# CHAPTER 6. ORAL PHYSIOTHERAPY

The objective of oral physiotherapy (oral hygiene) is the complete daily removal of dental plaque with a minimum of effort, time, and devices, using the simplest methods possible. The patient's plaque control procedures must be modified as changes occur in the soft tissue anatomy following periodontal surgery in order to be effective.

## TOOTHBRUSHING

### Manual Brushes

Parfitt (1963) reported that the toothbrush chosen by patients, often on the recommendation of their dentist, is usually too hard or stiff. Results often show that the bristles of the hard brush only reach the most accessible surfaces of the teeth, areas normally cleaned by the mastication of food and by the friction of the soft tissues. The hard brush does not clean interproximally and debris collects between the teeth, in relatively exposed positions, and at the gingival margin. An old brush with splayed bristles causes gingival damage. In attempting to brush the teeth at the gingival margin, the splayed bristles tend to pierce the soft tissues, causing pain and bleeding. The areas most often brushed by the patient are the buccal and labial surfaces of the upper teeth, and to a slightly lesser degree the same surfaces of the lower teeth. The palatal surfaces of the upper teeth and the lingual surfaces of the lower teeth are rarely cleaned during usual routine care. The terminal teeth in the dental arches, particularly the distal surfaces of these teeth, are difficult to reach with a toothbrush and invariably harbor debris.

O'Leary et al. (1970A) studied the deposition of particulate matter in the crevicular tissue by toothbrushing using two widely taught and accepted techniques. Thirty-eight (38) patients requiring surgical elimination of periodontal pockets brushed for 10 seconds with the roll or Bass technique at designated sites. For each toothbrushing technique, brushes had were pre-soaked in a solution containing carbon particles. On completion of the brushing procedure, the test sites were immediately rinsed and biopsied. No carbon particles were observed in the crevicular epithelium or underlying connective tissue of any test section for either technique. However, the results of this study do not eliminate the possibility that bacteria are sometimes introduced into the crevicular tissue and the circulating blood during toothbrushing, since common bacteria in crevicular tissue are considerably smaller than the carbon particles (mean size 2.5 μm) used in this study.

Lang et al. (1973) studied the frequency of effective oral hygiene procedures necessary to maintain gingival health. Thirty-two (32) dental students were assigned to four groups removing plaque at 12, 48, 72, and 96 hour intervals. The oral hygiene procedures were performed using Charters' brushing technique supplemented by dental floss and interdental woodsticks. Plaque was assessed using the plaque index and gingival health by the gingival index. Results demonstrated that effective oral hygiene procedures at intervals of 48 hours are compatible with gingival health. However, if the intervals between complete removal of bacterial plaque exceeded 48 hours, gingivitis developed.

Waerhaug (1981) reported on the effect of toothbrushing on subgingival plaque formation. Thirty-two (32) upper and lower molars in 4 healthy adult monkeys were used in a split-mouth design in which all teeth were cleaned initially, and then only one side was brushed using the Bass method 3 times a week for one year. During brushing, it could be noted that the bristles penetrated as far as 0.9 mm (0.5 to 1.0 mm) below the gingival margin.

### Rotary Brushes

Long and Killoy (1985) evaluated the effectiveness of the Interplak versus manual toothbrushing (modified Bass) in removing plaque in 14 orthodontic patients. Following disclosant and modified O'Leary scoring, mean post-brushing scores were 34% (range 12.5 to 52.9%) for the manual toothbrush and 16.5% (range 5.5 to 31.9%) for the Interplak instrument. The improvement in postbrushing scores after use of the Interplak instrument was significantly better than that of the manual toothbrush.

Youngblood et al. (1985) designed a study to examine the effectiveness of the Interplak instrument versus manual toothbrushing (modified Bass) in removing subgingival and interproximal plaque. Patients requiring extraction of teeth for periodontal or prosthetic reasons were chosen for study. Based on staining with 0.125% toluidine blue, the average depth of cleansing was 0.70 mm for the manual brush and 1.40 mm for the Interplak instrument, representing a statistically significant difference.

