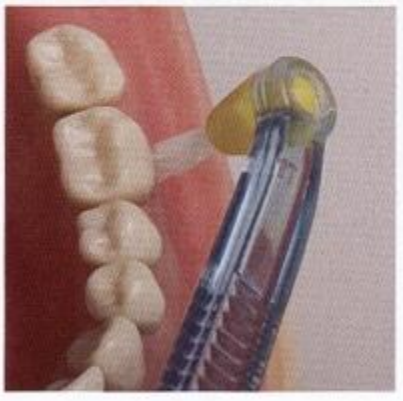
Procedure 6: Instruction for Single-Tufted/End-Tufted Brush

The single-tufted toothbrush is a small brush with a small, single tuft of short bristles attached to the end. The end-tufted brush has a number of small tufts attached in a similar manner. These brushes are ideal for cleansing areas of the dentition which cannot be reached with other oral hygiene aids. For example a lone standing tooth, the back surface of the last molar or tooth in the arch, wires and locks of orthodontic braces, grooves or the entrance to areas where roots split apart.

Instruction

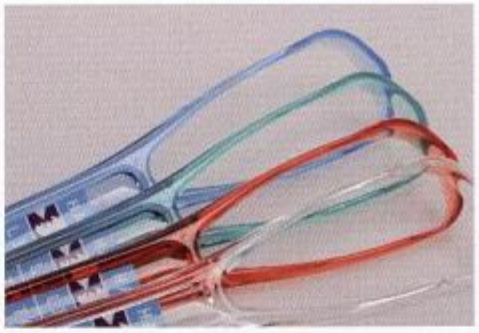
- Hold the single-tufted brush in the same way as a pen. This prevents too much force being applied to the gums.
- Place the single-tufted brush at an angle directed toward the gums (about 45°) – this allows the bristles to reach just under the gum margin.
- Use small, rotational pencil movements.
- The bristles of the brush will then rotate under and along the gum margin. The brush should then be slowly moved along the tooth surface to cover all areas.





Procedure 7: Use of Tongue Cleaners

Tongue cleaning is a useful addition to the daily oral hygiene routine. Many bacteria can be found within the grooves on the back of the tongue which can cause bad breath. By brushing or scraping the tongue this problem can be markedly helped or prevented entirely. One of the problems associated with tongue cleaning is that it can stimulate a gag reflex, especially when first using this procedure. This occurs more frequently with brushing than when using a scraper. Some people find it less of a problem if they clean their tongue in the evening.



Instruction

- There are various types of tongue cleaners: the most effective seems to be one having the form of a loop.
- Extend the tongue as far as possible out of your mouth.
- Breathe calmly through your nose.
- Place the tongue cleaner as far as possible on the back of the tongue and press lightly with it so that the tongue becomes flattened.
- Ensure full contact of the tongue cleaner with the tongue.
- Pull the tongue cleaner slowly forward.
- Clean the middle part of the tongue first using the raised edge on one side of the instrument.
- Use the smooth surface of the tongue cleaner on the sides of the tongue.
- Repeat these scraping movements a number of times.
- Rinse the mouth several times.

Remember to clean the tongue cleaner thoroughly after use.

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