Recent Advancements in Mechanical Oral Hygiene Aids- A Review

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ABSTRACT

Research in various clinical and public health domains has shown that the various preventive measures, undertaken by the individual, are effective in preventing most oral diseases. Gingivitis can be controlled by good personal oral hygiene practices that involve the daily removal of dental plaque, oral biofilm, and preventing their accumulation on the teeth and other parts of the oral cavity. Various mechanical and chemotherapeutic plaque control approaches are available; mechanical oral hygiene measures are supplemented by chemotherapeutic agents to greatly improve oral hygiene. The mechanical approach requires manual dexterity, compliance, and motivation, which leads to a constant search for new products with design modifications. The goal is to make its usage more effective in day-to-day oral hygiene practices. This article reviews the advancements in mechanical plaque control methods that aid in optimal oral hygiene maintenance.

KEYWORDS: Oral Hygiene Aids, Toothbrushing, Mechanical Plaque Control, Interdental Aids, Gingivitis, Dentistry

INTRODUCTION

Gingivitis is all-pervasive worldwide.1 Globally, most children have signs of gingivitis2,3 and, among adults, the initial stages of periodontal diseases are prevalent.2 Epidemiological studies and reviews have shown the prevalence of gingivitis to be very high in India.4,6 Gingivitis can be controlled by simple oral hygiene maintenance procedures as its primary aetiological factor, dental plaque can be removed by plaque control.5 Personal oral hygiene refers to maintaining the cleanliness of oral tissues to preserve oral health. It involves the removal of microbial plaque and prevention of its accumulation on teeth and gingiva, thus preventing gingivitis and periodontal disease.5,9

The other common non-communicable disease in humans that results in tooth loss is dental caries. Both these diseases also cause a negative impact on self-esteem and quality of life, along with other nutritional consequences. As with gingivitis, dental plaque is a major biological determinant of dental caries, which is why plaque control is important for its prevention and control. However, apart from routinely performed oral hygiene, regular usage of fluoride toothpaste is effective in dental caries prevention.10

Gingivitis, while not always resulting in periodontal destruction, is a consequence of inadequate supragingival plaque control.8,11 Despite extensive research, the risk for progression, and attachment loss at sites with signs of inflammation cannot be predicted.11 Thus, the goal of patient treatment is to remove the supragingival and subgingival microbial plaque as much as possible. This is well supported in the literature, and clinical trials have documented their beneficial effect.12-14

Current oral hygiene measures include mechanical aids (toothbrushes, floss, interdental cleansers, chewing gums) and chemotherapeutic agents (in mouth rinses, dentifrices and, chewing gums). The benefit derived from oral hygiene depends upon the manual dexterity, lifestyle, motivation, and oral condition of the individual. This paper reviews the advances in various mechanical plaque control aids, focusing on advancements in toothbrushes, interdental aids, and oral irrigation devices.

MECHANICAL PLAQUE CONTROL

Mechanical disruption and removal of plaque is simple and effective. The common measures include tooth brushing, tongue cleaning, and interdental plaque removal. The other objectives are to interfere with plaque formation by removing the pellicle, to deliver chemotherapeutic agents, and to reduce the accumulation of plaque and debris on the tongue and interdental areas. These mechanical aids can be broadly categorized as:15,16
1. Chewing sticks- Sticks of neem, meswak and mango, etc.
2. Toothbrushes- Manual and Powered, that vary based on function, design, type and diameter of bristles, number of tufts present, etc.
3. Tongue cleaners- Made of plastic, metals like stainless steel and copper, etc.
4. Interdental aids—
   a. Dental Floss—Manual and Powered, that vary based on its physical properties
   b. Interdental Brushes—Are conical or cylindrical, vary based on number of tufts, handle design, etc
   c. Oral irrigation systems—Portable/Non portable

Toothbrushes: These are designed primarily to promote cleanliness of teeth & oral cavity (American Dental Association Council on Dental Therapeutics). The manual toothbrush, most widely used device for removing oral biofilm, is well designed to remove plaque from the facial, lingual, and occlusal tooth surfaces.