Killoy et al. (1989) evaluated the effectiveness of a counter rotary toothbrush and conventional toothbrushes in removing plaque and reducing gingival bleeding. Both brushes reduced plaque indices and bleeding index, but the counter-rotary brush was superior in reducing bleeding index and plaque indices as measured by modified O'Leary and Turesky indices at all time intervals. There were no significant differences when the Surface Area Plaque Index was used.

### Brushing Techniques

In the Charters' technique, the brush is placed at right angles to the long axis of the teeth, gently forcing the bris-

tles between the teeth, being careful not to pierce the gums; i.e., bristles do not rest on the gums. With the bristles between the teeth, gentle pressure is exerted during slight rotary movements, causing the sides of the bristles to come into contact with the gum margin, producing an ideal massage. After 3 to 4 movements, the brush is removed and replaced in the same area, making another 3 to 4 movements. The brush is then moved the distance of one embrasure, and the process repeated, holding the sides of the bristles firmly on the gum margin. When teeth are missing, patients must depend on the sense of touch to keep the proper pressure, with the sides of the bristles on the gum margin. The Charters method is especially suitable for gingival massage. When used in conjunction with a soft-to-medium brush, this technique can be recommended for temporary cleaning in areas of healing wounds following periodontal surgery (Charters, 1948).

With the Bass method of toothbrushing, the head of a soft-to-medium toothbrush is placed parallel with the occlusal plane with the "tip" of the brush distal to the last molar. The bristles are placed at the gingival margin with an apical angle of 45° to the long axis of the teeth. A gentle vibratory motion is then exerted in the long axis of the bristles and the bristles are forced into the gingival sulcus as well as into the interproximal embrasures. This action should produce perceptible blanching of the gingiva. The brush is activated with a short back-and-forth motion without dislodging the tips of the bristles, completing 20 such strokes in the same position. Lift the brush, move it anteriorly, and repeat the process. For the palatal aspect of the maxillary anteriors and the lingual of the mandibular anteriors, the toothbrush is held in a vertical position. This technique may be used on the buccal, facial, palatal, and lingual surfaces of all teeth (Bass, 1948). With the modified Bass technique, an additional step is included. Following the vibratory motion, the bristles are swept towards the occlusal surface of the tooth, cleaning the remaining facial or lingual surface.

In the modified Stillman method of brushing, the bristle ends rest partly on the cervical position of the teeth and partly on the adjacent gingiva, directly apically at an oblique angle to the long axis of the teeth. Pressure is applied laterally against the gingival margin, producing a perceptible blanching. The brush is activated with 20 short back-and-forth strokes and is simultaneously moved in a coronal direction along the attached gingiva, the gingival margin, and the tooth surface. This process is repeated on all tooth surfaces, proceeding systematically around the mouth. With this technique, the sides rather than the ends of the bristles are used and penetration of the bristles into the gingival sulci is avoided. The modified Stillman method is recommended for cleaning in areas with progressing gingival recession and root exposure in order to prevent abrasive tissue destruction (Hirschfeld, 1953).

According to the Stillman method, the bristles rest partly on the gingiva and partly on the cervical portion of the teeth. The bristles are placed obliquely to the long axis of the tooth, or at an angle to the plane of the gingival surface and directed apically. Pressure on the gingiva is desired with the least amount of friction or injury. Sufficient pressure is applied by bending the bristles slightly, creating a perceptible gingival blanching. The brushing action is repeated several times, incorporating a slight rotary motion, but not enough to cause displacement of the bristles. The bristles may be bent in any of 3 directions, but the ends of the bristles should always remain as placed. This process is repeated on all tooth surfaces, proceeding systematically around the mouth. Only the occlusal surfaces of premolars and molars should be "scrubbed" (Stillman, 1932).

In the Fones' technique, the teeth are in occlusion and the brush is pressed rather vigorously against the teeth and gums and revolved in circles with as large a diameter as possible. This technique is fairly effective for young children who cannot or do not need a more complex toothbrushing procedure. Its value is limited in the treatment of periodontitis because it does not adequately engage the interproximal areas. The roll technique is easily performed and is most appropriate when the patient has normal oral health. In this technique, the bristles are placed well up on the gingiva at a 45° angle. The sides of the bristles are pressed against the tissue and simultaneously rolled incisally or occlusally against the gingiva and teeth, similar to the turning of a latchkey (Hine, 1950).

## DENTAL FLOSS

Lamberts et al. (1982) compared waxed and unwaxed floss to determine ability to remove plaque and effect on gingival health during a home oral hygiene program. Four groups of 20 patients on periodontal maintenance recall were given one of 4 floss products (2 waxed, 2 unwaxed). Seven to 10 days after a thorough prophylaxis, patients were given oral hygiene instructions by videotape. At 0, 28, and 56 days the patients were evaluated for plaque, gingivitis, gingival bleeding, and crevicular fluid. It was determined there was no statistical difference between the 4 types of floss in regards to their ability to remove plaque or prevent gingivitis.

In an identical study design, Wunderlich et al. (1982) demonstrated no difference between waxed and unwaxed floss in maintaining gingival health.

Wong and Wade (1985) compared the effectiveness of Super Floss and waxed dental floss as proximal surface cleansing agents in 34 subjects. Each subject used one agent twice daily for 2 weeks and then switched over to the other agent with the same frequency and for the same period. Plaque was stained with erythrosin and the plaque index of Wolffe used for evaluation. Super Floss was found to be superior (50.1%) to waxed dental floss (45.3%) in removing proximal plaque, but neither was 100% effective. No differences were found between maxillary and mandibular teeth.

A 2-week clinical trial was designed by Graves et al. (1989) to test the comparative effectiveness of waxed and unwaxed dental floss, dental tape, and toothbrushing in reducing interproximal bleeding. One hundred-nineteen (119) subjects with gingival inflammation were randomly assisted to 1 of 4 groups at the beginning of the study. The dental tape and the 2 dental flosses were equally effective in reducing interproximal bleeding and doubly effective as toothbrushing alone.

## INTERPROXIMAL CLEANING DEVICES

Three experimental studies were conducted by Gjermo and Flotra (1970) comparing the effect of different interdental cleaning devices. The results demonstrated that in young adults, dental floss removed more plaque at lingual interproximal surfaces than toothpicks. Toothpicks combined with a multi-tufted brush used on the oral surfaces were as effective in removing interproximal plaque as dental floss. The use of dental floss or toothpicks combined with a single-tufted brush may reduce the amount of plaque adhering to interproximal surfaces by an average of 50%. Wide interdental spaces are most efficiently cleaned with an interdental brush.

In 1976 Waerhaug evaluated the effects of the interdental brush. Sixty-seven (67) teeth scheduled for extraction were used for study. Before extraction, the teeth were cleaned with an interdental brush and a mark was made on the tooth surface to indicate the level of the gingival margin. After extraction, the teeth were stained and examined using a stereoscope. Observations indicates that plaque can be removed from 2 to 2.5 mm subgingivally using the interdental brush.

## DISCLOSING AGENTS

According to a review article by Tan (1981), disclosing agents have a demonstrated use in research, but there is no convincing evidence that they are of value either for home care or in the dental office. First described in 1914, they stain foreign matter including food debris, plaque, calculus, and pellicle. Raybin (1945) suggested six uses: by operator to aid in prophylaxis, monitoring, diagnosing, and education; by patient for home care; and by researcher to compare effectiveness of various products. Arnim (1963) introduced erythrosin. Fluorescent disclosing is more specific for plaque and not visible without UV light. Block et al. (1972) introduced an agent that stains mature plaque blue and immature plaque red. Disclosant wafers have been shown to improve plaque scores initially, but show a decline in use after 2 weeks. (End of Tan review).