Manual Toothbrushes: Manual toothbrushes, since its inception, have seen many modifications in search of superior and effective plaque removal to improve oral health. Toothbrushes currently available commercially come in various types, shapes, and sizes, with different head designs, and vary in quality, quantity and type of bristles. These newer bristle patterns, reconfigured from the traditional flat brushing plane, are said to enhance interdental access, although little supporting evidence exists. However, recommending specific toothbrushes based on scientific evidence is not quite possible as such evidence fail to highlight the advantage of any particular manual toothbrush design. No manual toothbrush design is better than the other, except for specific needs. Therefore, choosing a toothbrush could be considered a personal preference, with specific design features being recommended or preferred while addressing specific patient needs. In recent times, bamboo toothbrushes have gained popularity around the world due to their biodegradability. These brushes have a bamboo handle and nylon-4 or nylon-6 bristles. Bamboo is naturally antimicrobial and can be disposed of sustainably. Nylon bristles, however, need to be removed before disposal of the toothbrush for its effective biodegradation.

Powered Toothbrushes: Typically operated by electricity or battery, powered toothbrushes are defined by their modes of action and have shown to be safe. When used properly, most powered toothbrushes are as effective as manual toothbrushes in removing plaque and preventing and controlling gingival disease. Various generations of battery-powered toothbrushes are available (Table 1), configuring to different types of motions. (Table 2) A Cochrane systematic review and meta-analysis by Robinson RG, et al., 2005 showed that in reducing plaque and gingivitis, oscillating-rotating power toothbrush designs specifically were shown to be more effective than traditional manual toothbrushes. Results of a recent Cochrane systematic review and meta-analysis by Yacoo M, et al., 2017 shows 11% and 6% reduction in plaque & gingivitis (1-3 months of use) and 21% & 11% reduction in plaque and gingivitis (>3 months) respectively.

Chewable Toothbrushes: These devices were developed and commercialized in England. It is a miniature plastic moulded toothbrush that can be used without water, primarily for breath freshening. It contains an elastic part that compresses when squeezed by the upper and lower jaws and two brushes used for brushing the upper teeth and lower teeth. Some are marketed as coated with xylitol crystals which promote dental health by neutralizing plaque acidity on teeth and repairing tooth enamel. Literature shows that chewable brushes have a positive effect on plaque reduction in the care-dependent elderly while having an equivalent effect as that of manual toothbrushes in 10 to 12 year old children. Experimental studies have shown that chewable toothbrushes can be used as alternatives to manual toothbrushes in adults and children.

Finger brushes: These are soft and flexible, single moulded piece toothbrushes with multi-tufts made of soft silicon rubber. Indicated for children, institutionalized individuals, and elderly in care, these are not acceptable alternatives to regular manual toothbrushes.

Tooth Towelettes: These are finger-mounted wipes used whenever toothbrushing is not possible. The tooth towelettes are gauze squares, treated with some form of mouthwash to freshen breath. These are held between the thumb and index finger, and wiped on the tooth surface, moving from the cervical margin to the incisal or occlusal edge, cleaning the facial and lingual surfaces simultaneously. Tooth towelettes are effective in removing biofilm from anterior teeth for toddlers. Xylitol wipes are a useful adjunct in reducing the cariogenic bacteria, especially S. mutans, and an effective oral hygiene tool for caries prevention in young children.

Smart Toothbrushes: Solar activated toothbrushes (Eg: Soladey J3X) are examples of smart toothbrushes. These have a solar panel at the base that transmits electrons to the top of the toothbrush through a lead wire. Plaque removal and anti-bacterial effectiveness of these are attributed to the chemical reaction that is created when the electrons react with the acid in the mouth, thus negating the necessity of a toothpaste. The same amount of light that is utilized by a solar-powered calculator is sufficient for its operation. These are not manufactured anymore due to its high cost of production.

Interdental Aids: Most periodontal diseases commonly begin in the interdental col area because of its saddle-like shape that aids in harbouring plaque and food debris.

Dental Floss: The positive effect of dental flossing in the prevention of proximal caries and promotion of periodontal health is widely known. Optimal plaque removal is attained only when dental floss is used regularly, along with toothbrushing once every two to three days. Different types include Silk, Nylon (Multifilament, waxed or unwaxed, circular (floss) or flat (tape)) and Polytetrafluoroethylene (PTFE). The two main techniques of using dental floss are the Spool Method and the Circle or Loop Method, of which the latter is found to be more effective.

Recent advances include:
a. Floss Holders- Can be used by individuals lacking dexterity or compliance. Its effectiveness in reducing interproximal plaque and gingivitis is similar to that of handheld floss and is significantly more effective in helping individuals establish long-term flossing habit.

b. Powered Floss- These devices make interdental cleaning easier and improve patient compliance. They remove plaque biofilm, reduce bleeding and gingivitis similarly to string floss.\textsuperscript{38,40} These may be of a floss holder type with the floss pulled taut between a bow-shaped handle, or it can be a Single flexible nylon tip placed interproximally between the tooth and the papilla, long enough to reach the lingual aspect of the tooth.