## ORAL IRRIGATION DEVICES

O'Leary et al. (1970B) evaluated the ability of water pressure from oral irrigating devices to drive particulate matter into the crevicular tissue. The study was carried out in 3 parts with the same 3 oral irrigating devices in each part. India ink was used as a marker in the irrigating fluid. One device delivered a pulsating stream of water whose pressure was controlled by a pressure valve; the second device delivered a continuous stream of water whose pressure was controlled by a faucet valve; and the third device released a continuous stream of water whose pressure was generated by an effervescent tablet. Biopsy specimens from humans and beagle dogs were then evaluated on the basis of the number of inflammatory cells and the presence of carbon particles. The results demonstrated that carbon particles frequently penetrated the crevicular epithelium and underlying connective tissue of beagle and human gingival tissue when the areas were irrigated with water containing oxygen. The incidence of penetration did not appear to vary with the differing water pressures employed.

The comparative effectiveness of mouthrinsing and direct irrigation in the subgingival area was assessed by Pitcher et al. (1980). Eighty-two (82) untreated, periodontally-diseased teeth had gingival margins marked with a bur prior to probing. A disclosing solution was applied as a 10 ml rinse or irrigated toward the apex at the gingival margin (2.5 ml using 1.2 mm needle). After staining, the teeth were extracted and measured for dye penetration. The apical plaque front was stained with crystal violet. Direct irrigation at the crevice produced significantly greater penetration (mean 1.8 mm, PD = 5.4 mm) than mouthrinsing (mean, 0.2 mm; PD = 4.7 mm), but neither technique reached the apical plaque front. It was concluded that penetration with irrigation tended to increase with increasing pocket depth and that subgingival plaque ended 1.5 mm coronal to probing depth.

Hardy et al. (1982) studied a technique of direct irrigation that would reproducibly gain access to the apical plaque border. A total of 98 proximal surfaces on 68 teeth scheduled for extraction were studied. After making reference marks at the level of the gingival margin, disclosing solution was delivered from the gingival margin (superficial irrigation) and 3 mm apical to the gingival margin with a 23-gauge needle (deep irrigation) and the teeth extracted. The direct irrigation group penetrated to the apical plaque border 81% of the time and bottom of the pocket 56%, compared to the superficial irrigation (10% and 6%, respectively). Superficial irrigation penetrated an average of about 35% of pocket depth and deep irrigation penetrated an average of 95% of pocket depth. The results indicate that deep irrigation (3 mm) within periodontal pockets provides an efficient and predictable means of reaching the subgingival plaque apical border.

The effectiveness of an oral irrigator as a vehicle for delivering an aqueous solution into periodontal pockets was evaluated by Eakle et al. (1986). Nine patients requiring extraction due to advanced periodontitis were divided into 2 groups, each irrigated to the gingival margin using an irrigator containing erythrosin dye; one group at a 45° angle and the other at a 90° angle. The teeth were extracted and

the apical penetration of dye measured. Penetration at 90° was 71% for shallow pockets (0 to 3 mm); 44% for moderate pockets (4 to 7 mm); and 68% for deep pockets (≥ 7 mm). The 45° application showed 54%, 46%, and 58% respectively. No soft tissue injuries resulted. The results suggest that the oral irrigator will deliver an aqueous solution into periodontal pockets and will penetrate on average to approximately half the depth of the periodontal pockets.

Sanders et al. (1986) evaluated the effects of daily supragingival pulsated jet irrigation with 0.02% chlorhexidine and 0.05% metronidazole on the subgingival plaque as monitored using darkfield microscopy. Twenty-two (22) patients with periodontal pockets ≥ 4 mm and radiographic bone loss were monitored for 84 days. The results indicated only marginal benefits from supragingival irrigation regarding favorable shifts in the composition of subgingival plaque, as monitored by darkfield microscopy.

Greenstein (1987) reviewed the role of subgingival irrigation with chemotherapeutic agents. Many authors report oral rinses do not permeate subgingivally, and irrigation at the gingival margin does not reach greater than 3 mm. If subgingival irrigation is accomplished by inserting the tip 3 mm subgingivally, then agents could reach the apical border of plaque. Evaluating alterations in microflora is best accomplished on patients who have not been root planed prior to study. Studies with no prior scaling indicated that chlorhexidine reduced spirochetes but not always motile forms. *Bacteroides* was briefly reduced by $SNF_2$ and hydrogen peroxide, and *A. actinomycetemcomitans* was affected by hydrogen peroxide. *Treponemes* seemed to be unaffected by irrigation. Chlorhexidine reduced supragingival plaque at treated sites and decreased probing depth by about 1 mm after a single treatment. If daily subgingival irrigation was preceded by root planing, pockets were reduced about 2 mm. The gingival index was also reduced. After root planing, jet irrigation with or without antimicrobial agents reduced the bleeding index and probing depths. Improvement in clinical parameters without root planing lasted up to 10 weeks and 2 to 6 months with root planing. Chlorhexidine remains the agent of choice, but in high spirochete infections metronidazole may be more effective.

Using scanning electron microscopy (SEM) Cobb et al. (1988) evaluated human gingival biopsies of the pocket wall following supragingival irrigation with a Water Pik device set at 60 psi. Results showed the irrigation force induced no epithelial micro-ulceration or alteration of cell morphology, confirming the safety of using pulsating irrigation.

Ciancio et al. (1989) evaluated the efficacy of an antimicrobial mouthrinse delivered by an oral irrigation device twice daily. The gingival index, gingival crevicular fluid volume, plaque index, modified papillary bleeding index, probing depth, and attachment level were recorded in 66 patients. Subgingival plaque was sampled by means of sterile paper points and assessed by phase contrast and immunofluorescence microscopy. Parameters were repeated at 3 and 6 weeks. Results indicated that irrigation with or without an antimicrobial agent was effective in reducing plaque, suggesting that oral irrigation may have beneficial effects on oral health and that use of a chemotherapeutic agent will lead to greater reductions in plaque and gingival bleeding and to moderate decreases in the total bacteria counts detected by phase contract microscopy.

Scaling and root planing (SRP) was compared to SRP plus multiple irrigations with 2% chlorhexidine (CHX) or 2% CHX multiple irrigations alone (Southard et al., 1989). The effects of treatment on clinical and microbiological indices were evaluated overa 25-week period. All parameters were significantly reduced (versus baseline) in the SRP, SRP + CHX, and CHX alone. SRP + CHX resulted in significantly greater reduction in *P. gingivalis* counts which lasted up to 15 weeks. This combination therapy also resulted in significantly ($P \leq 0.05$) greater attachment gain at 5 and 7 weeks, compared to SRP alone. This study shows an adjunctive effect of a professionally applied irrigation with an antimicrobial to the beneficial effect of SRP.

In a 1990 study Flemmig et al. reported that the antimicrobial irrigation with 0.06% CHX reduced plaque (53.3%) and gingivitis (42.5%) significantly more than the 0.12% CHX (43.3%; 24.1%) rinse or water irrigation.

Braun and Ciancio (1992) evaluated the depth of subgingival delivery in mild to moderate periodontal disease using a newly designed irrigation tip in a powered oral irrigator. A total of 145 sites (teeth planned for extraction) were evaluated in 14 patients using the modified plaque index and plaque index. In the subgingival irrigation group (70 sites), the tip was placed 1 to 2 mm into the selected pocket, and sites irrigated with erythrosin solution 5 seconds per site each. The control group rinsed for 30 seconds with the erythrosin solution. Following examination, it was determined that in the rinse (control) group, mean pocket penetration in all sites ≤ 6 mm was 21%. In the irrigated group, mean pocket penetration was 90% in sites ≤ 6 mm and 64% in sites ≥ 7 mm. Lack of patient discomfort following irrigation suggests that tissue injury is not significant using this delivery system.