Interdental brushes: These are small-headed brushes available in varying width that match the interdental space. They can be conical or cylindrical, consisting of a central metal wire core, with soft nylon filaments twisted around. The superiority of interdental brushes is believed to be because of the higher efficacy of plaque removal and high patient acceptance owing to its ease of use.\textsuperscript{41} Recent advances in these include:

a. Sonic Interdental Brushes- Handles of these interdental brushes create gentle but effective vibrations that disrupt and dislodge plaque build-up. The vibrations also cause a mechanical lubricating effect, thus allowing the interdental brush to pass between the teeth.

b. Brushpick- [Dental Concepts, Paramus NJ, USA] These are new interdental cleaners in which one end resembles the interdental brushes, and instead of the metal or fibre bristles, it contains small elastomeric fingers that protrude perpendicularly from a plastic core. The other end is designed like a toothpick and is circular in cross-section. BrushPick significantly reduces plaque accumulation and gingival inflammation.\textsuperscript{42}

c. Colorimetric Interdental Probe- [IAP CURAPROX© colourimetric probe (Curaden, Kriens, Switzerland)] This probe is a graduated conical instrument with a rounded tip and has two parts. The working end comprises of coloured bands with increasing diameter, the largest section of each coloured band corresponds to the cleaning efficiency diameter of the relevant brush. The non-working part has a click-fastening joint for the attachment of a handle for easier use and access to interproximal areas in the back of the mouth.\textsuperscript{43} It is colour-coded. The interdental brushes with the same colour can be used in different interdental areas with similar diameters. Daily use of calibrated interdental brushes has shown to reduce periodontal pathogens, reestablish symbiotic microbiota, and decrease interdental inflammation and bleeding.\textsuperscript{44}

Oral Irrigators: Developed in 1962 by dentist Gerald Moyer and engineer John Mattingly, these are designed for both, professional care and home dental care. A stream of high-pressure pulsating water is used to remove plaque and food debris between teeth, and in the gingival crevice as an adjunct to toothbrushing. Oral irrigators are indicated in orthodontic patients, and patients with implants owing to their difficulty with conventional means of plaque control. These devices may be powered or unpowered and consist of a reservoir and a handle with replaceable tips of varied design.

The two main physical features of these devices are pulsation and pressure i.e. the pressure regulated by pulsation. These actions combined can disrupt bacterial activity, remove subgingival bacteria and loosely lodged debris and food particles. Pressure ranging between 50–90 psi shows optimum results and can be comfortably handled by healthy and inflamed tissues without damage.\textsuperscript{45,46} At this pressure, the water can reach deeper into the periodontal pocket than an average toothbrush, interdental aid, or rinsing. This penetration allows for better subgingival cleaning and deeper delivery of antimicrobial agents.

Literature shows that a standard jet tip reaches 71% in pockets of 0 to 3 mm, 44% in pockets of 4 to 7 mm, and 68% in pockets greater than 7 mm. Special tips designed to be placed slightly below the gingival margin delivers up to 90% in pockets that are 6 mm deep, and 64% in pockets with a depth of 7 mm or greater.\textsuperscript{47} Oral irrigators have shown a positive trend in improving gingival health as compared to conventional oral hygiene or toothbrushing only while having no beneficial effect in reducing dental plaque.\textsuperscript{48,49} 3-second treatment of pulsating water (1,200 pulses per minute) at medium pressure removed 99.9% of plaque biofilm.\textsuperscript{50}

CONCLUSION

The current oral hygiene measures, when appropriately used in conjunction with regular professional care, can reduce microbial load, thereby preventing periodontal disease and dental caries while maintaining oral health. The challenge for oral hygiene promotion is the effective delivery of these measures in combination with the effectual motivation of individuals and communities to aspire to better oral health. The evidence on the modified oral hygiene aids and their impact on individuals, except when indicated, are varied. Practitioners should customize these aids and their recommendations, and offer appropriate alternatives to the population rather than insisting on the usage of a single, universally recommended, cleaning aid.

REFERENCES


49. Husseini, A; Slot, DE; Van der Weijden, GA. The efficacy of oral irrigation in addition to a toothbrush on plaque and the clinical parameters of periodontal inflammation: a systematic review. Int J Dent Hyg. 2008;6(4):304-14

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