## TRAUMA AND ORAL HYGIENE

Gillette and Van House (1980) characterized abrasion as notch-shaped lesions usually at the CEJ and extending apically. Erosiona is chemically induced, saucer-shaped lesion. Toothbrush irritation is mechanical abrasion of the gingiva by the toothbrush. Lesions often appear fresh and ulcerated, and usually repair within 3 days following modified brushing. Recession also may be caused by calculus, plaque, habits, iatrogenic dentistry, and periodontal surgery. Water irrigating devices may cause periodontal abscesses, cellulitis, penetration of the maxillary sinus, gingival hemorrhage, and transient bacteremias. Dentifrices, mouthwashes, chewing gums, and disclosing agents may cause

allergic responses. Toothbrush bristles may cause acute abscesses. Bacteremias occur with oral hygiene procedures and increase with more advanced disease. Elimination of periodontal disease in at-risk patients is important; e.g., those requiring subacute bacterial endocarditis prophylaxis.

Hirschfeld (1953) discussed injuries of the marginal gingiva that may accompany toothbrushing. The author noted the effects of technique and repeated trauma, describing lacerations, stabbing, puncture, and perforation injuries.

Radentz et al. (1976) evaluated for brushing technique and type, and type and amount of dentifrice in 80 individuals, who were scored for cervical abrasion, gingival recession, pH, plaque, and gingival bleeding. The 40 individuals (50%) with cervical abrasion applied 17% more dentifrice than the non-abrasion group, demonstrating a significant correlation between quantity and prevalence. The highest percentage of abrasion occurred in the maxillary right quadrant, and the first three areas brushed. It was most prevalent on maxillary first molars and maxillary and mandibular premolars. Gingival recession also correlated well with cervical abrasion lesions and tended to occur in the older participants. The authors indicate that abrasion appears related to amount of dentifrice, gingival recession, and initial location of brushing.

In 1976 Sangnes reported that abrasion of tooth structure is mostly associated with the dentifrice while gingival lesions are more related to the toothbrush. Abrasion is the pathologic wearing away of substance by the friction of a foreign body. Tooth surfaces are polished and lesions appear on the side opposite the dominant hand, more often on maxilla. Abrasion tends to increase with hard bristles, horizontal brushing and brushing frequency. Gingival lesions develop more rapidly in the premolar areas (prominent areas) and gingival bleeding is more prevalent with a brush having thicker, unrounded bristles.

Reissten et al. (1978) measured the abrasion effect of enamel- and cementum-brushing with and without toothpaste using SEM on 12 unerupted third molar teeth. Horizontal brushing (soft nylon bristles) of the outer enamel and cementum surfaces was performed with a dentifrice slurry ($CACO_3$ abrasive) for 5 and 10 minutes. After brushing with toothpaste, all enamel surfaces were free of scratches, while the cementum surfaces exhibited scratches, which increased with the brushing period. Brushed control teeth with saline revealed much less abrasiveness when compared with toothpaste. This study suggests that the toothpaste is principally responsible for abrasiveness when used on a soft toothbrush.

Niemi et al. (1984) evaluated the stiffness of toothbrush bristles and the abrasiveness of dentifrices for influence on the degree of gingival erosion in 24 dental hygiene students. Two toothbrushes with different bristle thicknesses (soft 0.15 mm; hard, 0.23 mm) and 2 dentifrices, moderately and highly abrasive, were used. The use of the hard brush resulted in lower plaque scores and more gingival erosion than the soft brush. With both brushes a significantly greater number of lesions were recorded after use of an abrasive powder than when no dentifrice was used. The results indicate that the modest decrease in plaque scores with increasing stiffness of the toothbrush bristles and with increasing abrasiveness of the dentifrice is accompanied by increased damage to the soft gingival tissues.

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